SR Academy of Higher Education

Course Structure & Syllabi of the Proposed New Programs

Curriculum and Syllabi Overview

SR Academy of Higher Education (SRAHE) proposes to introduce a suite of innovative programs that emphasize a unique blend of teaching and research, focusing on key areas crucial to India's strategic needs. These programs are designed to address emerging challenges in energy, climate change, cultural preservation, and digital transformation, while simultaneously fostering skills and knowledge among the next generation of Indian youth. Each curriculum is meticulously crafted to ensure a balance between theoretical foundations and practical applications, equipping students with the skills needed to contribute to national development and global progress.

The programs emphasize interdisciplinary learning, encouraging students to explore the intersections of technology, environment, cultural heritage, and societal needs. By focusing on contemporary challenges and sustainable solutions, these curricula aim to develop leaders who are not only technically proficient but also socially responsible and committed to preserving India’s rich cultural and environmental heritage.

The proposed programs are aligned with the broader mission of SRAHE to create a cadre of skilled professionals who can contribute to the nation's strategic goals, including sustainable development, cultural preservation, and technological innovation. Through a blend of rigorous academic training and hands-on research, the institute aims to empower students to become thought leaders, innovators, and change-makers who will shape India's future in a rapidly evolving global landscape.

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Bachelor of Arts in Digital and Heritage Arts (B.A.)

Course Structure

Year 1

Semester-I

Course	Hours/Week			Credits
Introduction to Digital Arts	L: 3	T: 0	P: 2	4
Art History and Cultural Studies	L: 3	T: 1	P: 0	4
Fundamentals of Design Thinking	L: 3	T: 0	P: 2	4
Digital Tools and Techniques I	L: 2	T: 0	P: 4	4
Introduction to Digital Media	L: 3	T: 0	P: 2	4
Basics of Heritage Documentation	L: 3	T: 0	P: 2	4
			Total Credits	24

*L: Lecture T: Tutorial P: Practical

Semester-II

Course	Hours/Week			Credits
Introduction to Digital Humanities	L: 3	T: 0	P: 2	4
Cultural Preservation Practices	L: 3	T: 1	P: 0	4
Digital Tools and Techniques II	L: 2	T: 0	P: 4	4
Communication Skills for Arts	L: 2	T: 1	P: 2	4
Exploring Traditional Art Forms	L: 3	T: 0	P: 2	4
Environmental Awareness and Heritage Studies	L: 3	T: 0	P: 2	4
			Total Credits	**24**

Year 2

Semester-III

Course	Hours/Week			Credits
Digital Heritage Conservation	L: 3	T: 0	P: 2	4
Heritage Documentation Methods	L: 3	T: 0	P: 2	4
Digital Art Creation Techniques	L: 3	T: 0	P: 2	4
Introduction to Heritage Marketing	L: 3	T: 1	P: 0	4
Digital Storytelling I	L: 2	T: 0	P: 4	4
Minor Project	L: 0	T: 0	P: 6	4
			Total Credits	**24**

Semester-IV

Course	Hours/Week			Credits
Advanced Digital Storytelling	L: 3	T: 0	P: 2	4
Heritage Mapping and GIS	L: 3	T: 0	P: 2	4
Digital Preservation Techniques	L: 3	T: 1	P: 0	4
Multimedia Production for Heritage	L: 2	T: 0	P: 4	4
Public History and Community Engagement	L: 3	T: 0	P: 2	4
Internship I	L: 0	T: 0	P: 8	4
			Total Credits	**24**

Year 3

Semester-V

Course	Hours/Week			Credits
Applied Digital Arts	L: 3	T: 0	P: 2	4
Cultural Informatics	L: 3	T: 1	P: 0	4
3D Modelling for Heritage Sites	L: 3	T: 0	P: 2	4
Advanced Research Methods	L: 3	T: 1	P: 0	4
Major Project I (Capstone)	L: 0	T: 0	P: 8	4
			Total Credits	**20**

Semester-VI

Course	Hours/Week			Credits
Digital Archiving and Database Management	L: 3	T: 0	P: 2	4
Advanced Cultural Narratives	L: 3	T: 1	P: 0	4
Advanced Digital Media Production	L: 3	T: 0	P: 2	4
Internship II	L: 0	T: 0	P: 8	4
Major Project II (Capstone)	L: 0	T: 0	P: 8	4
			Total Credits	**20**

Syllabus

Year 1

Semester 1:

1. **Introduction to Digital Arts**

   This course introduces students to the field of digital arts, exploring its history, evolution, and contemporary trends. Students will learn to use essential digital art tools and software like Adobe Suite, focusing on principles of composition, color theory, and design. The course covers digital illustration, image manipulation techniques, and the differences between vector and raster graphics.

2. **Art History and Cultural Studies**

   This course explores key movements in Western and Eastern art history, analyzing the cultural artifacts and their significance through various eras. It examines how art has served as a tool for societal expression, from ritualistic uses to representations of power and propaganda. Students will gain skills in visual analysis and learn about the cross-cultural exchanges that have shaped global art traditions.

3. **Fundamentals of Design Thinking**

   Focused on creative problem-solving, this course introduces design thinking principles, emphasizing empathy mapping and human-centered design. Students will explore various frameworks for tackling complex problems in creative industries and learn how to prototype and iterate effectively. Case studies will demonstrate the impact of design thinking on the arts and cultural sectors.

4. **Digital Tools and Techniques I**

   This foundational course covers key digital tools used in creative work, including software like Photoshop, Illustrator, and InDesign. Students will learn basic techniques in digital photography and image editing, manage digital workflows, and explore introductory animation concepts. Emphasis is placed on developing a systematic approach to digital content creation.

5. **Introduction to Digital Media**

   This course covers the basics of digital media, focusing on various platforms like social media, websites, and apps. Students will learn video production, including pre-production planning, shooting, and editing. Additional focus is placed on writing for digital media, such as storyboarding and scriptwriting, and the importance of maintaining ethical standards in media practices.

6. **Basics of Heritage Documentation**

   Students will explore concepts of heritage, distinguishing between tangible and intangible forms, and learn methods for documenting cultural heritage. This includes photography, video documentation, and digital archiving practices. The course emphasizes the importance of ethical standards in documentation and introduces students to case studies from successful heritage documentation projects.

7. **Visual Storytelling Techniques**

   This course delves into storytelling through visual mediums, covering narrative structure, pacing, and character development. Students will learn to convey stories through photography, illustration, and graphic novels, along with storyboarding techniques used in animation and film. Analysis of famous visual storytelling works will help students understand how to create compelling narratives.

Semester 2:

1. **Introduction to Digital Humanities**

   This course explores the intersection of digital tools with the humanities, focusing on digital mapping, text analysis, and visualization. Students will learn about digital preservation methods, crowdsourcing for cultural studies, and the role of digital platforms in expanding access to historical data. The course includes case studies of successful digital humanities projects.

2. **Cultural Preservation Practices**

   Focusing on the importance of cultural heritage management, this course covers traditional methods of preserving art forms and the role of institutions like museums and libraries. Students will learn about community-driven preservation efforts and the challenges posed by globalization. The course emphasizes the value of local culture and heritage in a global context.

3. **Digital Tools and Techniques II**

   Building on foundational skills, this course advances students' abilities in software like Photoshop, Illustrator, and video editing tools such as Premiere Pro and After Effects. It introduces 3D modelling basics with Blender and web design principles, helping students create online portfolios to showcase their digital artwork and projects.

4. **Communication Skills for Arts Professionals**

   This course develops effective communication strategies for artists and cultural professionals, focusing on public speaking, presentation skills, and writing for criticism. Students will learn techniques for building professional networks in the arts, as well as negotiation and persuasion skills essential for client interactions and project proposals.

5. **Exploring Traditional Art Forms**

   Students will study a range of traditional art forms, such as painting, sculpture, and textile arts, with an emphasis on technique and cultural significance. The course includes field visits to meet artisans and document their craft. Students will compare traditional and contemporary art practices, analyzing how heritage influences modern artistic expression.

6. **Environmental Awareness and Heritage Studies**

   This course examines the relationship between the environment and heritage conservation, focusing on the impact of climate change on cultural sites. It covers sustainable practices in preserving historical landmarks and artifacts, with case studies on ecological conservation efforts. Students will also explore the role of art in raising environmental awareness.

Year 2

Semester 3:

1. **Digital Heritage Conservation**

   This course teaches the principles of conserving digital and physical heritage, with a focus on technology’s role in restoration and digitization. Students will learn about advanced techniques like 3D scanning, laser mapping, and the management of digital archives. Practical exercises will allow students to participate in digital conservation projects, understanding the challenges of preserving historical artifacts in the digital age.

2. **Heritage Documentation Methods**

   This course focuses on advanced techniques for documenting cultural heritage, including GIS mapping, high-quality photography, and recording oral histories. Students will be trained in using digital archiving software, adhering to ethical standards in documentation, and managing data for long-term accessibility. Case studies provide examples of effective heritage documentation projects.

3. **Digital Art Creation Techniques**

   This course covers advanced digital painting, illustration, and concept art. Students will learn character design and digital collage techniques, as well as basics of 2D and 3D animation. Emphasis is placed on developing a professional portfolio, showcasing a variety of digital artworks.

4. **Introduction to Heritage Marketing**

   Students will explore strategies for promoting cultural heritage through marketing, including branding cultural sites and designing visitor experiences for museums. They will learn to run social media campaigns that highlight cultural assets and analyze case studies of successful heritage marketing initiatives. The course focuses on the economic aspects of heritage management and tourism.

5. **Digital Storytelling I**

   This course focuses on creating compelling digital narratives through various media formats. Students will learn podcasting, producing short films, and designing interactive storytelling experiences. Emphasis is placed on scriptwriting, editing, and analyzing digital stories to understand the elements that engage audiences.

Semester 4:

1. **Advanced Digital Storytelling**

   This course delves into long-form digital storytelling, covering character development and story arcs. Students will create web series, explore virtual and augmented reality applications in storytelling, and analyze award-winning projects to understand best practices. The course emphasizes creating cohesive narratives across multiple digital platforms.

2. **Heritage Mapping and Geographic Information Systems (GIS)**

   This course introduces GIS technology and its applications in cultural mapping. Students will learn to create digital maps of historical sites, analyze spatial data, and design interactive maps for heritage tourism. Training in software like ArcGIS will equip students with practical skills for geographical data management.

3. **Digital Preservation Techniques**

   Focused on the digitization of text, audio, and visual records, this course covers methods for creating and managing metadata for digital archives. Students will learn best practices for long-term preservation, including data migration and the Open Archival Information

System (OAIS) model. Practical sessions include using software tools for managing digital collections.

4. **Multimedia Production for Heritage**

   This course covers video production, sound design, and interactive media for heritage projects. Students will create virtual tours, design multimedia installations for museums, and produce content for social media. Emphasis is placed on storytelling through various media to enhance audience engagement with cultural content.

5. **Public History and Community Engagement**

   Students will explore the role of public history in creating community narratives and preserving local traditions. The course includes designing history projects with local communities, conducting oral history workshops, and organizing exhibitions. It emphasizes collaboration with communities to document and share their stories.

6. **Art Criticism and Curation**

   This course introduces students to the principles of art criticism and curation, focusing on evaluating and interpreting artwork. Students will design exhibitions, write catalogue essays, and explore online curation techniques. Practical experience includes organizing an exhibition and developing skills in art criticism.

Year 3

Semester V

1. **Applied Digital Arts**

   This course focuses on the practical application of digital arts techniques in real-world contexts. Students will explore advanced digital illustration, interactive media, and digital installations, integrating creative and technical skills. The course includes case studies of digital art projects in public spaces, virtual galleries, and interactive exhibitions, encouraging students to create immersive digital experiences.

2. **Cultural Informatics**

   This course introduces students to the role of informatics in managing cultural data, including digital curation, metadata creation, and database management for museums and archives. Students will learn to use software tools for organizing cultural collections and developing digital repositories. The course emphasizes the intersection of technology and culture, exploring how digital tools can enhance the accessibility and analysis of cultural heritage.

3. **3D Modelling for Heritage Sites**

   This course provides students with skills in 3D modelling and rendering, focusing on applications in heritage conservation and virtual reconstructions. Using software like Blender or SketchUp, students will create digital models of historical artifacts, monuments, and architectural sites. Emphasis is placed on photogrammetry, digital sculpting, and the creation of detailed models suitable for virtual reality (VR) environments and interactive museum displays.

4. **Advanced Research Methods**

   This course develops students' abilities to conduct independent research in the field of digital and heritage arts. It covers qualitative and quantitative research methodologies, including case studies, surveys, ethnographic studies, and digital data analysis. Students will learn to frame research questions, conduct literature reviews, design research tools, and present their findings through academic writing and presentations. The course also includes ethical considerations in cultural research.

5. **Major Project I (Capstone)**

   This capstone project allows students to apply their knowledge and skills to a substantial project in the field of digital and heritage arts. Working under faculty supervision, students will develop a digital product, such as a virtual exhibition, a digital archive, or an interactive storytelling piece. The project emphasizes the integration of research, technical skills, and creative expression. Students will present their project to a panel for evaluation and feedback.

Semester VI

1. **Digital Archiving and Database Management**

   This course focuses on advanced techniques for digital archiving and managing large datasets related to cultural heritage. Students will explore best practices for metadata standards, digital repository management, and long-term preservation strategies. The course covers the use of content management systems (CMS) and digital asset management software, with a focus on maintaining accessibility and interoperability of digital archives. Practical exercises include building a small-scale digital archive.

2. **Advanced Cultural Narratives**

   This course explores the art of storytelling across various media, focusing on complex narratives that integrate cultural themes and histories. Students will analyze traditional and contemporary narratives, including indigenous storytelling, folklore, and mythological stories, and adapt them into digital formats like podcasts, web series, and interactive stories. The course encourages students to experiment with narrative structures and multimedia storytelling techniques.

3. **Advanced Digital Media Production**

   This course provides hands-on training in advanced techniques for producing digital media content. Students will learn high-level video editing, sound design, and special effects using software like Premiere Pro and After Effects. The course includes advanced techniques in green screen effects, motion graphics, and integrating audio-visual elements to create immersive media projects. Students will work on individual and group projects to produce short films, digital commercials, or virtual tours.

4. **Internship II**

   In this internship, students gain practical experience by working with cultural institutions, digital art studios, museums, or heritage conservation organizations. This 8-week internship focuses on applying the skills and knowledge gained throughout the program in a professional environment. Students will work on real-world projects, such as assisting with digital exhibitions, developing multimedia content, or contributing to heritage preservation efforts. The internship helps students build industry connections and prepares them for future career opportunities.

5. **Major Project II (Capstone)**

   The second capstone project requires students to further develop their expertise through a comprehensive project that addresses a complex challenge in digital and heritage arts. This could include designing a virtual museum, creating a digital storytelling platform, or developing a multimedia heritage documentation project. The project should demonstrate the student’s ability to synthesize research, creative vision, and technical execution. The final deliverable will be presented in a public exhibition or through an online platform, showcasing the student's readiness for professional practice in the field.

Master of Arts in Digital and Heritage Arts (M.A.)

Year 1

Semester-I

Course	Hours/Week			Credits (C)
Advanced Theories in Digital Arts	L: 3	T: 1	P: 0	4
Digital Heritage Conservation Techniques	L: 3	T: 0	P: 2	4
Research Methodologies in Digital Humanities	L: 3	T: 1	P: 0	4
Interactive Media Design for Heritage	L: 2	T: 0	P: 4	4
Elective I (Choose from a range of topics)	L: 3	T: 0	P: 2	4
			Total Credits	**20**

*L: Lecture T: Tutorial P: Practical

Semester-II

Course	Hours/Week			Credits (C)
Digital Curation and Archiving Practices	L: 3	T: 0	P: 2	4
Heritage Informatics and Data Visualization	L: 3	T: 1	P: 0	4
Advanced Digital Storytelling	L: 3	T: 0	P: 2	4
Elective II (Specialized Topic)	L: 3	T: 0	P: 2	4
Minor Project	L: 0	T: 0	P: 6	4
			Total Credits	**20**

Year 2

Semester-III

Course	Hours/Week			Credits (C)
Virtual Reality and Augmented Reality in Heritage	L: 3	T: 0	P: 2	4
Cultural Policy and Management	L: 3	T: 1	P: 0	4
Advanced 3D Modelling and Digital Restoration	L: 3	T: 0	P: 2	4
Elective III (Choose from a range of topics)	L: 3	T: 0	P: 2	4
Major Project I (Capstone)	L: 0	T: 0	P: 8	4
			Total Credits	**20**

Semester-IV

Course	Hours/Week			Credits (C)
Advanced Research Seminar	L: 3	T: 1	P: 0	4
Entrepreneurship in Digital Arts and Heritage	L: 3	T: 0	P: 2	4
Internship	L: 0	T: 0	P: 8	4
Major Project II (Thesis or Capstone)	L: 0	T: 0	P: 10	4
Elective IV (Specialized Topic)	L: 3	T: 0	P: 2	4

Elective Options:

- **Elective I**: Digital Cartography, Public Engagement in Heritage, Multimedia Production Techniques
- **Elective II**: AI and Machine Learning for Cultural Data, Ethics in Digital Humanities, Digital Anthropology
- **Elective III**: Game Design for Cultural Education, Museum Studies, Sound Design for Digital Media
- **Elective IV**: Heritage Tourism and Cultural Economics, Advanced Interactive Storytelling, Community-Based Heritage Documentation

Syllabus

Year 1

Semester I:

Advanced Theories in Digital Arts

This course explores critical theories related to digital arts, covering aesthetics, semiotics, and the impact of digital media on contemporary art practices. Topics include post-digital aesthetics, media theory, visual culture, and the interplay between digital technology and traditional art forms. The course emphasizes theoretical frameworks that shape the understanding and analysis of digital art practices, including the works of prominent digital artists and theorists.

Digital Heritage Conservation Techniques

This course focuses on advanced methodologies for the digital conservation of heritage artifacts and sites. It includes techniques like photogrammetry, 3D scanning, and the use of digital imaging software for restoration projects. Students will learn about managing digital archives, developing digital twins of cultural sites, and best practices for preserving digital artifacts. Practical sessions include using software for virtual reconstructions and digitizing physical objects.

Research Methodologies in Digital Humanities

This course equips students with research skills specific to digital humanities. It covers quantitative and qualitative research methods, including data collection, digital ethnography, text mining, and statistical analysis. Students will learn how to formulate research questions, conduct literature reviews, and use digital tools like NVivo and R for data analysis. Emphasis is placed on ethical research practices, particularly in handling digital archives and cultural data.

Interactive Media Design for Heritage

This course introduces the principles of designing interactive media experiences for heritage interpretation and education. Topics include user experience (UX) design, interactive storytelling, and the use of augmented reality (AR) and virtual reality (VR) for cultural heritage. Students will learn to develop interactive exhibits, mobile applications, and multimedia content tailored for museums and cultural sites, utilizing tools like Unity and Adobe XD.

Elective I (Choose from a range of topics)

Students can choose an elective that complements their interests and research goals. Options include courses like Digital Cartography, Public Engagement in Heritage, or Multimedia Production Techniques. Each elective involves both theoretical and practical components, with a focus on applying knowledge to real-world projects.

Semester II:

Digital Curation and Archiving Practices

This course covers the principles of curating digital collections, focusing on the management and preservation of digital archives. Students will explore metadata standards, digital cataloguing, and the use of content management systems (CMS) like Omeka for digital curation. Practical sessions involve creating digital exhibits and managing online archives, with a focus on accessibility and user engagement.

Heritage Informatics and Data Visualization

This course teaches students how to use data visualization tools to represent cultural and heritage data effectively. Topics include Geographic Information Systems (GIS), interactive mapping, and using software like Tableau for visual storytelling. Students will work on projects that involve creating digital maps, visualizing spatial and temporal data, and developing dashboards that display heritage information interactively.

Advanced Digital Storytelling

Students in this course will develop complex narratives for digital platforms, integrating video, audio, and interactive elements. Emphasis is placed on creating transmedia storytelling experiences, where stories are told across multiple platforms. Topics include narrative theory, scriptwriting for interactive media, and the production of web series and podcasts. Students will also explore virtual and augmented reality storytelling techniques.

Elective II (Specialized Topic)

The second elective allows students to focus on specialized topics like AI and Machine Learning for Cultural Data, Ethics in Digital Humanities, or Digital Anthropology. Each elective is designed to deepen the students' understanding of a niche area, with projects tailored to applying advanced concepts in a real-world context.

Minor Project

The Minor Project provides an opportunity for students to apply their learning to a focused research or creative project. Students might create a digital archive, design an interactive heritage map, or develop a digital storytelling piece. The project is intended to demonstrate the student’s ability to integrate research and practical skills into a coherent output.

Year 2

Semester III:

Virtual Reality and Augmented Reality in Heritage

This course explores the application of VR and AR technologies in the preservation, interpretation, and presentation of cultural heritage. Students will learn to create virtual tours, 3D reconstructions, and AR applications that enhance museum exhibits or heritage site experiences. The course includes hands-on training with platforms like Unity, Unreal Engine, and AR development tools, emphasizing user-centered design for immersive experiences.

Cultural Policy and Management

This course provides a comprehensive understanding of cultural policies and their impact on heritage management. Topics include the role of government, NGOs, and international organizations in cultural preservation, cultural rights, and intellectual property laws. Students will learn strategic management skills for cultural institutions, including museums, galleries, and heritage sites, with a focus on policy analysis and cultural entrepreneurship.

Advanced 3D Modelling and Digital Restoration

Building on previous skills, this course delves into advanced 3D modelling techniques for restoring damaged cultural artifacts and reconstructing historical sites. Students will use software like Blender and Autodesk Maya for high-resolution modelling, texture mapping, and rendering. The course also covers digital restoration techniques, including colour correction, surface reconstruction, and creating detailed models for virtual exhibitions and educational use.

Elective III (Choose from a range of topics)

Electives in this semester include options like Game Design for Cultural Education, Museum Studies, or Sound Design for Digital Media. These courses allow students to explore niche areas and develop specialized skills that align with their career aspirations. Each elective includes a project component, providing an opportunity to apply learning to practical challenges.

Major Project I (Capstone)

The first major project is an opportunity for students to create a significant work that combines digital arts and heritage studies. Students might design a virtual museum, develop a digital storytelling platform, or create an interactive exhibit. This project serves as a precursor to the final capstone, allowing students to refine their research skills and creative techniques.

Semester IV:

Advanced Research Seminar

This seminar-style course provides a platform for students to present their research findings and receive feedback from peers and faculty. It covers advanced topics in research design, peer review processes, and academic writing for digital humanities. Students will prepare for their final capstone project, refining their research questions and methodologies. The seminar also includes discussions on current trends and debates in digital and heritage arts.

Entrepreneurship in Digital Arts and Heritage

This course focuses on the entrepreneurial aspects of working in digital arts and heritage sectors. Topics include business planning, funding strategies, intellectual property management, and marketing for digital arts and cultural products. Students will learn how to launch and manage creative startups, work as independent consultants, or develop business plans for cultural projects.

Internship

The internship provides students with practical experience in a professional setting, such as digital art studios, museums, heritage conservation agencies, or tech companies specializing in cultural applications. Students will work on real-world projects, gaining hands-on experience in areas like digital content creation, heritage documentation, or VR development. The internship helps students build professional networks and develop industry-relevant skills.

Major Project II (Thesis or Capstone)

The final capstone project is a comprehensive research or creative project that showcases the student’s mastery of the program's core competencies. Students can choose to produce a written thesis or a creative capstone, such as a fully developed digital exhibition, a VR experience for a heritage site, or a multimedia storytelling project. The project is presented publicly, demonstrating the student's ability to combine research, creativity, and technical expertise.

Elective IV (Specialized Topic)

Students can select from electives like Heritage Tourism and Cultural Economics, Advanced Interactive Storytelling, or Community-Based Heritage Documentation. These courses are designed to provide a deeper understanding of specific fields, with a focus on applying advanced knowledge to real-world challenges in digital and heritage arts.

Bachelor of Technology in Smart Urban Infrastructure (B.Tech.)

Year 1 *L: Lecture T: Tutorial P: Practical

	Course	**Hours/Week**			**Credits**
Semester-I	Mathematics-I	L: 3	T: 1	P: 0	4
	Physics for Engineers	L: 3	T: 0	P: 2	4
	Engineering Mechanics	L: 3	T: 0	P: 2	4
	Fundamentals of Computing	L: 2	T: 0	P: 2	3
	Introduction to Smart Cities	L: 3	T: 0	P: 0	3
	Environmental Science	L: 2	T: 0	P: 0	2
				Total Credits	**20**

	Course	**Hours/Week**			**Credits**
Semester-II	Mathematics-II	L: 3	T: 1	P: 0	4
	Chemistry for Engineers	L: 3	T: 0	P: 2	4
	Basic Electrical and Electronics Engineering	L: 3	T: 0	P: 2	4
	Engineering Graphics	L: 1	T: 0	P: 4	3
	Introduction to Urban Planning	L: 3	T: 0	P: 0	3
	Technical Communication	L: 2	T: 0	P: 0	2
				Total Credits	**20**

Year 2

	Course	**Hours/Week**			**Credits**
Semester-III	Mathematics-III (Linear Algebra & Differential Equations)	L: 3	T: 1	P: 0	4
	Strength of Materials	L: 3	T: 0	P: 2	4
	Fluid Mechanics	L: 3	T: 0	P: 2	4
	Urban Infrastructure Systems	L: 3	T: 0	P: 0	3
	Surveying and Geomatics	L: 2	T: 0	P: 2	3
	Data Analysis for Urban Planning	L: 2	T: 0	P: 2	3
				Total Credits	**21**

	Course	**Hours/Week**			**Credits**
Semester-IV	Structural Analysis	L: 3	T: 0	P: 2	4
	Water Supply and Wastewater Management	L: 3	T: 0	P: 2	4
	Transportation Engineering	L: 3	T: 0	P: 2	4
	GIS and Remote Sensing	L: 2	T: 0	P: 2	3
	Smart Materials and Sustainable Building Technologies	L: 3	T: 0	P: 0	3
	Professional Ethics and Human Values	L: 1	T: 0	P: 0	1
				Total Credits	**19**

Year 3

	Course	Hours/Week			Credits
Semester-V	Design of Concrete Structures	L: 3	T: 0	P: 2	4
	Smart Grid Technologies	L: 3	T: 0	P: 2	4
	Urban Transport Systems	L: 3	T: 0	P: 0	3
	Urban Hydrology and Stormwater Management	L: 3	T: 0	P: 2	4
	Elective I (e.g., Intelligent Transport Systems)	L: 3	T: 0	P: 0	3
	Mini Project I	L: 0	T: 0	P: 4	2
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester-VI	Smart City Technologies and IoT	L: 3	T: 0	P: 2	4
	Urban Energy Systems	L: 3	T: 0	P: 2	4
	Solid Waste Management and Recycling	L: 3	T: 0	P: 2	4
	Urban Resilience and Disaster Management	L: 3	T: 0	P: 0	3
	Elective II (e.g., Urban Economics)	L: 3	T: 0	P: 0	3
	Mini Project II	L: 0	T: 0	P: 4	2
				Total Credits	**20**

Year 4

	Course	Hours/Week			Credits
Semester-VII	Advanced Structural Design	L: 3	T: 0	P: 2	4
	Smart Mobility Solutions	L: 3	T: 0	P: 2	4
	Urban Environment and Climate Change	L: 3	T: 0	P: 2	4
	Elective III (e.g., Urban Policy and Governance)	L: 3	T: 0	P: 0	3
	Major Project I	L: 0	T: 0	P: 8	4
	Internship I (4 weeks)	L: 0	T: 0	P: 4	1
				Total Credits	**20**

Semester-VIII	Course	Hours/Week			Credits
	Sustainable Urban Design	L: 3	T: 0	P: 2	4
	Smart Building Automation	L: 3	T: 0	P: 2	4
	Elective IV (e.g., Urban Sociology)	L: 3	T: 0	P: 0	3
	Elective V (e.g., Urban Governance and Planning)	L: 3	T: 0	P: 0	3
	Major Project II (Capstone Project)	L: 0	T: 0	P: 10	6
				Total Credits	**20**

Syllabus

Year 1

Semester I

Mathematics-I

This course covers essential topics in calculus, including derivatives, integrals, and their applications, as well as differential equations, matrices, and vector calculus. Students will explore the theoretical aspects of these mathematical concepts and learn to apply them to solve engineering problems, laying the foundation for advanced study in engineering analysis.

Physics for Engineers

This course provides a deep understanding of key physics principles such as mechanics, thermodynamics, optics, quantum mechanics, and electromagnetism. Emphasis is placed on understanding the practical applications of these principles in various engineering domains, with laboratory experiments reinforcing theoretical concepts through hands-on practice.

Engineering Mechanics

This course focuses on the fundamental principles of statics and dynamics, including the analysis of forces, equilibrium, friction, and motion. Students learn to solve problems involving the mechanics of rigid bodies using vector methods, free-body diagrams, and principles of kinematics and kinetics, essential for structural and mechanical engineering.

Fundamentals of Computing

Students are introduced to programming concepts and computational thinking using languages like Python or C++. The course includes data structures, algorithms, and basics of computer hardware, equipping students with practical skills in coding and computational problem-solving applicable to engineering tasks.

Introduction to Smart Cities

This course provides an overview of the concept of smart cities, exploring the integration of technology in urban spaces to enhance efficiency and quality of life. Topics include key components of smart city infrastructure, such as Internet of Things (IoT) applications, data analytics, and the role of digital technologies in urban management and planning.

Environmental Science

This course explores the interactions between natural systems and human activities, focusing on ecosystems, pollution control, and sustainable development. Students learn about the environmental impact of engineering projects and the principles of sustainable practices, preparing them to consider ecological factors in their engineering designs.

Semester II

Mathematics-II

This course covers advanced topics in multivariable calculus, Fourier series, Laplace transforms, complex numbers, and partial differential equations. It emphasizes the application of these mathematical tools to analyze and solve complex engineering problems, including the use of transforms for system analysis in various fields.

Chemistry for Engineers

This course introduces chemical principles relevant to engineering, such as thermodynamics, electrochemistry, corrosion, and the properties of materials. It also covers the chemistry of advanced materials like nanomaterials, providing students with an understanding of chemical processes and their practical applications in engineering design and innovation.

Basic Electrical and Electronics Engineering

This course provides foundational knowledge of electrical circuits and electronic devices, covering topics like DC and AC circuits, transformers, semiconductors, and basic control systems. Students learn to analyze electrical systems and understand the role of electronics in the automation and control of urban infrastructure.

Engineering Graphics

This course teaches students the skills required to create and interpret engineering drawings, including orthographic and isometric projections, sectional views, and technical illustrations. Using CAD software, students develop practical skills in drafting and design, which are essential for creating accurate engineering models and plans.

Introduction to Urban Planning

This course introduces the principles of urban design and planning, focusing on land use, zoning, infrastructure, and sustainable development. Students learn about the planning process and how to create efficient, liveable urban spaces, considering factors such as population density, transportation, and environmental impact.

Technical Communication

This course focuses on developing effective communication skills for technical contexts, including writing technical reports, giving presentations, and communicating complex ideas clearly and concisely. Emphasis is placed on professional writing and public speaking skills tailored for engineers.

Year 2

Semester III

Mathematics-III (Linear Algebra & Differential Equations)

This course explores advanced mathematical methods, including linear algebra, matrix theory, ordinary differential equations (ODEs), and partial differential equations (PDEs). Students learn to apply these methods in modelling and solving real-world engineering problems, with an emphasis on numerical methods for approximating solutions.

Strength of Materials

This course covers the behaviour of materials under various types of stress and strain, including concepts such as shear force, bending moment, and torsion. Students learn to analyze structural elements like beams and columns, applying principles of material mechanics to ensure the strength and stability of engineering structures.

Fluid Mechanics

This course focuses on the principles of fluid behaviour, including fluid statics and dynamics, viscosity, and flow through pipes. Students explore topics like Bernoulli's equation and open channel flow, gaining an understanding of how fluids behave under different conditions and how to design hydraulic systems for urban water management.

Urban Infrastructure Systems

This course provides an in-depth look at the components of urban infrastructure, including water supply, wastewater systems, transportation networks, and energy systems. Students learn how these systems are designed, integrated, and managed to create sustainable urban environments, with an emphasis on improving efficiency and resilience.

Surveying and Geomatics

This course introduces land surveying techniques, including the use of GPS and GIS for spatial data collection and analysis. Students learn to create accurate maps and models of urban areas using modern surveying tools, which are essential for planning and managing urban development projects.

Data Analysis for Urban Planning

This course focuses on the use of statistical analysis and data visualization techniques to inform urban planning decisions. Students learn to interpret GIS data, create predictive models, and use data analysis software to address challenges in urban development, such as traffic management and resource allocation.

Semester IV

Structural Analysis

This course explores methods for analyzing structures such as beams, trusses, and frames to determine their internal forces, deflections, and stability under different loading conditions. Emphasis is placed on understanding the behavior of structures under various loads and applying analysis techniques to ensure safety and durability in design.

Water Supply and Wastewater Management

This course covers the principles and practices of designing water supply and wastewater treatment systems. Students learn about water treatment processes, distribution network design, sewer systems, and the reuse of treated water. The course focuses on creating efficient and sustainable systems for urban water management.

Transportation Engineering

This course examines the design, analysis, and management of transportation systems, including road networks, public transit, and traffic control. Students learn to apply principles of traffic flow theory and highway design to improve urban mobility, safety, and accessibility, with a focus on sustainable transportation solutions.

GIS and Remote Sensing

This course provides an introduction to the use of GIS and remote sensing technologies for urban planning and analysis. Students learn techniques for processing satellite images, creating spatial databases, and analyzing geographic data for urban applications, such as land use planning and disaster management.

Smart Materials and Sustainable Building Technologies

This course focuses on the properties and applications of advanced materials in building construction, such as energy-efficient and green building materials. Students learn about innovative construction techniques and smart technologies for sustainable urban development, including energy management systems and smart building automation.

Professional Ethics and Human Values

This course emphasizes the ethical responsibilities of engineers in society, covering topics such as professional integrity, environmental ethics, and the social impact of engineering decisions. Students explore case studies and engage in discussions to develop a strong understanding of ethical practices in the engineering profession.

Year 3

Semester V

Design of Concrete Structures

This course covers the analysis and design of concrete structural elements such as beams, slabs, columns, and foundations. Topics include the design of reinforced concrete members based on limit state methods, shear and flexural behaviour, and detailing of reinforcement. Students will learn practical applications of design codes, safety factors, and the role of concrete in modern construction.

Smart Grid Technologies

This course introduces the concepts and technologies that constitute a smart grid, including advanced metering infrastructure, demand-side management, distributed energy resources, and grid automation. Students explore the integration of renewable energy sources, energy storage, and communication technologies to enhance grid reliability and efficiency. Case studies illustrate how smart grids are transforming urban energy management.

Urban Transport Systems

This course focuses on the planning, design, and management of urban transportation systems, including road networks, public transportation, pedestrian pathways, and cycling infrastructure. Students learn to analyze transportation demand, design effective traffic management solutions, and evaluate the environmental impact of different transportation modes. The course emphasizes sustainable urban mobility solutions.

Urban Hydrology and Stormwater Management

This course explores the principles of urban hydrology, including precipitation, infiltration, runoff estimation, and stormwater drainage design. Students learn to design stormwater management systems using detention basins, green infrastructure, and sustainable drainage solutions. The course emphasizes strategies for mitigating urban flooding and enhancing water quality in urban areas.

Elective I (e.g., Intelligent Transport Systems)

This elective allows students to explore specialized topics related to intelligent transportation systems (ITS). Topics may include vehicle-to-infrastructure communication, traffic flow optimization, automated traffic control, and the role of artificial intelligence in transport systems. Students gain insights into how ITS can enhance urban mobility and safety.

Mini Project I

In this hands-on project, students apply their knowledge to a practical problem related to smart urban infrastructure. Working in teams, they design and implement a small-scale project, such as developing a prototype for a smart traffic management system or creating a GIS-based urban analysis tool. The project emphasizes teamwork, problem-solving, and project management skills.

Semester VI

Smart City Technologies and IoT

This course focuses on the use of Internet of Things (IoT) technologies in creating smart city solutions. Students learn about IoT architectures, communication protocols, and data integration for smart applications such as smart lighting, waste management, air quality monitoring, and urban security. Hands-on labs involve designing and implementing IoT-based solutions for urban challenges.

Urban Energy Systems

This course covers energy generation, distribution, and consumption in urban settings, with a focus on renewable energy integration and energy efficiency. Students explore urban energy planning, smart metering, microgrids, and energy storage systems. The course emphasizes strategies for reducing carbon footprints and achieving energy sustainability in cities.

Solid Waste Management and Recycling

This course provides an in-depth understanding of municipal solid waste management, including collection, transportation, disposal, and recycling methods. Students learn about waste-to-energy technologies, composting, and the role of circular economy principles in waste management. Case studies focus on innovative waste management practices and policies in smart cities.

Urban Resilience and Disaster Management

This course examines strategies for enhancing the resilience of urban infrastructure to natural and human-made disasters. Topics include risk assessment, disaster mitigation planning, emergency response systems, and community-based disaster management. Students learn to design resilient infrastructure and develop disaster recovery plans for urban areas.

Elective II (e.g., Urban Economics)

This elective explores the economic principles that govern urban development, including real estate markets, housing economics, urban labour markets, and infrastructure financing. Students analyze the economic impacts of urban policies and study tools for economic planning in cities, with a focus on creating economically sustainable urban environments.

Mini Project II

Students undertake a second mini project, building on their previous experience. Projects may include designing an IoT-based smart city application, developing a simulation model for urban transportation, or implementing a renewable energy solution for a community. The focus is on refining technical skills and demonstrating creativity in solving urban challenges.

Year 4

Semester VII

Advanced Structural Design

This course delves into the design of complex structural systems, including multi-story buildings, bridges, and industrial structures. Students learn to use advanced software for structural analysis and design, focusing on dynamic loads, seismic design, and the use of composite materials. Emphasis is placed on ensuring structural safety, stability, and compliance with international codes.

Smart Mobility Solutions

This course explores advanced technologies and solutions for improving urban mobility, such as electric vehicles, autonomous transportation systems, and integrated multimodal transport networks. Students study the role of data analytics, mobility-as-a-service (MaaS), and urban mobility hubs in transforming how people move within cities. Case studies highlight innovative mobility solutions implemented worldwide.

Urban Environment and Climate Change

This course examines the impact of climate change on urban areas and the role of urban planning in climate adaptation and mitigation. Topics include urban heat islands, greenhouse gas emissions, green infrastructure, and climate-resilient urban design. Students explore policies and strategies for reducing the environmental footprint of cities and promoting sustainable urban living.

Elective III (e.g., Urban Policy and Governance)

This elective focuses on the governance frameworks and policies that shape urban development. Students learn about policy formulation, urban legislation, public-private partnerships, and stakeholder engagement. Case studies explore governance models for smart cities, with an emphasis on transparency, inclusivity, and effective urban management.

Major Project I

In this capstone project, students work in teams to address a complex problem in smart urban infrastructure. They design, develop, and test a solution, such as a comprehensive urban water management plan, a smart energy grid model, or an advanced transportation system. The project emphasizes practical application, innovation, and interdisciplinary collaboration.

Internship I (4 weeks)

Students complete a four-week internship with a company or organization involved in urban infrastructure, smart city development, or related fields. The internship provides hands-on experience, allowing students to apply their skills in a real-world setting and gain insights into industry practices and challenges.

Semester VIII

Sustainable Urban Design

This course explores principles and practices for designing sustainable urban environments. Students learn about green building standards, sustainable urban landscapes, and the integration of renewable energy in urban design. Case studies focus on successful sustainable urban projects around the world, emphasizing holistic approaches to urban development.

Smart Building Automation

This course covers the technologies used in automating building systems, such as heating, ventilation, air conditioning (HVAC), lighting, and security. Students learn to design smart building management systems (BMS) that optimize energy usage and improve user comfort. Practical sessions involve programming automation controllers and simulating smart building operations.

Elective IV (e.g., Urban Sociology)

This elective examines the social dynamics of urban life, including community structures, social equity, and the impact of urbanization on culture. Students explore the role of public spaces, urban social policies, and the challenges of creating inclusive and livable cities. The course integrates sociological theory with practical examples of urban social dynamics.

Elective V (e.g., Urban Governance and Planning)

This elective focuses on advanced topics in urban governance and strategic planning. Students explore techniques for long-term urban planning, regional planning, and sustainable development strategies. Topics include participatory planning processes, urban policy analysis, and regional development frameworks.

Major Project II (Capstone Project)

The final capstone project allows students to demonstrate their expertise through a comprehensive project that addresses a major challenge in smart urban infrastructure. Projects may include the development of a smart mobility platform, a renewable energy strategy for a city, or a digital platform for urban resource management. Students present their projects to a panel, showcasing their ability to integrate technical skills with strategic planning.

Master of Technology in Smart Urban Infrastructure (M.Tech.)

Year 1 *L: Lecture T: Tutorial P: Practical

	Course	Hours/Week			Credits
Semester-I	Advanced Urban Infrastructure Systems	L: 3	T: 1	P: 0	4
	Smart City Technologies and IoT	L: 3	T: 0	P: 2	4
	Sustainable Urban Design and Planning	L: 3	T: 0	P: 2	4
	Data Analytics for Urban Management	L: 2	T: 0	P: 2	3
	Elective I (e.g., GIS and Remote Sensing for Urban Planning)	L: 3	T: 0	P: 0	3
	Research Methodology	L: 2	T: 0	P: 0	2
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester-II	Advanced Transportation Systems	L: 3	T: 0	P: 2	4
	Urban Resilience and Disaster Management	L: 3	T: 0	P: 2	4
	Energy-Efficient Buildings and Smart Grids	L: 3	T: 0	P: 2	4
	Elective II (e.g., Urban Water Management)	L: 3	T: 0	P: 0	3
	Elective III (e.g., Urban Policy and Governance)	L: 3	T: 0	P: 0	3
	Mini Project	L: 0	T: 0	P: 6	2
				Total Credits	**20**

Year 2

	Course	Hours/Week			Credits
Semester-III	Smart Mobility Solutions	L: 3	T: 0	P: 2	4
	Urban Climate and Environmental Management	L: 3	T: 0	P: 2	4
	Elective IV (e.g., Advanced Structural Design)	L: 3	T: 0	P: 0	3
	Thesis Work - Part I	L: 0	T: 0	P: 10	5
	Internship (4 weeks)	L: 0	T: 0	P: 6	2
				Total Credits	**18**

	Course	Hours/Week			Credits
Semester-IV	Elective V (e.g., Urban Economics)	L: 3	T: 0	P: 0	3
	Elective VI (e.g., Sustainable Construction Practices)	L: 3	T: 0	P: 0	3
	Thesis Work - Part II (Final Defense)	L: 0	T: 0	P: 18	9
	Seminar	L: 0	T: 0	P: 2	2
	Comprehensive Viva	L: 0	T: 0	P: 0	1
				Total Credits	**18**

Elective Options:

- **Elective I**: GIS and Remote Sensing for Urban Planning, Digital Twin Technologies for Urban Infrastructure
- **Elective II**: Urban Water Management, Solid Waste Management and Circular Economy
- **Elective III**: Urban Policy and Governance, Public-Private Partnerships in Infrastructure
- **Elective IV**: Advanced Structural Design, Smart Construction Materials
- **Elective V**: Urban Economics, Climate-Adaptive Urban Planning
- **Elective VI**: Sustainable Construction Practices, Disaster Risk Reduction in Urban Areas

Syllabus

Year 1

Semester I

1. **Advanced Urban Infrastructure Systems**

   This course covers the principles and practices of designing and managing urban infrastructure, including transportation, energy, water supply, waste management, and communication systems. Students learn how these systems are integrated to support urban life and are exposed to advanced modelling techniques for analyzing infrastructure performance. The course emphasizes the importance of resilience, sustainability, and efficiency in urban systems, using case studies from global cities to illustrate successful infrastructure management practices.

2. **Smart City Technologies and IoT**

   This course introduces students to the technologies that enable smart cities, focusing on the Internet of Things (IoT) and its applications in urban management. Topics include IoT architectures, communication protocols, sensor networks, and data analytics. Students will explore how IoT can be used for real-time monitoring and control of urban systems such as traffic, waste management, energy grids, and public safety. Hands-on labs involve designing IoT solutions for urban challenges, such as smart street lighting and air quality monitoring.

3. **Sustainable Urban Design and Planning**

   This course emphasizes the principles of sustainable urban design, covering topics such as urban form, land use planning, green spaces, and climate-responsive design. Students learn strategies for designing cities that minimize environmental impact, promote energy efficiency, and enhance the quality of urban life. The course explores the role of urban planners in creating resilient and adaptable cities through the integration of sustainable practices in zoning, transportation, and infrastructure design.

4. **Data Analytics for Urban Management**

   This course provides a foundation in data analytics techniques used for managing urban systems. Topics include statistical analysis, machine learning, and data visualization methods, with a focus on their applications in urban planning and infrastructure management. Students learn to use tools such as GIS software and data analytics platforms to interpret large datasets, analyze urban trends, and make data-driven decisions for improving urban services and infrastructure.

5. **Elective I: GIS and Remote Sensing for Urban Planning**

   This elective focuses on the use of Geographic Information Systems (GIS) and remote sensing technologies for urban planning and development. Students learn to collect, analyze, and visualize spatial data to support urban decision-making. Topics include spatial analysis, land use mapping, urban growth modelling, and remote sensing image interpretation. Practical exercises involve using GIS software to analyze urban spatial patterns and assess the impact of urbanization.

6. **Research Methodology**

   This course equips students with the skills needed for conducting research in the field of smart urban infrastructure. Topics include research design, literature review, qualitative and quantitative research methods, and data collection techniques. Students learn how to formulate research questions, develop hypotheses, and use statistical tools to analyze data. The course prepares students for their thesis work by emphasizing ethical considerations and academic writing skills.

Semester II

1. **Advanced Transportation Systems**

   This course covers the design, analysis, and management of urban transportation systems, including public transit, road networks, and non-motorized transport options. Students learn about advanced traffic modelling, intelligent transportation systems (ITS), and the role of technology in improving urban mobility. The course emphasizes sustainable transport solutions such as electric vehicles, smart traffic management, and integrated multimodal transport systems. Case studies highlight successful urban transportation projects from around the world.

2. **Urban Resilience and Disaster Management**

   This course explores strategies for enhancing the resilience of urban infrastructure against natural and human-made disasters. Topics include risk assessment, disaster mitigation planning, emergency response systems, and recovery strategies. Students learn to design infrastructure that can withstand extreme events such as floods, earthquakes, and storms. The course includes practical sessions on creating disaster management plans and conducting vulnerability assessments for urban areas.

3. **Energy-Efficient Buildings and Smart Grids**

   This course focuses on designing energy-efficient buildings and integrating them into smart grids. Topics include building energy modelling, HVAC optimization, renewable energy integration, and smart energy management systems. Students explore how smart grids can balance energy demand and supply through the use of advanced metering infrastructure, demand response, and distributed energy resources. Practical exercises include using simulation software to design energy-efficient building systems and smart grid configurations.

4. **Elective II: Urban Water Management**

   This elective covers the principles of urban water management, focusing on water supply, wastewater treatment, stormwater management, and water reuse. Students learn to design sustainable water systems that ensure reliable water supply and minimize environmental impact. Topics include water quality monitoring, hydraulic modelling, and the integration of green infrastructure for urban water management. Case studies illustrate best practices in managing urban water resources in different climatic contexts.

5. **Elective III: Urban Policy and Governance**

   This course provides an understanding of the policy frameworks and governance structures that shape urban development. Students learn about urban legislation, public-private partnerships, stakeholder engagement, and policy analysis. The course explores the role of governance in enabling smart city initiatives, addressing challenges such as urban inequality, housing, and infrastructure financing. Case studies from various cities highlight innovative governance models and policy interventions.

6. Mini Project

In this project-based course, students work on a practical challenge related to smart urban infrastructure. They apply the knowledge and skills gained from their coursework to design and implement a solution, such as developing a GIS-based urban planning tool, designing a smart water management system, or creating a data-driven traffic management model. The mini project helps students build hands-on experience in solving real-world urban challenges.

Year 2

Semester III

1. Smart Mobility Solutions

This course delves into advanced technologies for improving urban mobility, including electric vehicles, autonomous transportation, and mobility-as-a-service (MaaS). Students study the role of data analytics, AI, and IoT in managing transportation networks, optimizing traffic flow, and reducing carbon emissions. The course emphasizes the design and implementation of smart mobility solutions that enhance accessibility and sustainability in urban areas.

2. Urban Climate and Environmental Management

This course examines the impact of climate change on urban areas and explores strategies for environmental management. Topics include urban heat islands, air quality management, green infrastructure, and climate-resilient urban planning. Students learn to assess the environmental footprint of cities and design interventions to mitigate climate impacts. The course integrates case studies of cities implementing climate adaptation and mitigation strategies.

3. Elective IV: Advanced Structural Design

This elective focuses on the design of complex structural systems, including high-rise buildings, bridges, and industrial structures. Students learn to analyze and design structures under various loading conditions, including seismic and wind loads, using advanced software tools. The course emphasizes safety, stability, and compliance with international structural design codes, preparing students for specialized roles in structural engineering.

4. Thesis Work - Part I

In this course, students begin work on their thesis, focusing on identifying a research problem, conducting a literature review, and developing a research plan. The project should address a significant challenge in the field of smart urban infrastructure, such as sustainable urban transport, smart energy systems, or climate adaptation strategies. Students work closely with a faculty advisor to refine their research objectives and methodology.

5. **Internship (4 weeks)**

   This course involves a four-week internship with a company, government agency, or research organization involved in smart city development or urban infrastructure management. The internship provides hands-on experience, allowing students to apply their skills in a professional setting and gain insights into industry practices and challenges. The experience helps students build a professional network and prepare for careers in the urban infrastructure sector.

Semester IV

1. **Elective V: Urban Economics**

   This course explores the economic aspects of urban development, including real estate markets, infrastructure financing, and economic planning. Students learn about the factors that drive urban growth, the economics of housing, and the impact of urban policies on economic development. The course emphasizes the role of economic analysis in making informed decisions for urban planning and development.

2. **Elective VI: Sustainable Construction Practices**

   This course focuses on sustainable construction techniques and materials, including green building standards, energy-efficient construction methods, and lifecycle assessment. Students learn how to integrate sustainability into building design, construction processes, and material selection. The course includes case studies of sustainable construction projects that demonstrate best practices in minimizing the environmental impact of building activities.

3. **Thesis Work - Part II (Final Defense)**

   In this course, students complete their thesis project, conducting detailed analysis, implementing their research plan, and documenting their findings. The project culminates in a final thesis presentation and defense before a panel of faculty members. The thesis should demonstrate the student’s ability to conduct independent research and make a meaningful contribution to the field of smart urban infrastructure.

4. Seminar

This course involves presenting research work, case studies, or new developments in smart urban infrastructure. Students develop skills in public speaking, technical presentation, and engaging with academic and professional audiences. The seminar course also provides a platform for discussing emerging trends and challenges in urban development.

5. Comprehensive Viva

This course assesses students' overall understanding of the program through an oral examination. Students are tested on their knowledge of key concepts, their ability to integrate learning across courses, and their readiness for professional practice in the field of smart urban infrastructure.

Bachelor of Technology in Health Informatics (B.Tech.)

Year 1

	Course	Hours/Week			Credits
Semester I	Fundamentals of Health Informatics	L: 3	T: 0	P: 2	4
	Mathematics-I (Calculus and Linear Algebra)	L: 3	T: 1	P: 0	4
	Basics of Programming	L: 3	T: 0	P: 2	4
	Anatomy and Physiology for Engineers	L: 3	T: 0	P: 2	4
	Digital Health Communication	L: 2	T: 0	P: 0	2
	Introduction to Biology	L: 2	T: 0	P: 0	2
	Total Credits				**20**

*L: Lecture T: Tutorial P: Practical

	Course	Hours/Week			Credits
Semester II	Health Information Systems	L: 3	T: 0	P: 2	4
	Mathematics-II (Probability and Statistics)	L: 3	T: 1	P: 0	4
	Data Structures and Algorithms	L: 3	T: 0	P: 2	4
	Medical Terminology and Healthcare Workflow	L: 3	T: 0	P: 0	3
	Database Management Systems	L: 3	T: 0	P: 2	4
	Technical Communication	L: 2	T: 0	P: 0	2
	Total Credits				**21**

Year 2

	Course	Hours/Week			Credits
Semester III	Electronic Health Records (EHR) Management	L: 3	T: 0	P: 2	4
	Health Data Analytics	L: 3	T: 0	P: 2	4
	Biostatistics	L: 3	T: 0	P: 2	4
	Introduction to Machine Learning	L: 3	T: 0	P: 2	4
	Elective I (e.g., Telemedicine Systems)	L: 3	T: 0	P: 0	3
	Mini Project I	L: 0	T: 0	P: 2	1
	Total Credits				**20**

Semester IV	Course	Hours/Week			Credits
	Health Information Security and Privacy	L: 3	T: 0	P: 2	4
	Clinical Decision Support Systems	L: 3	T: 0	P: 2	4
	Database Optimization for Health Data	L: 3	T: 0	P: 2	4
	Health Economics and Policy	L: 3	T: 0	P: 0	3
	Elective II (e.g., Health IoT and Wearable Devices)	L: 3	T: 0	P: 0	3
	Internship I (4 weeks)	L: 0	T: 0	P: 2	2
	Total Credits				**20**

Year 3

Semester V	Course	Hours/Week			Credits
	Advanced Health Data Management	L: 3	T: 0	P: 2	4
	Artificial Intelligence in Healthcare	L: 3	T: 0	P: 2	4
	Public Health Informatics	L: 3	T: 0	P: 2	4
	Cloud Computing for Health Data	L: 3	T: 0	P: 2	4
	Elective III (e.g., Genomics and Bioinformatics)	L: 3	T: 0	P: 0	3
	Mini Project II	L: 0	T: 0	P: 2	1
	Total Credits				**20**

Semester VI	Course	Hours/Week			Credits
	Healthcare Systems Engineering	L: 3	T: 0	P: 2	4
	Big Data Analytics in Healthcare	L: 3	T: 0	P: 2	4
	Advanced Programming for Health Informatics	L: 3	T: 0	P: 2	4
	Ethics and Legal Issues in Health Informatics	L: 3	T: 0	P: 0	3
	Elective IV (e.g., Advanced Medical Imaging Techniques)	L: 3	T: 0	P: 0	3
	Internship II (6 weeks)	L: 0	T: 0	P: 2	2
	Total Credits				**20**

Year 4

	Course	Hours/Week			Credits
Semester VII	Health Informatics Project Management	L: 3	T: 0	P: 2	4
	Predictive Analytics in Healthcare	L: 3	T: 0	P: 2	4
	Blockchain in Health Data Management	L: 3	T: 0	P: 2	4
	Elective V (e.g., Virtual Reality in Healthcare)	L: 3	T: 0	P: 0	3
	Capstone Project I	L: 0	T: 0	P: 6	3
	Seminar	L: 0	T: 0	P: 2	2
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester VIII	Elective VI (e.g., Data Ethics and Compliance in Healthcare)	L: 3	T: 0	P: 0	3
	Elective VII (e.g., Advanced Health Informatics Research)	L: 3	T: 0	P: 0	3
	Capstone Project II (Final Defense)	L: 0	T: 0	P: 12	8
	Comprehensive Viva	L: 0	T: 0	P: 0	1
				Total Credits	15

Elective Options:

Elective I: Telemedicine Systems, Mobile Health Applications, Digital Therapeutics

Elective II: Health IoT and Wearable Devices, Computational Biology, Personalized Medicine

Elective III: Genomics and Bioinformatics, Precision Medicine, Population Health Management

Elective IV: Advanced Medical Imaging Techniques, Health Robotics, Neuroinformatics

Elective V: Virtual Reality in Healthcare, Artificial Intelligence in Radiology, Remote Patient Monitoring

Elective VI: Data Ethics and Compliance in Healthcare, Global Health Informatics, Emerging Technologies in Health Informatics

Elective VII: Advanced Health Informatics Research, Advanced Data Visualization in Healthcare, Innovations in Digital Health

Syllabus

Year 1

Semester I

1. **Fundamentals of Health Informatics**

   This course introduces students to the core concepts of health informatics, including the role of information systems in healthcare, data management, and the use of technology to enhance patient care. Topics include the history of health informatics, health information exchange (HIE), electronic medical records (EMR), and the standards and protocols for secure data sharing in healthcare settings. Practical sessions involve exploring various health informatics systems and understanding their functionalities in real-world applications.

2. **Mathematics-I (Calculus and Linear Algebra)**

   This course covers essential mathematical concepts including calculus and linear algebra that are critical for understanding and modelling data in health informatics. Topics include limits, derivatives, integrals, matrix operations, vector spaces, and linear transformations. Students learn to apply these mathematical principles to solve problems in data analysis, system modelling, and computational algorithms in healthcare applications.

3. **Basics of Programming**

   This course introduces students to programming using languages such as Python or Java. Topics include variables, control structures, functions, data structures, and file handling. The course emphasizes the role of programming in automating health data processing, developing software tools for clinical applications, and managing health information systems. Students engage in hands-on programming assignments, building foundational skills necessary for advanced courses in health informatics.

4. **Anatomy and Physiology for Engineers**

   This course provides an overview of human anatomy and physiology, focusing on the major organ systems and their functions. Students learn about the structure and function of the cardiovascular, respiratory, nervous, and musculoskeletal systems, as well as the basics of human health and disease. This course is designed to provide a foundational understanding of the human body, which is crucial for designing and optimizing healthcare technology and information systems.

5. **Digital Health Communication**

   This course focuses on communication strategies and digital tools used to improve patient engagement and health education. Topics include telehealth communication, patient portals, digital media in health promotion, and the use of social media for public health campaigns. Students learn how effective communication can enhance patient outcomes and bridge gaps between healthcare providers and patients.

6. **Introduction to Biology**

   This course introduces fundamental biological concepts, including cell structure, genetics, evolution, and ecosystems. Students gain an understanding of the biological processes that influence human health and disease, providing a scientific foundation for advanced studies in health informatics and biostatistics.

Semester II

1. **Health Information Systems**

   This course delves into the design, implementation, and management of health information systems, including electronic health records (EHR), laboratory information systems (LIS), and radiology information systems (RIS). Students learn about the architecture of these systems, data interoperability, and the use of databases to store and retrieve patient information. Practical sessions involve exploring the use of health information systems in clinical settings and understanding the challenges of system integration.

2. **Mathematics-II (Probability and Statistics)**

   This course covers probability theory and statistical methods used in health data analysis. Topics include probability distributions, hypothesis testing, regression analysis, and statistical inference. Students learn to apply these statistical tools to analyze healthcare data, assess clinical trials, and make data-driven decisions in healthcare management. The course emphasizes practical applications, using statistical software for analyzing real-world health datasets.

3. **Data Structures and Algorithms**

   This course introduces students to the design and analysis of data structures and algorithms, focusing on their application in health informatics. Topics include arrays, linked lists, stacks, queues, trees, and sorting algorithms. Students learn to optimize data retrieval and storage in health databases, ensuring the efficient handling of large volumes of health data. The course includes programming assignments that reinforce algorithmic thinking in solving health informatics problems.

4. **Medical Terminology and Healthcare Workflow**

   This course provides an introduction to medical terminology and the workflows common in healthcare settings, such as hospital information systems, clinical pathways, and patient care processes. Students learn the language of medicine, which is essential for understanding clinical documentation and communicating effectively with healthcare professionals. The course also explores how workflow optimization can improve patient care and system efficiency.

5. **Database Management Systems**

   This course focuses on the design, implementation, and management of databases, with a special emphasis on healthcare applications. Topics include relational database models, SQL, data normalization, and database security. Students learn how to design and maintain databases that store patient records, medical images, and other healthcare information. Practical sessions involve creating and querying databases to support clinical decision-making.

6. **Technical Communication**

   This course aims to develop students' technical writing and presentation skills, focusing on the communication needs of the healthcare and technology sectors. Topics include writing reports, creating technical documentation, and delivering presentations. Students learn how to communicate complex technical information in a clear and concise manner to a variety of audiences, including healthcare professionals and policymakers.

Year 2

Semester III

1. **Electronic Health Records (EHR) Management**

   This course provides an in-depth understanding of the management of electronic health records (EHR), focusing on their design, implementation, and regulatory compliance. Students learn about the benefits and challenges of EHR adoption, including data standardization, privacy issues, and user interface design. Practical sessions involve using EHR systems to input, retrieve, and analyze patient data, and understanding how EHRs support clinical workflows.

2. **Health Data Analytics**

   This course teaches students to analyze and interpret health data to inform clinical decisions and improve patient outcomes. Topics include data cleaning, descriptive analytics, predictive modelling, and visualization techniques. Students use analytics tools like R or Python to analyze datasets from clinical trials, hospital records, and public health databases. The course emphasizes the role of analytics in identifying trends, evaluating treatment outcomes, and supporting evidence-based practice.

3. **Biostatistics**

   This course introduces statistical techniques used in analyzing biological and health data. Topics include survival analysis, logistic regression, ANOVA, and multivariate analysis. Students learn to design experiments, interpret statistical results, and apply biostatistical methods to clinical research. The course includes practical exercises involving the analysis of real-world biomedical data, preparing students for roles in research and clinical trials.

4. **Introduction to Machine Learning**

   This course covers the fundamentals of machine learning, with a focus on applications in healthcare. Topics include supervised and unsupervised learning, classification, clustering, and neural networks. Students learn to build predictive models that can analyze patient data, diagnose diseases, and recommend treatments. The course emphasizes hands-on learning, with projects that involve implementing machine learning algorithms using healthcare datasets.

5. **Elective I: Telemedicine Systems**

   This elective explores the technologies and infrastructure used in telemedicine, focusing on remote patient monitoring, video consultations, and virtual care. Students learn about the challenges of implementing telemedicine systems, including data security, patient consent, and integration with existing health information systems. The course includes case studies of successful telemedicine deployments and their impact on healthcare access and quality.

6. **Mini Project I**

   In this project-based course, students work on a small-scale research or development project related to health informatics. Projects may involve developing a software tool, conducting a data analysis study, or designing a prototype for a healthcare solution. The course emphasizes project management, teamwork, and the application of technical skills to solve real-world problems.

Semester IV

1. **Health Information Security and Privacy**

   This course focuses on the principles and practices of securing health information and ensuring patient privacy. Topics include encryption, authentication, access control, and compliance with regulations such as HIPAA (Health Insurance Portability and Accountability Act). Students learn how to identify security risks, implement data protection strategies, and manage cybersecurity incidents in healthcare settings.

2. **Clinical Decision Support Systems (CDSS)**

   This course introduces students to the design and implementation of Clinical Decision Support Systems (CDSS), which aid healthcare providers in making clinical decisions. Topics include the integration of CDSS with electronic health records, rule-based systems, and machine learning models for diagnostics. Students learn how CDSS can improve patient care by providing evidence-based recommendations and alerts for potential risks.

3. **Database Optimization for Health Data**

   This course focuses on advanced techniques for optimizing the performance of health databases. Topics include indexing, query optimization, database clustering, and data warehousing. Students learn to enhance the efficiency of database systems used in healthcare, ensuring rapid access to patient data for clinical decision-making. Practical sessions involve optimizing real-world health databases for speed and accuracy.

4. **Health Economics and Policy**

   This course examines the economic principles and policies that shape the healthcare industry, including the analysis of healthcare costs, insurance models, and the role of government in healthcare delivery. Students learn about the economic evaluation of health interventions, such as cost-effectiveness analysis and cost-benefit analysis. The course emphasizes the impact of policy decisions on healthcare access, quality, and equity.

5. **Elective II: Health IoT and Wearable Devices**

   This elective explores the role of the Internet of Things (IoT) and wearable technology in monitoring patient health and managing chronic conditions. Topics include the design and implementation of IoT devices, data integration with health information systems, and the use of wearable sensors for real-time health monitoring. Students learn about the challenges of data privacy and interoperability in IoT-based healthcare solutions.

6. **Internship I**

   This four-week internship provides students with hands-on experience in a healthcare or health technology organization. Students apply their knowledge of health informatics, data analytics, and information systems to real-world projects, gaining insights into industry practices and building professional networks.

Year 3

Semester V

1. Advanced Health Data Management

This course provides in-depth knowledge of managing large-scale health data systems, including data warehousing, cloud storage, and data interoperability. Topics include health data standards (e.g., HL7, FHIR), data integration, and the design of scalable databases for handling diverse healthcare data types. Students learn about the challenges of data interoperability between different health information systems and the role of data governance in maintaining data quality. Practical sessions involve working with health data management tools and cloud platforms, focusing on optimizing data storage and retrieval.

2. Artificial Intelligence in Healthcare

This course explores the application of artificial intelligence (AI) techniques in healthcare, focusing on improving patient outcomes through predictive analytics and automation. Topics include natural language processing (NLP) for medical records, computer vision for medical imaging, and AI-based clinical decision support. Students learn to develop and evaluate AI models for diagnosing diseases, predicting patient risk, and personalizing treatment plans. The course emphasizes practical applications, with hands-on projects using AI frameworks like TensorFlow and PyTorch.

3. Public Health Informatics

This course focuses on the use of information technology to improve public health outcomes, emphasizing data collection, surveillance, and analysis at the population level. Topics include epidemiological data analysis, health informatics for disease prevention, and digital tools for managing public health emergencies. Students learn about the role of geographic information systems (GIS) in tracking disease outbreaks and using data visualization tools to communicate public health information. The course includes case studies of digital public health interventions and their impact on community health.

4. Cloud Computing for Health Data

This course introduces cloud computing concepts and their applications in health informatics, focusing on the storage, processing, and analysis of large health datasets. Topics include cloud architectures, data security in the cloud, and the integration of cloud services with electronic health records (EHRs). Students learn to use cloud platforms like AWS, Azure, or Google Cloud to deploy health information systems and ensure data availability and scalability. Practical sessions involve setting up virtual machines, using cloud databases, and implementing secure data backup solutions.

5. Elective III: Genomics and Bioinformatics

This elective covers the intersection of genomics and bioinformatics, focusing on analyzing genetic data to improve health outcomes. Topics include DNA sequencing technologies, genomic data analysis, and computational methods for understanding genetic variations. Students learn about personalized medicine, where treatments are tailored to an individual's genetic profile, and the role of bioinformatics in disease research. Practical sessions involve analyzing genomic datasets using bioinformatics tools and understanding their applications in clinical practice.

6. Mini Project II

This project-based course allows students to work on a research or development project in health informatics, applying the concepts learned in previous courses. Projects may involve designing a health data analysis tool, developing an AI model for disease prediction, or implementing a cloud-based health information system. The course emphasizes teamwork, innovation, and effective communication of project outcomes.

Semester VI

1. Healthcare Systems Engineering

This course focuses on applying engineering principles to optimize healthcare delivery systems, improving efficiency, quality, and patient safety. Topics include systems analysis, workflow optimization, process improvement, and lean management in healthcare. Students learn about tools such as Six Sigma and process mapping to identify inefficiencies in clinical workflows and develop strategies for improvement. Case studies of successful systems engineering projects in hospitals and healthcare organizations illustrate the real-world impact of these methods.

2. Big Data Analytics in Healthcare

This course provides advanced knowledge of big data analytics, focusing on the analysis of large healthcare datasets to uncover patterns and insights. Topics include distributed computing frameworks like Hadoop and Spark, machine learning algorithms for big data, and the ethical considerations of handling large-scale patient data. Students learn to build and deploy data pipelines, analyze unstructured data from electronic health records, and use predictive analytics to support clinical decision-making. Practical sessions involve working with big data tools and datasets from health information systems.

3. Advanced Programming for Health Informatics

This course focuses on advanced programming techniques used in developing health informatics applications, including data integration, API development, and software optimization. Topics include RESTful APIs, microservices architecture, and the use of programming languages like Python, Java, and R for health data analysis. Students learn to design and build software solutions that integrate with existing health information systems and enhance their functionality. Practical exercises involve developing custom APIs and creating tools for data visualization and reporting.

4. Ethics and Legal Issues in Health Informatics

This course examines the ethical and legal considerations in the field of health informatics, focusing on patient privacy, data security, and compliance with regulations such as HIPAA, GDPR, and other health data protection laws. Students learn about ethical frameworks for handling sensitive health information, managing patient consent, and navigating the legal complexities of telemedicine and digital health services. Case studies explore real-world scenarios, emphasizing the balance between innovation and regulatory compliance in health informatics.

5. Elective IV: Advanced Medical Imaging Techniques

This elective explores advanced techniques in medical imaging, focusing on the use of imaging modalities like MRI, CT, and ultrasound in diagnostics and treatment. Students learn about image processing algorithms, 3D reconstruction, and AI-based image analysis. The course emphasizes the role of medical imaging in precision medicine and the integration of imaging data with electronic health records for improved patient care. Practical sessions involve working with medical imaging software and analyzing imaging datasets.

6. Internship II

This six-week internship provides students with hands-on experience in a healthcare or health technology organization. Students apply their knowledge of health informatics, AI, and data analytics to real-world projects, gaining insights into industry practices and building professional networks. The internship emphasizes the application of technical skills in practical settings, preparing students for roles in the health informatics industry.

Year 4

Semester VII

1. Health Informatics Project Management

This course focuses on project management principles applied to health informatics projects, including planning, execution, monitoring, and closure. Topics include project lifecycle management, risk assessment, resource allocation, and stakeholder communication. Students learn to use project management software and methodologies like Agile and Scrum to manage complex projects in healthcare settings. The course emphasizes the importance of leadership and teamwork in successfully implementing health information systems.

2. Predictive Analytics in Healthcare

This course delves into advanced predictive analytics techniques, focusing on their applications in personalized medicine, disease prevention, and patient management. Topics include time-series analysis, survival analysis, and the use of machine learning models to predict patient outcomes. Students learn to build predictive models that analyze patient data and support clinical decision-making. Practical sessions involve working with real-world healthcare datasets and developing models using software tools like R, Python, and SAS.

3. Blockchain in Health Data Management

This course explores the application of blockchain technology in securing and managing health data. Topics include blockchain fundamentals, smart contracts, decentralized health records, and interoperability challenges. Students learn how blockchain can enhance data security, integrity, and patient privacy by providing a tamper-proof digital ledger for health transactions. The course includes practical projects that involve designing blockchain-based solutions for health data management.

4. Elective V: Virtual Reality in Healthcare

This elective focuses on the use of virtual reality (VR) and augmented reality (AR) in healthcare for training, therapy, and patient education. Topics include the development of VR simulations for medical training, AR applications for surgery, and the use of immersive technology in pain management and rehabilitation. Students learn about the design and implementation of VR systems in healthcare settings and their impact on patient engagement and outcomes. Practical sessions involve developing VR simulations for specific healthcare applications.

5. Capstone Project I

This course involves the initial phase of the capstone project, where students identify a research problem or development opportunity in health informatics. Students work in teams to develop a project proposal, conduct a literature review, and begin the design or data collection process. The capstone project emphasizes innovation, problem-solving, and the integration of skills gained throughout the program.

6. Seminar

This course involves presenting research findings, discussing emerging trends in health informatics, and analyzing case studies. Students develop skills in technical communication, critical thinking, and public speaking, preparing them to present complex information to diverse audiences. The seminar encourages peer feedback and fosters a collaborative learning environment.

Semester VIII

1. Elective VI: Data Ethics and Compliance in Healthcare

This elective focuses on the ethical considerations and regulatory frameworks that govern the use of data in healthcare. Topics include data privacy, informed consent, ethical AI in healthcare, and compliance with regulations like GDPR and HIPAA. Students learn to develop ethical guidelines for handling patient data and to navigate the legal landscape of digital health. The course emphasizes real-world applications through case studies and scenario-based learning.

2. Elective VII: Advanced Health Informatics Research

This elective explores advanced topics in health informatics research, including grant writing, research methodologies, and the design of clinical trials. Students learn to conduct independent research on emerging technologies and data analytics in healthcare. The course prepares students for research-oriented roles in academia, industry, and research institutions. Students work on developing a research proposal and presenting their findings to faculty and peers.

3. Capstone Project II (Final Defense)

This course involves completing the capstone project initiated in Semester VII. Students finalize their research, analyze data, and write a detailed project report. The project culminates in a final presentation to a panel of faculty members, where students defend their findings and demonstrate their ability to integrate theoretical knowledge with practical applications. The capstone project emphasizes problem-solving, critical thinking, and effective communication.

4. Comprehensive Viva

The comprehensive viva is an oral examination that assesses students' overall understanding of the concepts and skills learned throughout the program. It includes topics such as health data management, AI applications in healthcare, system optimization, and ethical considerations in health informatics. The viva tests students' ability to integrate knowledge from various courses and apply it to solving real-world challenges in health informatics.

Master of Technology in Health Informatics (M.Tech.)

Year 1

	Course	Hours/Week			Credits
Semester I	Advanced Health Informatics	L: 3	T: 0	P: 2	4
	Health Data Management and Analytics	L: 3	T: 0	P: 2	4
	Biostatistics and Research Methodology	L: 3	T: 0	P: 2	4
	Health Information Security and Privacy	L: 3	T: 0	P: 2	4
	Elective I (e.g., Telemedicine Systems)	L: 3	T: 0	P: 0	3
	Seminar I	L: 0	T: 0	P: 2	2
				Total Credits	**21**

*L: Lecture T: Tutorial P: Practical

	Course	Hours/Week			Credits
Semester II	Clinical Decision Support Systems	L: 3	T: 0	P: 2	4
	Artificial Intelligence in Healthcare	L: 3	T: 0	P: 2	4
	Health Economics and Policy	L: 3	T: 0	P: 0	3
	Advanced Database Management for Health Data	L: 3	T: 0	P: 2	4
	Elective II (e.g., Health IoT and Wearable Devices)	L: 3	T: 0	P: 0	3
	Mini Project	L: 0	T: 0	P: 4	2
				Total Credits	**20**

Year 2

	Course	Hours/Week			Credits
Semester III	Big Data Analytics in Healthcare	L: 3	T: 0	P: 2	4
	Innovation and Entrepreneurship in Health Informatics	L: 3	T: 0	P: 0	3
	Elective III (e.g., Genomics and Bioinformatics)	L: 3	T: 0	P: 0	3
	Thesis Work - Part I	L: 0	T: 0	P: 12	5
	Internship (4 weeks)	L: 0	T: 0	P: 4	2
				Total Credits	**17**

	Course	Hours/Week			Credits
Semester IV	Elective IV (e.g., Advanced Medical Imaging Techniques)	L: 3	T: 0	P: 0	3
	Elective V (e.g., Ethics and Legal Issues in Health Informatics)	L: 3	T: 0	P: 0	3
	Thesis Work - Part II (Final Defense)	L: 0	T: 0	P: 16	8
	Seminar II	L: 0	T: 0	P: 2	2
	Comprehensive Viva	L: 0	T: 0	P: 0	1
				Total Credits	**17**

Elective Options:

Elective I: Telemedicine Systems, Digital Therapeutics, Advanced Data Visualization

Elective II: Health IoT and Wearable Devices, Personalized Medicine, Computational Biology

Elective III: Genomics and Bioinformatics, Precision Medicine, Public Health Informatics

Elective IV: Advanced Medical Imaging Techniques, VR/AR in Healthcare, Health Robotics

Elective V: Ethics and Legal Issues in Health Informatics, Data Governance, Emerging Trends in Health Technology

Syllabus

Year 1

Semester I

1. **Advanced Health Informatics**

   This course delves into the core concepts of health informatics, including the use of advanced health information systems, data exchange standards, and interoperability frameworks. Topics include electronic health record (EHR) integration, clinical workflows, and the design and management of health information exchange (HIE) systems. Students learn about the latest trends in digital health, such as telemedicine, mobile health (mHealth), and digital patient engagement. The course emphasizes the application of these systems in real-world healthcare settings to enhance patient care and streamline clinical processes.

2. **Health Data Management and Analytics**

   This course focuses on techniques for managing and analyzing large-scale health data. Topics include data collection methods, data warehousing, and database management specific to healthcare settings. Students explore the use of advanced analytical techniques to derive insights from clinical and operational data, using tools such as SQL, R, and Python. The course covers predictive analytics, data visualization, and the use of dashboards for clinical decision-making. Practical exercises involve working with real-world health data sets to improve the understanding of patient outcomes and optimize health services.

3. **Biostatistics and Research Methodology**

   This course provides a comprehensive understanding of statistical methods and research techniques used in health informatics. Topics include descriptive statistics, inferential statistics, regression analysis, and survival analysis, as well as the design of clinical trials and observational studies. Students learn to design research studies, formulate hypotheses, and apply statistical software tools for data analysis. The course emphasizes interpreting statistical results and their implications for healthcare practice and policy, preparing students for research-focused roles in the health sector.

4. **Health Information Security and Privacy**

   This course covers the principles and practices for securing health information and ensuring patient privacy. Topics include encryption, access control, data masking, and secure data transmission protocols. Students learn about legal frameworks such as HIPAA, GDPR, and other data protection regulations that govern the handling of health data. The course emphasizes risk assessment, security audits, and incident response strategies to protect against cyber threats in healthcare settings. Practical sessions involve implementing security measures for health information systems and assessing their effectiveness.

5. **Elective I: Telemedicine Systems**

   This elective explores the infrastructure and technologies that enable remote patient care, including telemedicine platforms, remote monitoring devices, and video consultation tools. Topics include the design and implementation of telehealth systems, integration with EHRs, and regulatory considerations. Students learn about the challenges and opportunities of telemedicine, such as patient consent, reimbursement, and ensuring data security. Practical sessions involve designing a prototype telemedicine system and evaluating its impact on patient care and healthcare delivery.

6. **Seminar I**

   This course focuses on enhancing students' communication and presentation skills, specifically within the field of health informatics. Students are required to present recent research, technological advancements, or case studies related to health informatics, facilitating discussions with peers and faculty. The seminar encourages critical thinking and helps students stay updated on emerging trends in health informatics.

Semester II

1. **Clinical Decision Support Systems (CDSS)**

   This course introduces students to the design and implementation of clinical decision support systems, which aid clinicians in making informed decisions based on clinical data. Topics include rule-based systems, machine learning models, and integration with electronic health records (EHR). Students learn how to develop and deploy decision support tools that provide evidence-based recommendations, alert healthcare providers to potential risks, and improve patient outcomes. Practical sessions involve creating CDSS prototypes and evaluating their effectiveness in real-world clinical scenarios.

2. **Artificial Intelligence in Healthcare**

   This course explores the application of artificial intelligence (AI) in improving healthcare delivery and patient outcomes. Topics include natural language processing (NLP) for analyzing clinical notes, computer vision for medical imaging, and deep learning models for predictive analytics. Students learn to develop and implement AI algorithms to diagnose diseases, predict patient deterioration, and personalize treatment plans. The course emphasizes practical applications, with hands-on projects using AI tools and frameworks like TensorFlow and PyTorch to process healthcare data.

3. **Health Economics and Policy**

This course examines the economic principles and policy frameworks that shape healthcare delivery. Topics include health insurance models, cost-benefit analysis of health interventions, and the economic evaluation of healthcare technologies. Students learn about the impact of policy decisions on healthcare access, quality, and equity, and explore how economic incentives can drive innovation in the healthcare sector. Case studies analyze the implementation of healthcare policies in different countries and their outcomes, preparing students to engage in policy-making and healthcare management.

4. **Advanced Database Management for Health Data**

This course covers the design, optimization, and management of databases for storing and processing health data. Topics include relational database management systems (RDBMS), NoSQL databases, and cloud-based data storage solutions. Students learn to design scalable databases that support high-performance queries and ensure data integrity and security. The course includes practical exercises in database normalization, indexing, and query optimization, with a focus on managing complex healthcare data such as patient records and medical images.

5. **Elective II: Health IoT and Wearable Devices**

This elective explores the role of the Internet of Things (IoT) and wearable technology in monitoring patient health and managing chronic conditions. Topics include the design and implementation of IoT devices, data integration with health information systems, and the use of wearable sensors for real-time health monitoring. Students learn about the challenges of ensuring data privacy and interoperability in IoT-based healthcare solutions. Practical sessions involve developing prototypes of wearable devices and integrating them with health data platforms.

6. **Mini Project**

This project-based course allows students to apply the knowledge gained from their coursework to a small-scale research or development project. Students work on developing a software tool, conducting a data analysis study, or designing a health informatics solution. The course emphasizes problem-solving, project management, and the presentation of project results, preparing students for larger research projects in their thesis work.

Year 2

Semester III

1. **Big Data Analytics in Healthcare**

   This course provides advanced knowledge of big data analytics techniques applied to healthcare. Topics include distributed computing frameworks such as Hadoop and Spark, real-time data streaming, and the analysis of unstructured data from electronic health records (EHRs). Students learn to process large datasets, build data pipelines, and use machine learning models to extract insights from clinical data. The course emphasizes practical applications, with projects involving the analysis of large-scale health datasets and the development of predictive models.

2. **Innovation and Entrepreneurship in Health Informatics**

   This course focuses on fostering innovation and entrepreneurship in the digital health space. Students learn about the process of creating health informatics startups, from ideation and business model development to securing funding and scaling solutions. Topics include lean startup methodology, market analysis, and intellectual property management in healthcare. The course includes case studies of successful health informatics ventures, and students develop business plans for their own digital health solutions.

3. **Elective III: Genomics and Bioinformatics**

   This elective covers the intersection of genomics and bioinformatics, focusing on the analysis of genetic data to improve patient care. Topics include DNA sequencing technologies, computational methods for analyzing genomic data, and applications of bioinformatics in precision medicine. Students learn to interpret genetic variations, understand their impact on health, and develop tools for personalized medicine. Practical sessions involve working with genomic datasets and bioinformatics software to analyze genetic information.

4. **Thesis Work - Part I**

   In this course, students begin their thesis research by identifying a research problem in health informatics, conducting a literature review, and developing a research methodology. The thesis may focus on areas such as AI applications in healthcare, optimizing health information systems, or analyzing health data for improved patient outcomes. Students work closely with faculty advisors to refine their research questions and prepare for data collection and analysis.

5. **Internship (4 weeks)**

   This course involves a four-week internship with a healthcare organization, health technology company, or research institution. Students gain practical experience in applying health informatics skills to real-world projects, such as implementing digital health solutions or conducting health data analysis. The internship helps students bridge the gap between academic learning and industry practices, providing valuable insights into the healthcare sector.

Semester IV

1. **Elective IV: Advanced Medical Imaging Techniques**

   This elective focuses on advanced medical imaging techniques used in diagnostics and treatment. Topics include the principles of MRI, CT, ultrasound, and PET imaging, as well as image reconstruction and analysis methods. Students learn about the integration of medical imaging data with electronic health records (EHRs) and the role of AI in enhancing image interpretation. Practical sessions involve analyzing imaging data using specialized software tools and developing applications for improved diagnostics.

2. **Elective V: Ethics and Legal Issues in Health Informatics**

   This elective examines the ethical and legal considerations that govern the handling of health information. Topics include patient consent, data privacy, ethical AI in healthcare, and compliance with regulations like HIPAA, GDPR, and emerging data protection laws. Students learn to develop ethical guidelines for handling sensitive health data and navigate the complexities of legal frameworks in digital health. The course emphasizes real-world applications through case studies and scenario-based learning.

3. **Thesis Work - Part II (Final Defense)**

   This course involves completing the thesis project, including data analysis, interpretation of results, and writing the final thesis report. The project culminates in a defense before a panel of faculty members, where students present their research findings and demonstrate their ability to integrate theoretical knowledge with practical applications. The thesis should contribute new insights to the field of health informatics, emphasizing innovation and the potential to improve healthcare delivery.

4. **Seminar II**

   This course involves presenting research findings, discussing recent trends in health informatics, and analyzing case studies. Students develop skills in technical communication, critical thinking, and public speaking, preparing them to present complex ideas to diverse audiences. The seminar encourages peer feedback and fosters a collaborative learning environment.

5. **Comprehensive Viva**

   The comprehensive viva is an oral examination that assesses students' overall understanding of the concepts and skills learned throughout the program. It includes topics such as health data management, AI applications in healthcare, clinical decision support, and ethical considerations in health informatics. The viva tests students' ability to integrate knowledge from various courses and apply it to solving real-world challenges in health informatics.

Bachelor of Technology in Environmental Informatics (B.Tech.)

Year 1

	Course	Hours/Week			Credits
Semester I	Fundamentals of Environmental Science	L: 3	T: 0	P: 2	4
	Mathematics-I (Calculus and Linear Algebra)	L: 3	T: 1	P: 0	4
	Basics of Programming	L: 3	T: 0	P: 2	4
	Introduction to Environmental Informatics	L: 3	T: 0	P: 0	3
	Chemistry for Environmental Engineers	L: 3	T: 0	P: 2	4
	Environmental Studies	L: 2	T: 0	P: 0	2
				Total Credits	**21**

*L: Lecture T: Tutorial P: Practical

	Course	Hours/Week			Credits
Semester II	Environmental Data Analysis	L: 3	T: 0	P: 2	4
	Mathematics-II (Probability and Statistics)	L: 3	T: 1	P: 0	4
	Data Structures and Algorithms	L: 3	T: 0	P: 2	4
	Physics for Environmental Applications	L: 3	T: 0	P: 2	4
	Remote Sensing and GIS	L: 3	T: 0	P: 2	4
	Technical Communication	L: 2	T: 0	P: 0	2
				Total Credits	**22**

Year 2

	Course	Hours/Week			Credits
Semester III	Environmental Monitoring Techniques	L: 3	T: 0	P: 2	4
	Climate Change Science	L: 3	T: 0	P: 2	4
	Database Management Systems	L: 3	T: 0	P: 2	4
	Hydrology and Water Resource Management	L: 3	T: 0	P: 2	4
	Elective I (e.g., Environmental Biotechnology)	L: 3	T: 0	P: 0	3
	Mini Project I	L: 0	T: 0	P: 2	1
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester IV	Environmental Modelling and Simulation	L: 3	T: 0	P: 2	4
	Energy Systems and Sustainability	L: 3	T: 0	P: 2	4
	Advanced Programming for Environmental Informatics	L: 3	T: 0	P: 2	4
	Ecology and Ecosystem Management	L: 3	T: 0	P: 2	4
	Elective II (e.g., Air Quality Management)	L: 3	T: 0	P: 0	3
	Internship I (4 weeks)	L: 0	T: 0	P: 2	2
				Total Credits	**21**

Year 3

	Course	Hours/Week			Credits
Semester V	Big Data Analytics for Environmental Data	L: 3	T: 0	P: 2	4
	Geographic Information System (GIS) Applications	L: 3	T: 0	P: 2	4
	Environmental Impact Assessment (EIA)	L: 3	T: 0	P: 2	4
	Waste Management and Circular Economy	L: 3	T: 0	P: 2	4
	Elective III (e.g., Renewable Energy Technologies)	L: 3	T: 0	P: 0	3
	Mini Project II	L: 0	T: 0	P: 2	1
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester VI	Machine Learning for Environmental Applications	L: 3	T: 0	P: 2	4
	Sustainable Urban Planning	L: 3	T: 0	P: 2	4
	Advanced Remote Sensing	L: 3	T: 0	P: 2	4
	Environmental Law and Policy	L: 3	T: 0	P: 0	3
	Elective IV (e.g., Environmental Toxicology)	L: 3	T: 0	P: 0	3
	Internship II (6 weeks)	L: 0	T: 0	P: 2	2
				Total Credits	**20**

Year 4

	Course	Hours/Week			Credits
Semester VII	Advanced Environmental Data Analysis	L: 3	T: 0	P: 2	4
	Climate Risk Assessment and Management	L: 3	T: 0	P: 2	4
	Blockchain for Environmental Monitoring	L: 3	T: 0	P: 2	4
	Elective V (e.g., Disaster Management)	L: 3	T: 0	P: 0	3
	Capstone Project I	L: 0	T: 0	P: 6	3
	Seminar	L: 0	T: 0	P: 2	2
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester VIII	Elective VI (e.g., Smart Environmental Sensors)	L: 3	T: 0	P: 0	3
	Elective VII (e.g., Coastal and Marine Informatics)	L: 3	T: 0	P: 0	3
	Capstone Project II (Final Defense)	L: 0	T: 0	P: 12	8
	Comprehensive Viva	L: 0	T: 0	P: 0	1
				Total Credits	**15**

Elective Options:

Elective I: Environmental Biotechnology, Urban Ecology, Environmental Chemistry

Elective II: Air Quality Management, Soil Science and Management, Environmental Hydraulics

Elective III: Renewable Energy Technologies, Conservation Biology, Energy Efficiency in Buildings

Elective IV: Environmental Toxicology, Sustainable Agriculture, Biodiversity Informatics

Elective V: Disaster Management, Wetland Ecology, Environmental Ethics

Elective VI: Smart Environmental Sensors, Eco-informatics, Remote Environmental Sensing

Elective VII: Coastal and Marine Informatics, Forest Informatics, Water Quality Modelling

Syllabus

Year 1

Semester I

1. **Fundamentals of Environmental Science**

   This course provides an introduction to the fundamental concepts of environmental science, covering topics such as ecosystems, biogeochemical cycles, environmental pollution, and natural resource management. Students learn about the interaction between living organisms and their environment, the impact of human activities on ecosystems, and the importance of biodiversity. The course emphasizes the need for sustainable practices to protect natural resources, with practical sessions that involve fieldwork and laboratory experiments.

2. **Mathematics-I (Calculus and Linear Algebra)**

   This course covers essential mathematical concepts, including calculus, differential equations, and linear algebra, which are fundamental for analyzing and modelling environmental systems. Topics include limits, derivatives, integrals, matrix operations, vector spaces, and linear transformations. Students learn to apply these mathematical techniques to solve real-world problems, such as modelling population dynamics, analyzing environmental data, and optimizing resource use.

3. **Basics of Programming**

   This course introduces students to programming using languages such as Python or Java, focusing on building foundational coding skills. Topics include variables, control structures, loops, functions, and data structures. Students learn to write programs that automate data analysis, process environmental data, and simulate ecological models. The course includes hands-on assignments that develop problem-solving skills and prepare students for advanced courses in environmental informatics.

4. **Introduction to Environmental Informatics**

   This course provides an overview of the field of environmental informatics, which integrates information technology with environmental science to analyze and manage ecological data. Topics include data collection techniques, environmental databases, and data visualization methods. Students learn how to use software tools for environmental modeling, data analysis, and GIS mapping. The course emphasizes the importance of data-driven decision-making in addressing environmental challenges.

5. **Chemistry for Environmental Engineers**

   This course explores the chemical principles underlying environmental processes, focusing on water chemistry, soil chemistry, and atmospheric chemistry. Topics include chemical reactions, stoichiometry, pH, redox reactions, and the analysis of pollutants. Students learn how to conduct chemical analyses in the lab and apply their knowledge to assess environmental pollution and design solutions for water and soil remediation.

6. **Environmental Studies**

   This course covers the relationship between human activities and the environment, focusing on sustainability and environmental protection. Topics include environmental laws, climate change, conservation of biodiversity, and sustainable development. Students explore case studies of environmental challenges and the role of policy in managing these issues. The course emphasizes the importance of individual and collective action in promoting sustainable practices.

Semester II

1. **Environmental Data Analysis**

   This course focuses on statistical techniques and data analysis methods used in environmental studies. Topics include descriptive statistics, hypothesis testing, regression analysis, and time-series analysis. Students learn to analyze large datasets from environmental monitoring programs, such as air and water quality data, using software like R or Python. The course includes practical sessions that involve cleaning, visualizing, and interpreting environmental data to support decision-making.

2. **Mathematics-II (Probability and Statistics)**

   This course provides a deeper understanding of probability theory and statistical methods, essential for analyzing variability in environmental data. Topics include probability distributions, statistical inference, sampling methods, and multivariate analysis. Students apply these concepts to model environmental phenomena, conduct risk assessments, and analyze data from ecological studies. The course emphasizes practical applications and uses statistical software for data analysis.

3. **Data Structures and Algorithms**

   This course covers the design and analysis of data structures and algorithms, focusing on their application in environmental data management. Topics include arrays, linked lists, trees, graphs, sorting algorithms, and search algorithms. Students learn to optimize data storage and retrieval in environmental databases, ensuring efficient processing of large datasets. The course includes programming assignments that reinforce algorithmic thinking in solving environmental problems.

4. **Physics for Environmental Applications**

   This course introduces the principles of physics relevant to environmental studies, such as energy transfer, fluid dynamics, and thermodynamics. Topics include the laws of motion, heat transfer, and the behavior of fluids in natural systems. Students learn how these principles apply to environmental processes, such as atmospheric circulation, river flow, and energy systems. The course includes laboratory sessions where students conduct experiments to understand physical phenomena in the environment.

5. **Remote Sensing and GIS**

   This course focuses on the use of remote sensing and Geographic Information Systems (GIS) for environmental monitoring and analysis. Topics include satellite imagery, aerial photography, spatial data analysis, and map creation. Students learn to use GIS software to analyze land use patterns, track deforestation, monitor water resources, and assess the impacts of climate change. Practical sessions involve working with geospatial data and applying remote sensing techniques to real-world environmental challenges.

6. **Technical Communication**

   This course aims to develop students' written and oral communication skills, focusing on the needs of environmental professionals. Topics include technical writing, report preparation, and presentation skills. Students learn how to effectively communicate complex environmental data and research findings to a variety of audiences, including policymakers, scientists, and the general public.

Year 2

Semester III

1. **Environmental Monitoring Techniques**

   This course introduces methods for monitoring environmental parameters such as air quality, water quality, soil health, and biodiversity. Topics include sampling techniques, sensor technologies, and data logging systems. Students learn to design monitoring programs and interpret data from environmental sensors and field surveys. The course emphasizes hands-on learning through fieldwork and laboratory experiments, preparing students to collect and analyze data for environmental assessments.

2. Climate Change Science

This course explores the science of climate change, focusing on the physical processes that drive climate variability and change. Topics include the greenhouse effect, carbon cycling, ocean-atmosphere interactions, and climate feedback mechanisms. Students learn about the impacts of climate change on ecosystems, water resources, and human societies, as well as strategies for mitigation and adaptation. The course includes modelling exercises and case studies of climate impacts in different regions.

3. Database Management Systems

This course covers the design, implementation, and management of databases, with a focus on managing environmental data. Topics include relational database models, SQL, data normalization, and database security. Students learn to design databases that store large volumes of spatial and environmental data, ensuring efficient retrieval and analysis. Practical sessions involve creating and querying databases using industry-standard database management systems.

4. Hydrology and Water Resource Management

This course examines the principles of hydrology and their application to the management of water resources. Topics include the hydrological cycle, watershed management, groundwater flow, and surface water quality. Students learn about the techniques for managing water resources sustainably, addressing issues such as water scarcity, pollution, and flood control. The course includes field visits to study local water systems and hands-on exercises in hydrological modelling.

5. Elective I: Environmental Biotechnology

This elective focuses on the use of biotechnology to address environmental challenges, such as bioremediation, wastewater treatment, and soil restoration. Topics include microbial processes, genetic engineering for environmental applications, and the role of biotechnology in reducing pollution. Students learn about the design of biotechnological systems for treating contaminated environments and the potential of biotechnology in sustainable development.

6. Mini Project I

In this project-based course, students work on a small-scale research or development project related to environmental informatics. Projects may involve developing a software tool, conducting a data analysis study, or designing a prototype for environmental monitoring. The course emphasizes problem-solving, innovation, and effective communication of project results.

Semester IV

1. **Environmental Modelling and Simulation**

   This course covers the development and application of models to simulate environmental systems, such as air quality, water flow, and ecological dynamics. Topics include mathematical modelling techniques, system dynamics, and computational tools. Students learn to build models that predict environmental changes and assess the impacts of human activities. Practical sessions involve using software tools like MATLAB or Python to simulate real-world environmental scenarios.

2. **Energy Systems and Sustainability**

   This course explores the principles of energy production, conversion, and use, focusing on sustainable energy solutions. Topics include renewable energy technologies (e.g., solar, wind, hydro), energy efficiency, and the environmental impacts of different energy sources. Students learn about the transition to low-carbon energy systems and the role of policy in promoting clean energy adoption. The course includes projects that involve designing sustainable energy systems and analyzing their economic and environmental feasibility.

3. **Advanced Programming for Environmental Informatics**

   This course focuses on advanced programming techniques used in developing environmental informatics applications. Topics include data integration, API development, and the use of programming languages like Python and Java for environmental data analysis. Students learn to build software tools that integrate with GIS systems and analyze complex environmental datasets. Practical exercises involve developing applications for data visualization and real-time monitoring.

4. **Ecology and Ecosystem Management**

   This course provides an understanding of ecological principles and their application to the management of ecosystems. Topics include population dynamics, community interactions, biodiversity conservation, and habitat restoration. Students learn about the strategies for managing natural resources sustainably and protecting endangered species. The course includes fieldwork and case studies to illustrate the real-world challenges of ecosystem management.

5. **Elective II: Air Quality Management**

This elective focuses on the techniques and policies for managing air quality, including the sources and effects of air pollution. Topics include atmospheric chemistry, air dispersion modelling, and air quality monitoring methods. Students learn about strategies for reducing emissions from industrial and transportation sources, as well as the health impacts of air pollution. Practical sessions involve using software tools to model air pollution dispersion and assess air quality trends.

6. **Internship I**

This four-week internship provides hands-on experience in an environmental organization or research institution. Students apply their knowledge of environmental monitoring, data analysis, and modelling to real-world projects, gaining insights into industry practices and building professional networks.

Year 3

Semester V

1. **Big Data Analytics for Environmental Data**

This course introduces students to big data analytics techniques applied to environmental data. Topics include data mining, machine learning algorithms, and processing large datasets from sensors, satellites, and environmental monitoring networks. Students learn to use tools like Hadoop, Spark, and data visualization software to extract meaningful insights from vast environmental datasets. Practical sessions involve analyzing real-world environmental data, such as climate patterns, pollution levels, and biodiversity trends, to support sustainable decision-making.

2. **Geographic Information System (GIS) Applications**

This course focuses on the advanced applications of GIS in environmental analysis, including spatial modeling, data visualization, and geospatial analysis. Topics include terrain modeling, spatial statistics, and the use of GIS for managing natural resources and urban planning. Students work with GIS software such as ArcGIS or QGIS to analyze spatial data, create thematic maps, and solve complex environmental problems. Practical sessions involve case studies of GIS applications in areas like watershed management, land use planning, and disaster risk reduction.

3. **Environmental Impact Assessment (EIA)**

This course covers the principles and practices of Environmental Impact Assessment, a critical process for evaluating the potential environmental impacts of proposed projects.

Topics include EIA methodologies, regulatory frameworks, public participation, and the assessment of impacts on air, water, soil, and biodiversity. Students learn to prepare EIA reports and conduct impact assessments for projects such as infrastructure development, industrial facilities, and renewable energy installations. Case studies and role-playing exercises provide a practical understanding of the EIA process and its application in real-world scenarios.

4. **Waste Management and Circular Economy**

   This course explores sustainable waste management practices and the principles of the circular economy, which aims to minimize waste and maximize resource use. Topics include solid waste management, recycling technologies, waste-to-energy processes, and the design of circular business models. Students learn about the environmental impacts of waste disposal, the challenges of managing hazardous waste, and strategies for transitioning to a circular economy. The course includes practical sessions involving site visits to waste management facilities and projects focused on designing sustainable waste management systems.

5. **Elective III: Renewable Energy Technologies**

   This elective focuses on the principles, design, and operation of renewable energy systems, such as solar, wind, hydro, and biomass energy. Students learn about the technologies used to harness these energy sources, their environmental benefits, and the challenges of integrating them into the power grid. The course includes practical sessions involving the simulation and analysis of renewable energy systems, with a focus on optimizing their performance and assessing their economic feasibility.

6. **Mini Project II**

   In this project-based course, students work on a research or development project related to environmental informatics. Projects may involve designing a software tool for environmental data analysis, developing a GIS-based application for habitat mapping, or conducting a study on renewable energy deployment. The course emphasizes teamwork, innovation, and effective communication of project results.

Semester VI

1. **Machine Learning for Environmental Applications**

   This course covers machine learning techniques and their applications in analyzing environmental data and predicting ecological trends. Topics include supervised and unsupervised learning, neural networks, and deep learning models. Students learn to develop machine learning models for tasks such as species distribution modelling, climate prediction, and remote sensing data analysis. Practical sessions involve using Python and libraries like TensorFlow and scikit-learn to implement models and analyze environmental datasets.

2. **Sustainable Urban Planning**

   This course focuses on the principles of sustainable urban planning, emphasizing strategies for creating eco-friendly, resilient, and livable cities. Topics include urban design, green infrastructure, transportation planning, and climate adaptation for urban areas. Students learn about smart city technologies, energy-efficient buildings, and urban water management. Case studies highlight successful examples of sustainable urban planning around the world. Practical exercises involve using GIS and planning tools to develop urban designs that balance development with environmental sustainability.

3. **Advanced Remote Sensing**

   This course delves into advanced techniques in remote sensing, focusing on the analysis of satellite data for environmental monitoring. Topics include hyperspectral imaging, LiDAR, synthetic aperture radar (SAR), and advanced image processing techniques. Students learn to extract information from remote sensing data to study land use changes, monitor deforestation, track climate change impacts, and assess natural disasters. Practical sessions involve using remote sensing software to analyze high-resolution satellite imagery and develop maps for environmental applications.

4. **Environmental Law and Policy**

   This course examines the legal and policy frameworks that govern environmental protection at the national and international levels. Topics include environmental regulations, pollution control laws, international treaties, and sustainable development goals (SDGs). Students learn about the role of policy in addressing issues like climate change, biodiversity loss, and pollution. Case studies illustrate how laws and regulations are applied in different contexts, helping students understand the complexities of environmental governance.

5. **Elective IV: Environmental Toxicology**

   This elective focuses on the study of toxic substances in the environment and their effects on human health and ecosystems. Topics include the pathways and fate of pollutants, bioaccumulation, and the mechanisms of toxicity. Students learn about the assessment of environmental risks and the methods for monitoring and managing exposure to hazardous substances. Practical sessions involve analyzing environmental samples for toxic substances and conducting toxicity tests.

6. **Internship II**

   This six-week internship provides students with hands-on experience in an environmental organization, research institute, or consultancy firm. Students apply their skills in environmental data analysis, GIS, and remote sensing to real-world projects, gaining insights into industry practices and building professional networks. The internship emphasizes practical problem-solving and prepares students for careers in environmental informatics.

Year 4

Semester VII

1. **Advanced Environmental Data Analysis**

   This course covers advanced techniques for analyzing and interpreting complex environmental datasets. Topics include multivariate analysis, spatial statistics, time-series analysis, and machine learning applications in environmental research. Students learn to handle large datasets from environmental sensors, climate models, and geospatial databases, using tools like R, Python, and GIS software. Practical sessions involve working on projects that require the integration of diverse datasets to study ecological trends, pollution levels, and climate change impacts.

2. **Climate Risk Assessment and Management**

   This course explores methods for assessing and managing risks associated with climate change and extreme weather events. Topics include vulnerability assessment, risk mapping, adaptation strategies, and disaster preparedness. Students learn to develop risk management plans for sectors such as agriculture, water resources, and urban infrastructure. The course includes case studies of climate adaptation projects and exercises in using GIS and statistical tools to assess climate risks in different regions.

3. **Blockchain for Environmental Monitoring**

   This course examines the application of blockchain technology in managing environmental data and promoting transparency in environmental monitoring. Topics include the principles of blockchain, smart contracts, and decentralized data management. Students learn how blockchain can be used to track carbon credits, ensure the traceability of sustainable supply chains, and create transparent environmental reporting systems. Practical sessions involve developing blockchain-based solutions for tracking environmental data and ensuring data integrity.

4. **Elective V: Disaster Management**

   This elective focuses on the strategies for preparing for, responding to, and recovering from natural and human-made disasters. Topics include disaster risk reduction, emergency response planning, and the use of GIS and remote sensing for disaster monitoring. Students learn about the social, economic, and environmental impacts of disasters and the role of technology in disaster management. Case studies include examples of disaster response efforts and the development of disaster risk management plans.

5. **Capstone Project I**

   This course involves the initial phase of the capstone project, where students identify a research problem or development opportunity in environmental informatics. Students develop a project proposal, conduct a literature review, and begin data collection or prototype development. The capstone project emphasizes innovation, problem-solving, and the integration of skills gained throughout the program.

6. **Seminar**
   This course involves presenting research findings, discussing recent trends in environmental informatics, and analyzing case studies. Students develop skills in technical communication, critical thinking, and public speaking, preparing them to present complex information to diverse audiences. The seminar encourages peer feedback and fosters a collaborative learning environment.

Semester VIII

1. **Elective VI: Smart Environmental Sensors**

   This elective focuses on the design and deployment of smart sensors for monitoring environmental parameters such as air quality, water quality, and soil moisture. Topics include sensor technologies, wireless sensor networks, data integration, and real-time monitoring systems. Students learn about the use of Internet of Things (IoT) devices for environmental data collection and the challenges of ensuring data accuracy and reliability. Practical sessions involve developing sensor prototypes and integrating them with data analytics platforms.

2. **Elective VII: Coastal and Marine Informatics**

   This elective explores the use of informatics in studying and managing coastal and marine environments. Topics include oceanography, marine biodiversity, coastal erosion, and the impact of climate change on marine ecosystems. Students learn to use GIS, remote sensing, and modelling tools to study coastal processes and monitor marine resources.

Practical exercises involve analyzing data from ocean sensors, satellite imagery, and marine research projects.

3. **Capstone Project II (Final Defense)**

   This course involves completing the capstone project initiated in Semester VII, including data analysis, interpretation of results, and writing a detailed project report. The project culminates in a final presentation to a panel of faculty members, where students defend their findings and demonstrate their ability to apply theoretical knowledge to practical environmental challenges. The capstone project emphasizes research quality, technical innovation, and effective communication.

4. **Comprehensive Viva**

   The comprehensive viva is an oral examination that assesses students' overall understanding of the concepts and skills learned throughout the program. It includes topics such as environmental data analysis, GIS applications, climate adaptation strategies, and advanced environmental modelling. The viva tests students' ability to integrate knowledge from various courses and apply it to solving real-world challenges in environmental informatics.

Master of Technology in Environmental Informatics (M.Tech.)

Year 1

Semester I	Course	Hours/Week			Credits
	Advanced Environmental Science	L: 3	T: 0	P: 2	4
	Geospatial Data Analysis and Remote Sensing	L: 3	T: 0	P: 2	4
	Environmental Data Analytics	L: 3	T: 0	P: 2	4
	Environmental Modelling and Simulation	L: 3	T: 0	P: 2	4
	Elective I (e.g., Environmental Law and Policy)	L: 3	T: 0	P: 0	3
	Seminar I	L: 0	T: 0	P: 2	2
	Total Credits				**21**

*L: Lecture T: Tutorial P: Practical

Semester II	Course	Hours/Week			Credits
	Machine Learning for Environmental Applications	L: 3	T: 0	P: 2	4
	Climate Risk Assessment and Adaptation	L: 3	T: 0	P: 2	4
	Sustainable Energy Systems	L: 3	T: 0	P: 2	4
	Advanced GIS and Spatial Analysis	L: 3	T: 0	P: 2	4
	Elective II (e.g., Environmental Impact Assessment)	L: 3	T: 0	P: 0	3
	Mini Project	L: 0	T: 0	P: 4	2
	Total Credits				**21**

Year 2

	Course	Hours/Week			Credits
Semester III	Big Data Analytics for Environmental Data	L: 3	T: 0	P: 2	4
	Innovation and Entrepreneurship in Environmental Informatics	L: 3	T: 0	P: 0	3
	Elective III (e.g., Disaster Management and Resilience)	L: 3	T: 0	P: 0	3
	Thesis Work - Part I	L: 0	T: 0	P: 12	5
	Internship (4 weeks)	L: 0	T: 0	P: 4	2
	Total Credits				**17**

	Course	Hours/Week			Credits
Semester IV	Elective IV (e.g., Advanced Remote Sensing Techniques)	L: 3	T: 0	P: 0	3
	Elective V (e.g., Water Resource Management)	L: 3	T: 0	P: 0	3
	Thesis Work - Part II (Final Defense)	L: 0	T: 0	P: 16	8
	Seminar II	L: 0	T: 0	P: 2	2
	Comprehensive Viva	L: 0	T: 0	P: 0	1
				Total Credits	**17**

Elective Options:

Elective I: Environmental Law and Policy, Environmental Chemistry, Conservation Biology

Elective II: Environmental Impact Assessment, Air Quality Management, Environmental Ethics

Elective III: Disaster Management and Resilience, Sustainable Urban Planning, Renewable Energy Integration

Elective IV: Advanced Remote Sensing Techniques, Biodiversity Informatics, Eco-informatics

Elective V: Water Resource Management, Coastal and Marine Informatics, Soil Science and Management

Syllabus

Year 1

Semester I

1. **Advanced Environmental Science**

   This course explores advanced topics in environmental science, including the study of ecosystems, biodiversity, and the impacts of human activities on natural systems. Topics include climate change, pollution control, ecological modelling, and sustainable resource management. Students learn about cutting-edge research in areas such as climate science, conservation biology, and environmental toxicology. The course emphasizes the use of scientific methods to assess environmental issues and develop solutions for sustainable development, with practical sessions that involve field studies and laboratory experiments.

2. **Geospatial Data Analysis and Remote Sensing**

   This course focuses on the use of remote sensing and geospatial data analysis for environmental monitoring and decision-making. Topics include satellite image processing, spatial data analysis, digital elevation models (DEMs), and the use of Geographic Information Systems (GIS) in analyzing environmental changes. Students learn to apply remote sensing techniques to monitor land use changes, assess natural disasters, and study climate impacts. The course includes hands-on sessions using software tools like ArcGIS or QGIS, where students analyze satellite imagery and create geospatial maps for real-world applications.

3. **Environmental Data Analytics**

   This course teaches students to analyze and interpret complex environmental datasets using statistical and computational methods. Topics include data cleaning, time-series analysis, multivariate analysis, and data visualization techniques. Students use programming languages like Python or R to analyze data from environmental sensors, climate models, and monitoring networks. The course emphasizes the application of data analytics to identify trends, assess risks, and support evidence-based decision-making in environmental management. Practical sessions involve working with real-world environmental datasets, such as air quality, water quality, and biodiversity data.

4. **Environmental Modelling and Simulation**

   This course covers the principles and techniques of modelling and simulation used to understand and predict environmental processes. Topics include mathematical modelling of ecological systems, climate modelling, hydrological models, and pollution dispersion models. Students learn to use simulation software and computational tools to create models that represent complex environmental interactions and forecast future scenarios. The course includes practical exercises using software tools like MATLAB or specialized environmental modelling platforms to simulate real-world environmental phenomena and assess the impact of human activities.

5. **Elective I: Environmental Law and Policy**

   This elective explores the legal frameworks and policies that regulate environmental protection at the national and international levels. Topics include environmental legislation, pollution control laws, international agreements such as the Paris Agreement, and sustainable development goals (SDGs). Students analyze case studies to understand the role of law and policy in addressing environmental challenges such as climate change, biodiversity loss, and pollution. The course emphasizes the importance of integrating scientific knowledge with policy-making to promote sustainable practices.

6. **Seminar I**

   This course focuses on enhancing students' communication and presentation skills within the field of environmental informatics. Students present research findings, discuss emerging trends in environmental science, and analyze case studies related to sustainability and technology. The seminar encourages critical thinking and peer feedback, helping students develop the ability to communicate complex information to diverse audiences.

Semester II

1. **Machine Learning for Environmental Applications**

   This course covers machine learning techniques and their applications in analyzing environmental data and making predictions. Topics include supervised and unsupervised learning, neural networks, and deep learning models. Students learn to develop and apply machine learning algorithms for tasks such as species distribution modelling, climate trend analysis, and remote sensing data interpretation. Practical sessions involve using tools like TensorFlow and scikit-learn to build models that analyze large environmental datasets and support data-driven decision-making.

2. **Climate Risk Assessment and Adaptation**

   This course focuses on assessing risks associated with climate change and developing strategies for adaptation. Topics include vulnerability assessment, risk mapping, climate adaptation planning, and the use of GIS and statistical tools for analyzing climate impacts. Students learn about the effects of climate change on various sectors, such as agriculture, water resources, and urban infrastructure, and explore ways to build resilience. The course includes case studies of climate adaptation projects, emphasizing practical approaches to managing climate risks.

3. **Sustainable Energy Systems**

   This course explores the design, operation, and integration of sustainable energy systems, including solar, wind, hydro, and biomass energy. Topics include energy conversion technologies, energy storage, grid integration, and the environmental impacts of different energy sources. Students learn about the role of sustainable energy in mitigating climate change and transitioning to a low-carbon economy. Practical sessions involve analyzing the performance of renewable energy systems using simulation tools and assessing their economic feasibility.

4. **Advanced GIS and Spatial Analysis**

   This course focuses on advanced techniques in GIS and spatial analysis for environmental applications. Topics include spatial interpolation, geostatistics, spatial pattern analysis, and multi-criteria decision analysis (MCDA). Students learn to use GIS software to conduct spatial analysis for environmental planning, habitat suitability studies, and resource management. Practical exercises involve working with complex geospatial data and applying spatial analysis techniques to solve real-world environmental challenges.

5. **Elective II: Environmental Impact Assessment (EIA)**

   This elective provides an in-depth understanding of the Environmental Impact Assessment process, a critical tool for evaluating the potential impacts of development projects. Topics include EIA methodologies, regulatory requirements, public participation, and mitigation measures. Students learn to conduct impact assessments for projects such as infrastructure development, mining, and renewable energy installations. The course includes case studies and practical sessions where students prepare EIA reports and analyze their effectiveness in minimizing environmental impacts.

6. **Mini Project**

   In this project-based course, students work on a small-scale research or development project related to environmental informatics. Projects may involve analyzing climate data, developing a GIS-based tool for habitat mapping, or designing a model for assessing water quality. The course emphasizes problem-solving, innovation, and effective communication of project results, preparing students for larger research projects in their thesis work.

Year 2

Semester III

1. **Big Data Analytics for Environmental Data**

   This course explores techniques for analyzing large and complex environmental datasets using big data technologies. Topics include distributed computing frameworks such as Hadoop and Spark, data visualization with big data tools, and real-time data processing. Students learn to manage and analyze unstructured data from sensors, satellite imagery, and environmental monitoring systems. Practical sessions involve using big data platforms to process large-scale datasets and extract insights for applications such as climate modelling, pollution tracking, and biodiversity analysis.

2. **Innovation and Entrepreneurship in Environmental Informatics**

   This course focuses on fostering innovation and entrepreneurship in the field of environmental informatics. Students learn about the process of developing and commercializing new technologies, from ideation and market analysis to business model development and securing funding. Topics include sustainable business practices, intellectual property management, and case studies of successful startups in the environmental sector. Students develop business plans for innovative solutions in environmental technology, preparing them for leadership roles in sustainable enterprises.

3. **Elective III: Disaster Management and Resilience**

   This elective covers the principles of disaster management, focusing on strategies for mitigating, preparing for, and responding to natural and human-made disasters. Topics include risk assessment, emergency planning, resilience building, and the use of GIS and remote sensing for disaster monitoring. Students learn to design disaster management plans that address the impacts of events such as floods, earthquakes, and wildfires. The course includes case studies of disaster response efforts and practical exercises in using geospatial tools to assess disaster risks.

4. **Thesis Work - Part I**

   In this course, students begin their thesis research, focusing on identifying a research problem, conducting a literature review, and developing a research methodology. The thesis may address topics such as environmental data analytics, climate risk assessment, or the use of GIS for natural resource management. Students work closely with faculty advisors to refine their research questions and prepare for data collection and analysis. The course emphasizes scientific rigor, critical thinking, and the ability to apply theoretical knowledge to practical problems.

5. **Internship (4 weeks)**

   This course involves a four-week internship with an environmental organization, research institute, or technology company. Students gain practical experience in applying their skills in environmental data analysis, GIS, and remote sensing to real-world projects. The internship provides valuable industry insights, allowing students to build professional networks and prepare for careers in environmental informatics.

Semester IV

1. **Elective IV: Advanced Remote Sensing Techniques**

   This elective delves into advanced remote sensing methods, including hyperspectral imaging, synthetic aperture radar (SAR), LiDAR, and high-resolution satellite imagery. Topics include data acquisition, image processing, and the integration of remote sensing data with GIS for environmental applications. Students learn to use remote sensing data for detailed analysis of land cover changes, vegetation health, and climate impacts.

Practical sessions involve using specialized software to process and analyze remote sensing data for environmental monitoring and research.

2. **Elective V: Water Resource Management**

   This elective focuses on the sustainable management of water resources, addressing issues such as water scarcity, pollution, and climate change impacts on water systems. Topics include watershed management, hydrological modelling, groundwater management, and water quality assessment. Students learn about the use of GIS and remote sensing for monitoring water resources and designing sustainable water management plans. Case studies highlight best practices in managing water resources in various regions and contexts.

3. **Thesis Work - Part II (Final Defense)**

   This course involves completing the thesis project initiated in Semester III, including data analysis, interpretation of results, and writing a detailed thesis report. Students defend their thesis before a panel of faculty members, demonstrating their ability to conduct independent research and apply advanced concepts in environmental informatics. The final defense emphasizes research quality, technical innovation, and effective communication of findings.

4. **Seminar II**

   This course involves presenting research findings, discussing recent trends in environmental informatics, and analyzing case studies. Students develop skills in technical communication, critical thinking, and public speaking, preparing them to present complex ideas to diverse audiences. The seminar encourages peer feedback and fosters a collaborative learning environment.

5. **Comprehensive Viva**

   The comprehensive viva is an oral examination that assesses students' overall understanding of the concepts and skills learned throughout the program. It includes topics such as environmental data analytics, GIS applications, climate adaptation strategies, and advanced modeling. The viva tests students' ability to integrate knowledge from various courses and apply it to solving real-world challenges in environmental informatics.

Bachelor of Technology in Energy Informatics (B.Tech.)

Year 1

	Course	Hours/Week			Credits
Semester-I	Fundamentals of Energy Systems	L: 3	T: 1	P: 0	4
	Mathematics-I	L: 3	T: 1	P: 0	4
	Introduction to Programming	L: 3	T: 0	P: 2	4
	Physics for Energy Engineering	L: 3	T: 0	P: 2	4
	Basics of Electrical Engineering	L: 3	T: 0	P: 2	4
				Total Credits	**20**

*L: Lecture T: Tutorial P: Practical

	Course	Hours/Week			Credits
Semester-II	Renewable Energy Sources	L: 3	T: 0	P: 2	4
	Mathematics-II	L: 3	T: 1	P: 0	4
	Data Structures and Algorithms	L: 3	T: 0	P: 2	4
	Chemistry for Energy Applications	L: 3	T: 0	P: 2	4
	Environmental Science and Sustainability	L: 2	T: 0	P: 0	2
	Technical Communication	L: 2	T: 0	P: 0	2
				Total Credits	**20**

Year 2

	Course	Hours/Week			Credits
Semester-III	Energy Management and Optimization	L: 3	T: 0	P: 2	4
	Thermodynamics and Heat Transfer	L: 3	T: 1	P: 0	4
	Database Management Systems	L: 3	T: 0	P: 2	4
	Smart Grid Technologies	L: 3	T: 0	P: 2	4
	Elective I (e.g., Energy Storage Systems)	L: 3	T: 0	P: 0	3
	Mini Project I	L: 0	T: 0	P: 2	1
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester-IV	Power Systems and Distribution	L: 3	T: 1	P: 0	4
	Machine Learning for Energy Data	L: 3	T: 0	P: 2	4
	Advanced Programming for Energy Informatics	L: 3	T: 0	P: 2	4
	Internet of Things (IoT) in Energy	L: 3	T: 0	P: 2	4
	Elective II (e.g., Solar Energy Systems)	L: 3	T: 0	P: 0	3
	Internship I (4 weeks)	L: 0	T: 0	P: 2	1
				Total Credits	**20**

Year 3

	Course	Hours/Week			Credits
Semester-V	Energy Economics and Policy	L: 3	T: 0	P: 2	4
	Control Systems for Energy Applications	L: 3	T: 1	P: 0	4
	Big Data Analytics for Energy	L: 3	T: 0	P: 2	4
	Energy Simulation and Modelling	L: 3	T: 0	P: 2	4
	Elective III (e.g., Wind Energy Systems)	L: 3	T: 0	P: 0	3
	Mini Project II	L: 0	T: 0	P: 2	1
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester-VI	Power Electronics for Renewable Energy	L: 3	T: 0	P: 2	4
	Predictive Analytics for Energy Systems	L: 3	T: 0	P: 2	4
	Distributed Energy Resources	L: 3	T: 0	P: 2	4
	Sustainable Energy Systems	L: 3	T: 0	P: 0	3
	Elective IV (e.g., Hydrogen Energy)	L: 3	T: 0	P: 0	3
	Internship II (4 weeks)	L: 0	T: 0	P: 2	1
				Total Credits	**20**

Year 4

	Course	Hours/Week			Credits (C)
Semester-VII	Smart Energy Grids and Cybersecurity	L: 3	T: 0	P: 2	4
	Energy Efficiency and Auditing	L: 3	T: 0	P: 2	4
	Advanced Power System Analysis	L: 3	T: 1	P: 0	4
	Elective V (e.g., Geothermal Energy)	L: 3	T: 0	P: 0	3
	Capstone Project I	L: 0	T: 0	P: 6	2
	Seminar	L: 0	T: 0	P: 2	2
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester-VIII	Energy Informatics Research and Trends	L: 3	T: 0	P: 0	3
	Elective VI (e.g., Nuclear Energy Systems)	L: 3	T: 0	P: 0	3
	Capstone Project II (Final Defense)	L: 0	T: 0	P: 12	8
	Comprehensive Viva	L: 0	T: 0	P: 0	1
				Total Credits	**15**

Syllabus

Year 1

Semester I

1. **Fundamentals of Energy Systems**

   This course introduces the basic principles of energy systems, focusing on conventional and renewable energy sources. Topics include the global energy landscape, energy generation, transmission, and distribution processes. Students will learn about the energy flow in electrical systems, the role of power plants, and the environmental impacts of energy production. Practical examples and case studies help students understand the importance of energy conservation and sustainable practices in modern energy systems.

2. **Mathematics-I**

   This course covers essential mathematical concepts needed for engineering applications. Topics include calculus, linear algebra, and differential equations, with applications to problems in energy systems. Students learn to use mathematical tools to solve equations related to energy modelling and analysis, laying a strong foundation for more advanced topics in energy informatics.

3. **Introduction to Programming**

   This course provides an introduction to programming using languages such as Python or C++. Students will learn basic programming constructs, data types, control structures, and functions. The course also covers algorithm design and problem-solving techniques with an emphasis on applications in energy systems, including data analysis and automation of energy processes.

4. **Physics for Energy Engineering**

   This course covers fundamental physics concepts relevant to energy engineering. Topics include mechanics, thermodynamics, electricity, and magnetism. Students learn how these principles are applied to energy production and the operation of energy systems, such as power plants and electrical grids. Laboratory exercises include experiments related to energy conversion and the behaviour of electrical circuits.

5. **Basics of Electrical Engineering**

   This course provides a foundational understanding of electrical engineering concepts, with a focus on their applications in energy systems. Topics include electrical circuits, alternating current (AC) and direct current (DC) systems, transformers, and basic electrical machines. Students learn to analyze and design simple electrical systems, gaining hands-on experience through laboratory work that involves testing and troubleshooting electrical components.

Semester II

1. **Renewable Energy Sources**

   This course covers the principles and technologies of renewable energy sources, including solar, wind, hydro, and biomass energy. Students learn about the design, operation, and efficiency of renewable energy systems and their role in transitioning to a sustainable energy future. Case studies focus on the integration of renewable energy into national grids and the challenges of scaling up renewable energy deployment.

2. **Mathematics-II**

   Building on Mathematics-I, this course delves deeper into advanced mathematical topics such as vector calculus, Fourier series, partial differential equations, and numerical methods. These tools are essential for solving complex energy informatics problems, including modelling energy flows, optimizing energy systems, and analyzing energy data.

3. **Data Structures and Algorithms**

   This course introduces students to essential data structures such as arrays, linked lists, stacks, queues, trees, and graphs, as well as algorithms for sorting, searching, and optimization. The course emphasizes the importance of data structures and algorithms in efficiently handling and analyzing large datasets in energy informatics, with practical programming assignments related to energy data management.

4. **Chemistry for Energy Applications**

   This course focuses on the chemical processes involved in energy production and storage. Topics include electrochemistry, fuel cells, batteries, and the chemical reactions in combustion and renewable energy systems. Laboratory sessions provide hands-on experience with energy-related chemical processes, including the analysis of fuels and the operation of batteries and fuel cells.

5. **Environmental Science and Sustainability**

   This course explores the environmental impacts of energy systems and the principles of sustainability. Topics include pollution control, waste management, carbon footprints, and the role of energy efficiency in mitigating climate change. The course emphasizes sustainable practices in energy production and consumption, with case studies on energy policies and environmental regulations.

6. **Technical Communication**

   This course is designed to enhance students' written and oral communication skills, focusing on technical reporting, documentation, and presentation. Students learn how to effectively communicate complex technical information to both technical and non-technical audiences, essential for roles in energy informatics where clear communication of data insights is crucial.

Year 2

Semester III

1. **Energy Management and Optimization**

   This course covers energy management strategies for optimizing energy use in industrial, commercial, and residential settings. Topics include energy auditing, demand-side management, and energy efficiency technologies. Students learn to analyze energy usage patterns and develop optimization models to reduce energy consumption and operational costs.

2. **Thermodynamics and Heat Transfer**

   This course explores the principles of thermodynamics and heat transfer, focusing on their applications in energy systems. Topics include the laws of thermodynamics, energy conversion processes, and heat exchange mechanisms. Students apply these concepts to the design and analysis of energy systems, such as power plants, heat exchangers, and refrigeration systems.

3. **Database Management Systems**

   This course introduces the principles of database management systems (DBMS) and their applications in energy informatics. Students learn about relational databases, SQL, and NoSQL databases, focusing on how to store, retrieve, and manage large datasets generated by energy systems. Practical assignments involve designing and implementing databases to manage energy data, such as power grid information or energy consumption records.

4. **Smart Grid Technologies**

   This course provides an overview of smart grid technologies, focusing on the integration of information and communication technologies (ICT) with traditional power grids. Topics include smart meters, grid automation, demand response, and distributed energy resources (DER). Students learn about the challenges and opportunities associated with building smart energy grids that enhance grid stability, security, and energy efficiency.

5. **Elective I: Energy Storage Systems**

   This elective focuses on the design and operation of energy storage systems, including batteries, pumped hydro storage, and compressed air energy storage. Students learn about the role of storage technologies in balancing supply and demand in energy systems, as well as their importance for integrating renewable energy sources into the grid.

6. **Mini Project I**

   In this project-based course, students work in teams to develop a solution for a practical problem related to energy informatics. Projects may involve developing a software tool for energy monitoring, optimizing energy consumption in a small system, or analyzing energy data to identify trends. The project emphasizes teamwork, problem-solving, and applying theoretical knowledge to real-world challenges.

Semester IV

1. **Power Systems and Distribution**

   This course covers the principles of power systems, focusing on the generation, transmission, and distribution of electrical power. Topics include load flow analysis, fault analysis, and power system protection. Students learn to design and analyze power distribution networks, with an emphasis on ensuring the reliability and stability of energy supply systems.

2. **Machine Learning for Energy Data**

   This course introduces students to machine learning techniques and their applications in energy informatics. Topics include supervised and unsupervised learning, neural networks, and decision trees. Students learn to build predictive models using energy data, such as forecasting energy demand, optimizing energy production, and detecting anomalies in energy systems.

3. **Advanced Programming for Energy Informatics**

   This course builds on previous programming knowledge, focusing on advanced programming techniques for energy informatics. Topics include object-oriented programming, data structures, and algorithm optimization. Students develop software applications for energy management, data analysis, and automation in energy systems, using programming languages such as Python or Java.

4. **Internet of Things (IoT) in Energy**

   This course explores the role of the Internet of Things (IoT) in transforming energy systems. Topics include IoT architectures, communication protocols, and sensors used in energy monitoring and control. Students learn how IoT devices are used to create smart energy systems, such as smart homes, automated energy grids, and real-time energy monitoring systems.

5. **Elective II: Solar Energy Systems**

   This elective focuses on the design, installation, and operation of solar energy systems. Topics include photovoltaic (PV) cells, solar thermal systems, and solar power plant design. Students learn about the technologies used to harness solar energy, the factors influencing system performance, and the challenges of integrating solar power into the grid.

6. **Internship I**

   This course involves a four-week internship in an energy-related industry or research organization. Students gain practical experience in applying their knowledge of energy informatics to real-world projects, such as energy system optimization, renewable energy integration, or energy data analysis.

Year 3

Semester V

1. **Energy Economics and Policy**

   This course explores the economic and policy aspects of energy systems. Topics include energy market structures, energy pricing, subsidies, and energy policy frameworks. Students learn about the economic factors influencing energy production and consumption, as well as the role of government policies in promoting energy efficiency, renewable energy adoption, and environmental sustainability.

2. **Control Systems for Energy Applications**

   This course covers the principles of control systems, focusing on their applications in energy systems. Topics include feedback control, PID controllers, and control of energy generation and distribution systems. Students learn to design and implement control systems for optimizing the performance of energy systems, such as power plants, smart grids, and energy storage systems.

3. **Big Data Analytics for Energy**

This course introduces students to big data analytics techniques and their applications in energy informatics. Topics include data mining, data warehousing, and real-time data processing. Students learn to analyze large datasets generated by energy systems, such as smart meter data, sensor data from power grids, and energy consumption patterns, to extract insights and support decision-making.

4. **Energy Simulation and Modelling**

   This course focuses on the use of simulation and modelling tools to analyze energy systems. Topics include energy flow modelling, simulation of power generation systems, and renewable energy integration. Students learn to use software such as MATLAB/Simulink to simulate energy processes and optimize system designs for efficiency and performance.

5. **Elective III: Wind Energy Systems**

   This elective covers the design, operation, and analysis of wind energy systems. Topics include wind turbine technology, aerodynamics, wind farm design, and the integration of wind power into the grid. Students learn about the challenges of site selection, energy yield estimation, and the environmental impacts of wind energy projects.

6. **Mini Project II**

   In this project-based course, students work on a more advanced project related to energy informatics. The project may involve developing an optimization algorithm for energy management, building a predictive model for energy demand, or designing a control system for a renewable energy source. Students present their projects in a seminar format, emphasizing technical skills and effective communication.

Semester VI

1. **Power Electronics for Renewable Energy**

   This course focuses on the role of power electronics in integrating renewable energy sources into power systems. Topics include converters, inverters, and power conditioning equipment used in solar, wind, and other renewable energy systems. Students learn to design and analyze power electronic circuits, gaining hands-on experience with power electronic devices used in energy applications.

2. **Predictive Analytics for Energy Systems**

   This course introduces predictive analytics techniques for forecasting energy demand, optimizing energy production, and managing energy storage. Students learn to use machine learning models, time-series analysis, and statistical methods to predict trends in energy consumption and production. Practical sessions involve building predictive models using real-world energy datasets.

3. **Distributed Energy Resources**

   This course covers the concepts and technologies behind distributed energy resources (DERs), such as rooftop solar, microgrids, and battery storage. Topics include the integration of DERs into existing power grids, the role of energy management systems, and the challenges of ensuring grid stability with high penetration of distributed generation. The course emphasizes the importance of DERs in transitioning to a decentralized, sustainable energy future.

4. **Sustainable Energy Systems**

   This course explores the design and implementation of sustainable energy systems that minimize environmental impacts and maximize energy efficiency. Topics include life cycle analysis, sustainable energy project management, and the role of innovation in developing green technologies. Case studies focus on best practices in sustainable energy systems from around the world.

5. **Elective IV: Hydrogen Energy**

   This elective focuses on hydrogen as an emerging energy carrier, covering hydrogen production methods, storage, and fuel cell technology. Students learn about the role of hydrogen in decarbonizing the energy sector, the challenges of developing a hydrogen economy, and the potential applications of hydrogen in transportation and industry.

6. **Internship II**

   This course involves a second four-week internship where students gain deeper industry exposure. The internship may involve working on a specific project in an energy company, research organization, or government agency. Students gain practical experience and insights into the latest trends and challenges in the energy sector.

Year 4

Semester VII

1. **Smart Energy Grids and Cybersecurity**

   This course focuses on the technologies and challenges associated with smart energy grids, with an emphasis on cybersecurity. Topics include grid automation, cybersecurity threats to critical infrastructure, and strategies for securing energy networks. Students learn to design secure smart grid architectures and develop protocols for protecting energy data.

2. **Energy Efficiency and Auditing**

   This course explores methods for improving energy efficiency in various sectors, including industry, transportation, and buildings. Topics include energy auditing techniques, energy performance metrics, and strategies for reducing energy consumption. Students learn to conduct energy audits and develop plans for implementing energy-saving measures.

3. **Advanced Power System Analysis**

   This course delves into advanced topics in power system analysis, including transient stability analysis, power system dynamics, and voltage regulation. Students learn to use simulation tools to analyze complex power system behaviour and to design systems that ensure reliable and stable energy delivery.

4. **Elective V: Geothermal Energy**

   This elective covers the principles and applications of geothermal energy. Topics include geothermal resource assessment, drilling techniques, and the design of geothermal power plants. Students learn about the potential of geothermal energy as a reliable and sustainable energy source, as well as the environmental and economic considerations of geothermal projects.

5. **Capstone Project I**

   In this course, students work on a capstone project that integrates their knowledge of energy informatics into a comprehensive project. The project may involve designing an energy management system, developing a data-driven energy optimization tool, or conducting a feasibility study for a renewable energy project. The project is presented to a panel of faculty members, emphasizing research, design, and communication skills.

6. **Seminar**

   This course involves presenting research topics or case studies related to energy informatics, developing skills in technical communication and presentation. Students discuss recent advancements in the energy sector, share their internship experiences, and analyze emerging trends in energy technology and policy.

Semester VIII

1. **Energy Informatics Research and Trends**

   This course explores recent research and trends in the field of energy informatics. Topics include emerging technologies, data-driven energy management, and the role of informatics in achieving energy sustainability. Students analyze current research papers and discuss the future directions of energy informatics, preparing them for research roles or further studies in the field.

2. **Elective VI: Nuclear Energy Systems**

   This elective covers the principles of nuclear energy production, including nuclear fission, reactor design, and radiation safety. Students learn about the challenges of nuclear energy, such as waste management, safety concerns, and regulatory issues. The course emphasizes the role of nuclear energy in achieving low-carbon energy goals and the development of next-generation nuclear technologies.

3. **Capstone Project II (Final Defense)**

   In this course, students complete their capstone project, including detailed analysis, implementation, and presentation. The project culminates in a final defense before a panel, where students demonstrate their ability to integrate knowledge from across the curriculum to address a complex energy challenge. The capstone project showcases students' skills in research, design, and problem-solving in the field of energy informatics.

4. **Comprehensive Viva**

   This course assesses students' overall understanding of the concepts and skills learned throughout the program. The comprehensive viva involves oral examinations on key topics such as energy systems, data analytics, smart grids, and renewable energy technologies. The viva is designed to evaluate students' ability to integrate knowledge from various courses and apply it to solving real-world energy challenges.

Master of Technology in Energy Informatics (M.Tech.)

Year 1

	Course	Hours/Week			Credits
Semester-I	Advanced Energy Systems	L: 3	T: 0	P: 2	4
	Data Analytics for Energy Management	L: 3	T: 0	P: 2	4
	Smart Grids and IoT Applications	L: 3	T: 0	P: 2	4
	Renewable Energy Integration	L: 3	T: 0	P: 2	4
	Research Methodology in Energy Informatics	L: 2	T: 0	P: 0	2
	Elective I (e.g., Energy Storage Systems)	L: 3	T: 0	P: 0	3
				Total Credits	**21**

*L: Lecture T: Tutorial P: Practical

	Course	Hours/Week			Credits
Semester-II	Machine Learning for Energy Systems	L: 3	T: 0	P: 2	4
	Power Systems Analysis and Optimization	L: 3	T: 0	P: 2	4
	Distributed Energy Resources	L: 3	T: 0	P: 2	4
	Advanced Programming for Energy Informatics	L: 3	T: 0	P: 2	4
	Elective II (e.g., Energy Policy and Economics)	L: 3	T: 0	P: 0	3
	Mini Project	L: 0	T: 0	P: 6	2
				Total Credits	**21**

Year 2

	Course	Hours/Week			Credits
Semester-III	Big Data in Energy Informatics	L: 3	T: 0	P: 2	4
	Energy Efficiency and Auditing	L: 3	T: 0	P: 2	4
	Advanced Power Electronics for Renewable Integration	L: 3	T: 0	P: 2	4
	Elective III (e.g., Hydrogen Energy Systems)	L: 3	T: 0	P: 0	3
	Thesis Work - Part I	L: 0	T: 0	P: 12	5
	Internship (4 weeks)	L: 0	T: 0	P: 4	2
				Total Credits	**22**

	Course	Hours/Week			Credits
Semester-IV	Elective IV (e.g., Nuclear Energy Systems)	L: 3	T: 0	P: 0	3
	Elective V (e.g., AI for Renewable Energy)	L: 3	T: 0	P: 0	3
	Thesis Work - Part II (Final Defense)	L: 0	T: 0	P: 16	8
	Seminar	L: 0	T: 0	P: 2	2
	Comprehensive Viva	L: 0	T: 0	P: 0	1
				Total Credits	**17**

Elective Options:

- **Elective I**: Energy Storage Systems, Electric Vehicle Technologies, Sustainable Energy Systems
- **Elective II**: Energy Policy and Economics, Smart City Technologies, Climate Change and Adaptation
- **Elective III**: Hydrogen Energy Systems, Wind Energy Technology, Advanced Topics in Battery Technology
- **Elective IV**: Nuclear Energy Systems, Geothermal Energy, Advanced Grid Management
- **Elective V**: AI for Renewable Energy, Blockchain in Energy Systems, Advanced Data Visualization for Energy Analytics

Syllabus

Year 1

Semester I

1. **Advanced Energy Systems**

   This course provides a comprehensive understanding of advanced energy systems, focusing on the design, analysis, and operation of both conventional and renewable energy sources. Topics include thermodynamic cycles, power generation, energy conversion processes, and energy system integration. The course also explores the challenges of integrating renewable energy sources like wind, solar, and bioenergy into existing energy grids. Students learn to model and simulate energy systems using software tools, emphasizing efficiency improvements and sustainability in energy generation.

2. **Data Analytics for Energy Management**

   This course introduces the principles and methods of data analytics applied to energy management. Students learn to collect, clean, analyze, and visualize large datasets related to energy consumption, production, and distribution. Topics include time-series analysis, predictive modeling, clustering, and regression techniques. The course emphasizes the use of data analytics for optimizing energy systems, demand forecasting, and improving decision-making processes in energy management. Practical exercises involve using programming languages like Python and R for data analysis and building energy dashboards.

3. Smart Grids and IoT Applications

This course covers the concepts and technologies behind smart grids, focusing on the integration of the Internet of Things (IoT) in energy systems. Students learn about smart meters, grid automation, demand response, and distributed energy resources (DERs). Topics include communication protocols, sensor networks, and real-time data monitoring for grid management. The course emphasizes the role of IoT in enhancing grid reliability, improving energy efficiency, and enabling renewable energy integration. Practical sessions involve developing IoT-based solutions for smart grid applications.

4. Renewable Energy Integration

This course explores the technical and economic challenges of integrating renewable energy sources into power grids. Students study the characteristics of various renewable energy technologies, such as solar PV, wind turbines, hydropower, and bioenergy, and learn how to model their behaviour in power systems. The course also covers grid integration issues, including voltage stability, frequency regulation, and energy storage solutions. Case studies and simulations provide practical insights into the successful integration of renewable energy into existing infrastructure.

5. Research Methodology in Energy Informatics

This course provides students with the skills needed to conduct research in the field of energy informatics. Topics include research design, data collection methods, literature review, statistical analysis, and academic writing. Students learn to formulate research questions, develop hypotheses, and apply appropriate methodologies to solve complex energy-related problems. The course prepares students for their thesis work by emphasizing critical thinking, ethical considerations, and best practices in research.

6. Elective I: Energy Storage Systems

This elective focuses on the design, operation, and application of energy storage technologies, including batteries, flywheels, supercapacitors, and pumped hydro storage. Students learn about the role of energy storage in balancing supply and demand, stabilizing power grids, and enabling higher penetration of renewable energy. The course covers technical, economic, and environmental aspects of different storage systems, with practical exercises on modelling storage behaviour and analyzing their integration into energy systems.

Semester II

1. **Machine Learning for Energy Systems**

   This course introduces machine learning techniques and their applications in energy systems. Students learn about supervised and unsupervised learning, neural networks, and deep learning models. Topics include predictive analytics for energy demand forecasting, anomaly detection in energy grids, and optimization of renewable energy production. Practical sessions involve building machine learning models using Python libraries, with a focus on interpreting results and applying them to real-world energy data.

2. **Power Systems Analysis and Optimization**

   This course covers the analysis and optimization of power systems, focusing on load flow analysis, fault analysis, and stability studies. Students learn to design and optimize power networks for reliable and efficient operation, using tools such as MATLAB/Simulink. Topics include power system stability, voltage regulation, economic dispatch, and optimal power flow. The course emphasizes the application of optimization techniques to solve challenges in modern power systems, such as integrating renewable energy and managing distributed energy resources.

3. **Distributed Energy Resources**

   This course explores the role of distributed energy resources (DERs) in modern energy systems, including solar PV, wind power, microgrids, and battery storage. Students learn about the challenges and opportunities of integrating DERs into power grids, focusing on grid interconnection standards, energy management strategies, and the impact of DERs on grid stability. The course emphasizes the role of DERs in transitioning to a decentralized energy model, supporting the development of resilient and sustainable energy systems.

4. **Advanced Programming for Energy Informatics**

   This course builds on students' programming skills, focusing on developing software solutions for energy informatics. Topics include data structures, algorithms, and advanced programming techniques using Python or Java. Students learn to develop applications for energy monitoring, data analysis, and real-time energy management. The course emphasizes the importance of software development in automating energy systems and creating tools for optimizing energy use in smart grids.

5. **Elective II: Energy Policy and Economics**

   This elective examines the economic principles and policy frameworks that shape energy markets. Students learn about energy pricing, subsidies, regulation, and the economic impacts of renewable energy adoption. The course covers global energy policies, carbon pricing mechanisms, and the role of government incentives in promoting clean energy. Case studies highlight successful policy interventions that have driven energy transitions in different regions.

6. **Mini Project**

   In this course, students work on a practical project related to energy informatics. The project involves identifying a real-world problem, developing a solution using data analytics or programming, and presenting the findings. Projects may include designing a tool for energy forecasting, creating a dashboard for monitoring energy use, or analyzing the performance of a renewable energy system. The course emphasizes practical problem-solving skills and the application of theoretical knowledge.

Year 2

Semester III

1. **Big Data in Energy Informatics**

   This course explores the use of big data technologies for managing and analyzing large-scale energy data. Students learn about data storage architectures, distributed computing frameworks, and real-time data processing using Hadoop and Spark. Topics include data mining, data visualization, and the application of big data analytics in optimizing energy consumption and monitoring power grids. Practical exercises involve using big data tools to analyze datasets from smart meters, IoT devices, and renewable energy sources.

2. **Energy Efficiency and Auditing**

   This course focuses on methods and technologies for improving energy efficiency in industrial, commercial, and residential settings. Students learn about energy auditing techniques, energy performance indicators, and strategies for reducing energy consumption. The course covers energy efficiency standards, building energy management systems, and best practices for implementing energy-saving measures. Practical sessions include conducting energy audits and developing recommendations for improving energy efficiency.

3. **Advanced Power Electronics for Renewable Integration**

   This course covers the role of power electronics in integrating renewable energy sources into the power grid. Topics include converters, inverters, and power conditioning devices used in solar and wind power systems. Students learn to design and analyze power electronic circuits, focusing on their applications in energy conversion, grid integration, and energy storage systems. Laboratory sessions provide hands-on experience with power electronic devices and their role in enhancing the efficiency and reliability of renewable energy systems.

4. **Elective III: Hydrogen Energy Systems**

   This elective focuses on hydrogen as an alternative energy carrier, covering hydrogen production methods, storage technologies, and fuel cell systems. Students learn about the potential of hydrogen in decarbonizing sectors like transportation, industry, and power generation. The course emphasizes the challenges of developing a hydrogen economy, including infrastructure needs, safety concerns, and economic feasibility. Practical exercises involve analyzing the performance of hydrogen fuel cells and designing hydrogen-based energy systems.

5. **Thesis Work - Part I**

   In this course, students begin their thesis work, focusing on identifying a research problem, conducting a literature review, and developing a research methodology. The thesis should address a significant challenge in the field of energy informatics, such as optimizing renewable energy integration, developing predictive models for energy demand, or improving the cybersecurity of smart grids. Students work closely with a faculty advisor to refine their research questions and plan their data collection and analysis methods.

6. **Internship (4 weeks)**

   This course involves a four-week internship with a company or research organization involved in energy systems, smart grids, or renewable energy. The internship provides hands-on experience in applying energy informatics tools to real-world problems, such as energy optimization, data analysis, or project management. Students gain practical skills and insights into industry practices, preparing them for their professional careers.

Semester IV

1. **Elective IV: Nuclear Energy Systems**

   This elective covers the principles and applications of nuclear energy, focusing on nuclear fission, reactor design, and radiation safety. Students learn about the role of nuclear energy in achieving low-carbon energy goals, as well as the challenges of waste management, reactor safety, and public acceptance. The course also explores next-generation nuclear technologies, such as small modular reactors (SMRs) and thorium-based reactors, emphasizing their potential in diversifying the energy mix.

2. **Elective V: AI for Renewable Energy**

   This elective explores the use of artificial intelligence in optimizing renewable energy systems. Students learn about AI techniques such as neural networks, deep learning, and reinforcement learning, focusing on their applications in renewable energy forecasting, grid management, and predictive maintenance. The course emphasizes the role of AI in enhancing the efficiency and reliability of renewable energy systems, using practical examples from solar, wind, and hybrid energy projects.

3. **Thesis Work - Part II (Final Defense)**

   In this course, students complete their thesis work, conducting data analysis, interpreting results, and writing their final thesis report. The project culminates in a thesis defense, where students present their research findings to a panel of faculty members. The thesis should demonstrate a deep understanding of energy informatics principles and contribute new knowledge or solutions to the field. The defense emphasizes research quality, analytical rigor, and the ability to communicate complex concepts effectively.

4. **Seminar**

   This course involves presenting research findings, discussing recent trends in energy informatics, and analyzing case studies. Students develop skills in technical communication and public speaking, preparing them to present complex information to diverse audiences. The seminar encourages peer feedback and fosters discussion on emerging technologies and challenges in the energy sector.

5. **Comprehensive Viva**

   The comprehensive viva is an oral examination that assesses students' overall understanding of the concepts and skills learned throughout the program. It includes topics such as energy systems, data analytics, smart grids, and renewable energy integration. The viva tests students' ability to integrate knowledge from various courses and apply it to solving real-world energy challenges, preparing them for leadership roles in the energy industry.

Bachelor of Technology in Design Thinking and Technology Management

Year 1 *L: Lecture T: Tutorial P: Practical

	Course	Hours/Week			Credits
Semester-I	Introduction to Design Thinking	L: 3	T: 0	P: 2	4
	Mathematics for Design and Innovation	L: 3	T: 1	P: 0	4
	Basics of Programming	L: 3	T: 0	P: 2	4
	Fundamentals of Engineering Graphics	L: 2	T: 0	P: 2	3
	Physics for Engineers	L: 3	T: 1	P: 0	4
	Communication Skills for Designers	L: 2	T: 0	P: 0	2
				Total Credits	**21**

	Course	Hours/Week			Credits
Semester-II	Design Thinking Process and Tools	L: 3	T: 0	P: 2	4
	Mathematics-II: Linear Algebra and Probability	L: 3	T: 1	P: 0	4
	Introduction to Human-Centered Design	L: 3	T: 0	P: 2	4
	Fundamentals of Materials and Manufacturing	L: 3	T: 0	P: 2	4
	Introduction to Technology Management	L: 3	T: 0	P: 0	3
	Environmental Science	L: 2	T: 0	P: 0	2
				Total Credits	**21**

Year 2

	Course	Hours/Week			Credits
Semester-III	Innovation and Creativity in Design	L: 3	T: 0	P: 2	4
	Data Analysis and Visualization	L: 3	T: 0	P: 2	4
	Digital Prototyping and Fabrication	L: 3	T: 0	P: 2	4
	Principles of Management	L: 3	T: 0	P: 0	3
	Elective I (e.g., Design for Sustainability)	L: 3	T: 0	P: 0	3
	Mini Project I	L: 0	T: 0	P: 2	2
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester-IV	Product Design and Development	L: 3	T: 0	P: 2	4
	Systems Thinking for Complex Problems	L: 3	T: 0	P: 2	4
	UX/UI Design Principles	L: 3	T: 0	P: 2	4
	Technology Entrepreneurship	L: 3	T: 0	P: 0	3
	Elective II (e.g., Artificial Intelligence in Design)	L: 3	T: 0	P: 0	3
	Internship I (4 weeks)	L: 0	T: 0	P: 2	2
				Total Credits	**20**

Year 3

	Course	Hours/Week			Credits
Semester-V	Advanced Design Thinking	L: 3	T: 0	P: 2	4
	Strategic Management for Innovation	L: 3	T: 0	P: 0	3
	Data-Driven Decision Making	L: 3	T: 0	P: 2	4
	Technology Road mapping	L: 3	T: 0	P: 0	3
	Elective III (e.g., Design for Emerging Markets)	L: 3	T: 0	P: 0	3
	Mini Project II	L: 0	T: 0	P: 2	2
				Total Credits	**20**

	Course	Hours/Week			Credits
Semester-VI	Service Design and Management	L: 3	T: 0	P: 2	4
	Innovation Management and Intellectual Property	L: 3	T: 0	P: 0	3
	Big Data and AI Applications in Design	L: 3	T: 0	P: 2	4
	Design Thinking for Social Impact	L: 3	T: 0	P: 0	3
	Elective IV (e.g., Design Thinking in Healthcare)	L: 3	T: 0	P: 0	3
	Internship II (6 weeks)	L: 0	T: 0	P: 2	2
				Total Credits	**19**

Year 4

	Course	Hours/Week			Credits
Semester-VII	Design Strategy and Business Models	L: 3	T: 0	P: 2	4
	Managing Technology and Innovation	L: 3	T: 0	P: 0	3
	Advanced UX Research	L: 3	T: 0	P: 2	4
	Elective V (e.g., Virtual Reality in Design)	L: 3	T: 0	P: 0	3
	Capstone Project I	L: 0	T: 0	P: 6	3
	Seminar	L: 0	T: 0	P: 2	2
				Total Credits	**19**

	Course	Hours/Week			Credits
Semester-VIII	Advanced Technology Management	L: 3	T: 0	P: 0	3
	Elective VI (e.g., Sustainable Design Practices)	L: 3	T: 0	P: 0	3
	Capstone Project II (Final Defense)	L: 0	T: 0	P: 12	8
	Comprehensive Viva	L: 0	T: 0	P: 0	1
				Total Credits	**15**

Elective Options:

Elective I: Design for Sustainability, Human Factors Engineering, Applied Creativity Techniques

Elective II: Artificial Intelligence in Design, IoT for Smart Products, Advanced Materials for Product Design

Elective III: Design for Emerging Markets, Behavioural Economics in Design, Innovation in Manufacturing

Elective IV: Design Thinking in Healthcare, Innovation in Education, Design for Rural Development

Elective V: Virtual Reality in Design, Augmented Reality for User Experience, Advanced Prototyping Techniques

Elective VI: Sustainable Design Practices, Design for Circular Economy, Ethical Design Principles

Syllabus

Year 1

Semester I

1. **Introduction to Design Thinking**

   This course introduces the fundamental concepts and principles of design thinking, focusing on the iterative process of empathizing, defining, ideating, prototyping, and testing. Students explore how design thinking can be applied to solve real-world problems across industries. Through hands-on workshops and case studies, students learn to develop a user-centered approach to problem-solving, emphasizing creativity and collaboration in creating innovative solutions.

2. **Mathematics for Design and Innovation**

   This course covers essential mathematical concepts required for design and innovation, including calculus, linear algebra, and geometry. Topics such as optimization, functions, and systems of equations are explored in the context of design applications, such as modelling physical systems and analyzing design parameters. Students develop skills in applying mathematical reasoning to solve problems in engineering and design.

3. **Basics of Programming**

   This course introduces students to the fundamentals of programming using languages such as Python or Java. Students learn basic programming constructs, including variables, loops, functions, and data structures. The course emphasizes the importance of programming in automating design processes, creating digital prototypes, and analyzing data in design projects. Practical assignments involve developing simple programs and understanding how software can enhance the design workflow.

4. **Fundamentals of Engineering Graphics**

   This course covers the basics of technical drawing and computer-aided design (CAD). Students learn to create detailed engineering drawings, including orthographic projections, isometric views, and sectional views. The course emphasizes the importance of precision in graphical communication, providing foundational skills for creating accurate design representations. Practical sessions involve using CAD software to produce 2D and 3D models of design concepts.

5. **Physics for Engineers**

   This course provides a fundamental understanding of physics principles relevant to engineering, including mechanics, waves, and electromagnetism. Students explore the application of these concepts in the design and analysis of physical systems, such as structures, mechanical devices, and electrical circuits. The course includes laboratory exercises that reinforce theoretical concepts through hands-on experiments.

6. **Communication Skills for Designers**

   This course focuses on developing effective communication skills tailored to the needs of designers. Students learn to present their ideas clearly through verbal and written communication, create compelling design pitches, and collaborate in multidisciplinary teams. The course also emphasizes storytelling techniques to convey the value of design concepts to various stakeholders.

Semester II

1. **Design Thinking Process and Tools**

   This course delves deeper into the stages of the design thinking process, providing students with practical tools for ideation, prototyping, and user testing. Topics include brainstorming techniques, rapid prototyping, user journey mapping, and empathy mapping. Through project-based learning, students apply these tools to develop and test innovative solutions for real-world challenges, learning to iterate quickly based on user feedback.

2. **Mathematics-II: Linear Algebra and Probability**

   This course covers linear algebra and probability theory, focusing on their applications in design and technology management. Topics include matrices, vector spaces, eigenvalues, probability distributions, and statistical inference. Students learn to apply these mathematical concepts to analyze data, optimize design processes, and make informed decisions based on probability models.

3. **Introduction to Human-Centered Design**

   This course explores the principles of human-centered design, emphasizing the importance of understanding user needs and behaviours. Students learn to conduct user research, create personas, and develop design solutions that prioritize user experiences. The course emphasizes empathy and the iterative refinement of products and services to enhance usability and user satisfaction.

4. **Fundamentals of Materials and Manufacturing**

   This course provides an overview of materials used in product design, including metals, polymers, ceramics, and composites. Students learn about the properties and applications of different materials, as well as the manufacturing processes used to create products, such as casting, machining, and 3D printing. Practical sessions involve selecting materials for specific design projects and understanding the trade-offs between material properties and manufacturing costs.

5. **Introduction to Technology Management**

   This course introduces students to the strategic management of technology in organizations. Topics include innovation management, technology adoption, and the impact of emerging technologies on business models. Students learn to assess technological trends, develop technology roadmaps, and create strategies for leveraging technology to gain a competitive advantage in the market.

6. **Environmental Science**

   This course explores the relationship between human activities and the environment, focusing on sustainable practices in design and technology management. Topics include pollution control, waste management, renewable energy, and sustainable product design. Students learn about the environmental impacts of manufacturing processes and how to apply sustainability principles in their design projects.

Year 2

Semester III

1. **Innovation and Creativity in Design**

   This course emphasizes the role of creativity and innovation in the design process. Students learn techniques for enhancing creativity, such as lateral thinking, mind mapping, and creative problem-solving. The course explores how to foster a culture of innovation within organizations and encourages students to challenge conventional design approaches. Practical projects involve generating creative solutions for complex design challenges.

2. **Data Analysis and Visualization**

   This course teaches students how to analyze and visualize data to inform design decisions. Topics include descriptive statistics, data visualization techniques, and data storytelling. Students learn to use software tools such as Tableau and Excel to create interactive visualizations and dashboards that make complex data more accessible. The course emphasizes the importance of data-driven decision-making in design and technology management.

3. **Digital Prototyping and Fabrication**

   This course focuses on the use of digital tools for prototyping and fabrication, including 3D modelling, 3D printing, laser cutting, and CNC machining. Students learn to create digital models of their design concepts and produce physical prototypes using digital fabrication techniques. The course emphasizes rapid prototyping as a means of testing and refining design ideas, allowing for quick iterations based on user feedback.

4. **Principles of Management**

   This course covers fundamental management concepts, including organizational behaviour, leadership, project management, and strategic planning. Students learn how management principles apply to design and technology-driven organizations, focusing on how to lead teams, manage projects, and achieve strategic goals. Case studies are used to illustrate the application of management principles in real-world scenarios.

5. **Elective I: Design for Sustainability**

   This elective explores sustainable design principles and practices, focusing on creating products and services that minimize environmental impact. Students learn about life cycle assessment, eco-design strategies, and sustainable material selection. The course emphasizes the role of designers in promoting sustainability and teaches students how to balance ecological, economic, and social considerations in their design projects.

6. **Mini Project I**

   In this project-based course, students work on a small-scale design project, applying the principles of design thinking and technology management learned so far. Projects may involve designing a new product, service, or user interface, with a focus on solving a specific problem identified through user research. The mini project emphasizes creativity, prototyping, and effective presentation of the final solution.

Semester IV

1. **Product Design and Development**

   This course focuses on the process of designing and developing new products, from concept generation to market launch. Students learn about user-centered design, product lifecycle management, and design for manufacturability. The course emphasizes the importance of aligning product design with market needs, using techniques such as concept testing, design validation, and prototyping.

2. **Systems Thinking for Complex Problems**

   This course introduces students to systems thinking as a framework for addressing complex design challenges. Topics include systems mapping, feedback loops, and leverage points. Students learn to analyze complex systems, identify underlying patterns, and develop holistic solutions that address the root causes of problems. The course emphasizes the interconnectedness of social, environmental, and technological systems in design.

3. **UX/UI Design Principles**

   This course covers the principles of user experience (UX) and user interface (UI) design, focusing on creating intuitive and engaging digital products. Students learn about user flows, wireframing, interaction design, and visual design. The course emphasizes the importance of usability testing and iterative design, helping students create digital interfaces that meet user needs and expectations.

4. **Technology Entrepreneurship**

   This course explores the process of starting and scaling technology-driven ventures. Students learn about business model innovation, lean startup methodology, and venture financing. The course emphasizes the role of design thinking in developing products and services that solve customer problems, with a focus on creating value in competitive markets.

5. **Elective II: Artificial Intelligence in Design**

   This elective focuses on the role of artificial intelligence (AI) in enhancing the design process. Topics include AI-driven design tools, generative design, and the use of machine learning to analyze user data and improve product experiences. Students learn how to leverage AI for automating repetitive design tasks and developing innovative solutions that adapt to user behaviour.

6. **Internship I**

   This course involves a four-week internship in a design or technology-driven organization. Students gain hands-on experience in applying design thinking and technology management principles to real-world projects. The internship allows students to build industry connections, understand professional practices, and refine their skills in a practical setting.

Year 3

Semester V

1. **Advanced Design Thinking**

   This course builds on the foundational concepts of design thinking, focusing on advanced techniques such as co-creation, speculative design, and strategic foresight. Students learn to facilitate workshops, engage stakeholders, and develop scenarios for future innovation. The course emphasizes applying design thinking at a strategic level to drive organizational change and develop long-term innovation strategies.

2. **Strategic Management for Innovation**

   This course explores the strategic aspects of managing innovation within organizations. Topics include competitive strategy, innovation ecosystems, and the role of leadership in fostering a culture of innovation. Students learn how to align innovation efforts with organizational goals, create strategic plans, and develop metrics for measuring innovation success.

3. **Data-Driven Decision Making**

   This course teaches students how to use data to make informed decisions in the design and management of technology. Topics include predictive analytics, decision trees, and simulation models. Students learn to apply these tools to optimize design processes, improve customer experiences, and identify opportunities for innovation. The course emphasizes the importance of integrating quantitative analysis with design thinking.

4. **Technology Roadmapping**

   This course covers the process of technology roadmapping, a strategic planning tool used to align technological capabilities with market needs. Students learn to create roadmaps that guide the development of new products and technologies, considering factors such as technological trends, user needs, and competitive dynamics. The course emphasizes scenario planning and the importance of agility in managing technology evolution.

5. **Elective III: Design for Emerging Markets**

   This elective explores the challenges and opportunities of designing products and services for emerging markets. Students learn about cultural sensitivity, affordability, and the unique needs of users in developing economies. The course emphasizes designing solutions that are accessible, scalable, and impactful in diverse socio-economic contexts.

6. **Mini Project II**

   In this project-based course, students work on a more advanced design project, focusing on integrating design thinking and technology management principles. Projects may involve developing a new product or service prototype, conducting user testing, and iterating based on feedback. The mini project encourages students to tackle more complex challenges and present their solutions in a professional setting.

Semester VI

1. **Service Design and Management**

   This course focuses on the principles of service design, emphasizing the creation of user-centric services that deliver meaningful experiences. Students learn about service blueprinting, journey mapping, and the design of touchpoints across digital and physical channels. The course emphasizes the importance of aligning service design with business goals to create competitive advantages in the marketplace.

2. **Innovation Management and Intellectual Property**

   This course covers the management of innovation processes and the strategic use of intellectual property (IP) to protect new ideas and technologies. Topics include patent strategy, IP licensing, and trademarks. Students learn to navigate the complexities of IP law, develop strategies for protecting innovation, and understand the role of IP in competitive advantage.

3. **Big Data and AI Applications in Design**

   This course explores the use of big data and artificial intelligence (AI) in design and innovation. Students learn about data mining, AI-driven design tools, and the analysis of user data to personalize experiences. The course emphasizes how designers can use AI to enhance creativity, automate repetitive tasks, and develop adaptive products that respond to user needs.

4. **Design Thinking for Social Impact**

   This course focuses on using design thinking to address social challenges, such as poverty, healthcare access, and education. Students learn to design solutions that are inclusive, sustainable, and scalable, applying design principles to create positive change in communities. The course emphasizes stakeholder engagement, ethical considerations, and the impact of design on society.

5. **Elective IV: Design Thinking in Healthcare**

   This elective explores the application of design thinking in the healthcare sector, focusing on improving patient experiences, designing medical devices, and optimizing healthcare services. Students learn about human-centered design approaches in healthcare, engaging with patients, healthcare providers, and other stakeholders to create solutions that enhance care delivery.

6. **Internship II**

   This course involves a six-week internship in a design, innovation, or technology-driven organization. Students gain hands-on experience working on projects that integrate design thinking with technology management, applying their skills in real-world settings. The internship prepares students for their final year by providing valuable industry insights and professional networking opportunities.

Year 4

Semester VII

1. **Design Strategy and Business Models**

   This course explores the intersection of design and business strategy, focusing on how design can drive business innovation. Topics include business model design, value proposition development, and market positioning. Students learn to create strategies that leverage design as a competitive advantage, aligning design efforts with business goals to create sustainable growth.

2. **Managing Technology and Innovation**

   This course covers the management of technological innovation, focusing on strategies for fostering a culture of innovation within organizations. Topics include innovation frameworks, change management, and the role of leadership in driving technology adoption. Students learn to develop strategies for managing technological change, assessing the risks and opportunities of new technologies.

3. **Advanced UX Research**

   This course focuses on advanced methods for researching user experiences, including ethnographic research, usability testing, and data-driven UX analysis. Students learn to design research studies, analyze user behaviour, and translate research findings into actionable design insights. The course emphasizes the importance of understanding user needs to create products and services that deliver exceptional user experiences.

4. **Elective V: Virtual Reality in Design**

   This elective explores the use of virtual reality (VR) in the design process, focusing on creating immersive experiences and virtual prototypes. Students learn to develop VR environments, design user interfaces for VR applications, and evaluate the impact of VR on user experience. The course emphasizes the potential of VR to transform industries such as entertainment, education, and healthcare.

5. **Capstone Project I**

   This course involves working on a comprehensive capstone project that integrates design thinking and technology management principles. Students work on real-world challenges, developing innovative solutions and creating detailed design prototypes. The project emphasizes research, user testing, and iterative development, culminating in a presentation to faculty and industry experts.

6. **Seminar**

   This course involves presenting research findings, discussing recent developments in design and technology management, and analyzing case studies. Students develop skills in public speaking and technical communication, preparing them to present complex ideas to diverse audiences. The seminar encourages discussion on emerging trends in design, technology, and innovation.

Semester VIII

1. **Advanced Technology Management**

   This course explores advanced topics in managing technology in organizations, including technology adoption strategies, digital transformation, and managing technological risk. Students learn to assess the strategic implications of new technologies, develop digital strategies, and manage the integration of technology into business processes.

2. **Elective VI: Sustainable Design Practices**

   This elective focuses on designing products, services, and systems with sustainability in mind. Students learn about circular design principles, life cycle analysis, and eco-design strategies that minimize environmental impact. The course emphasizes designing for a sustainable future, with projects that explore innovative ways to reduce resource consumption and enhance product longevity.

3. **Capstone Project II (Final Defense)**

   This course involves completing the capstone project started in Semester VII, with a focus on refining the solution, conducting thorough testing, and preparing for a final presentation. Students present their projects to a panel of faculty and industry experts, demonstrating their ability to integrate design thinking, technology management, and innovation. The project emphasizes practical problem-solving, strategic thinking, and professional presentation skills.

4. **Comprehensive Viva**

   The comprehensive viva is an oral examination that assesses students' overall understanding of the concepts and skills learned throughout the program. It covers topics such as design thinking, technology management, user experience design, and innovation strategy. The viva tests students' ability to integrate knowledge from various courses and apply it to solving complex design and management challenges.

Master of Technology in Design Thinking and Technology Management

Year 1

	Course	Hours/Week			Credits
Semester-I	Advanced Design Thinking Methods	L: 3	T: 0	P: 2	4
	Innovation Management	L: 3	T: 0	P: 2	4
	Strategic Technology Management	L: 3	T: 0	P: 2	4
	User Experience (UX) Design and Research	L: 3	T: 0	P: 2	4
	Research Methodology in Design and Technology	L: 2	T: 0	P: 0	2
	Elective I (e.g., Design for Sustainability)	L: 3	T: 0	P: 0	3
				Total Credits	**21**

*L: Lecture T: Tutorial P: Practical

	Course	Hours/Week			Credits
Semester-II	Systems Thinking and Complexity	L: 3	T: 0	P: 2	4
	Data-Driven Decision Making	L: 3	T: 0	P: 2	4
	Service Design and Management	L: 3	T: 0	P: 2	4
	Technology Entrepreneurship	L: 3	T: 0	P: 2	4
	Elective II (e.g., AI in Design)	L: 3	T: 0	P: 0	3
	Mini Project	L: 0	T: 0	P: 6	2
				Total Credits	**21**

Year 2

	Course	Hours/Week			Credits
Semester-III	Design Strategy and Business Innovation	L: 3	T: 0	P: 2	4
	Advanced Prototyping and Digital Fabrication	L: 3	T: 0	P: 2	4
	Innovation and Intellectual Property Management	L: 3	T: 0	P: 0	3
	Elective III (e.g., Design Thinking in Healthcare)	L: 3	T: 0	P: 0	3
	Thesis Work - Part I	L: 0	T: 0	P: 12	5
	Internship (4 weeks)	L: 0	T: 0	P: 4	2
				Total Credits	**21**

	Course	Hours/Week			Credits
Semester-IV	Elective IV (e.g., Sustainable Design Practices)	L: 3	T: 0	P: 0	3
	Elective V (e.g., Virtual Reality in Design)	L: 3	T: 0	P: 0	3
	Thesis Work - Part II (Final Defense)	L: 0	T: 0	P: 16	8
	Seminar	L: 0	T: 0	P: 2	2
	Comprehensive Viva	L: 0	T: 0	P: 0	1
				Total Credits	17

Elective Options:

Elective I: Design for Sustainability, Human-Centered Design, Advanced Data Visualization

Elective II: AI in Design, Digital Transformation, IoT for Smart Products

Elective III: Design Thinking in Healthcare, Behavioural Design, Design for Rural Development

Elective IV: Sustainable Design Practices, Circular Economy, Ethical Design Principles

Elective V: Virtual Reality in Design, Augmented Reality for User Experience, Advanced Digital Interfaces

Syllabus

Year 1

Semester I

1. **Advanced Design Thinking Methods**

   This course delves into advanced techniques in design thinking, focusing on methods for empathizing with users, defining complex problems, ideating innovative solutions, prototyping rapidly, and testing concepts. Topics include co-design, speculative design, and future-oriented design practices. Students learn to facilitate design thinking workshops, engage stakeholders, and use advanced ideation tools. The course emphasizes developing solutions for real-world challenges through case studies and project-based learning, allowing students to apply design thinking principles to diverse industries.

2. **Innovation Management**

   This course explores the process of managing innovation within organizations, focusing on creating and sustaining a culture of innovation. Topics include types of innovation (incremental, disruptive, open innovation), managing innovation pipelines, and strategies for fostering creativity in teams. Students learn about the innovation lifecycle, from idea generation to commercialization, and explore frameworks for evaluating the potential of new ideas. The course includes case studies from successful companies to understand best practices and the role of leadership in driving innovation.

3. **Strategic Technology Management**

   This course focuses on the strategic management of technology and its impact on business competitiveness. Topics include technology life cycle, technology adoption models, and strategies for leveraging emerging technologies to gain a competitive edge. Students learn how to develop technology roadmaps, assess the business impact of technological changes, and align technology strategy with business goals. The course emphasizes strategic decision-making, using real-world scenarios to help students understand the complexities of managing technology in a dynamic business environment.

4. **User Experience (UX) Design and Research**

   This course provides an in-depth understanding of user experience design, focusing on user research methods, interaction design, and usability testing. Students learn to conduct interviews, surveys, and usability tests to gather insights into user needs and behaviours. The course covers key UX principles such as information architecture, wireframing, and prototyping. Practical assignments involve creating user personas, designing wireframes, and testing prototypes to refine user interfaces, aiming to create products and services that provide exceptional user experiences.

5. **Research Methodology in Design and Technology**

   This course equips students with the skills needed to conduct research in the fields of design and technology management. Topics include research design, data collection methods (qualitative and quantitative), literature review, and statistical analysis. Students learn to formulate research questions, develop hypotheses, and apply appropriate methodologies for solving complex problems in design and innovation. The course prepares students for their thesis work, emphasizing the importance of academic integrity and ethical considerations in research.

6. **Elective I: Design for Sustainability**

   This elective explores the principles and practices of sustainable design, focusing on creating products, services, and systems that minimize environmental impact. Topics include life cycle assessment, eco-design strategies, and the circular economy. Students learn to design for recyclability, reduce resource consumption, and consider the social, economic, and environmental impacts of their design decisions. Case studies of successful sustainable design projects illustrate the application of these principles in various industries.

Semester II

1. **Systems Thinking and Complexity**

   This course introduces systems thinking as a framework for addressing complex problems in design and technology management. Students learn about systems mapping, feedback loops, leverage points, and causal loop diagrams. The course emphasizes understanding the interconnections within complex systems and the unintended consequences of design interventions. Students apply systems thinking to analyze real-world challenges, developing holistic solutions that consider the broader context of the problem.

2. **Data-Driven Decision Making**

   This course focuses on the use of data analytics to inform decision-making processes in design and technology management. Students learn about predictive analytics, data visualization, and statistical modelling. Topics include time-series analysis, regression models, and data-driven strategies for optimizing design processes and improving user experiences. The course emphasizes the integration of quantitative data with qualitative insights from user research, teaching students to make informed decisions that drive innovation and business success.

3. **Service Design and Management**

   This course explores the design of services with a focus on creating user-centered, efficient, and effective service experiences. Topics include service blueprinting, customer journey mapping, and touchpoint design. Students learn to design seamless service experiences that integrate digital and physical interactions, focusing on improving user satisfaction and loyalty. The course emphasizes the importance of aligning service design with organizational goals and managing service delivery to create competitive advantages.

4. **Technology Entrepreneurship**

   This course examines the process of creating and growing technology-driven ventures. Students learn about lean startup methodology, business model development, market analysis, and venture financing. The course emphasizes the role of design thinking in identifying market opportunities, validating business ideas, and creating products that meet customer needs. Students engage in developing startup pitches, crafting business plans, and understanding the challenges of scaling a technology venture.

5. **Elective II: AI in Design**

   This elective explores the application of artificial intelligence (AI) in enhancing the design process. Students learn about AI-driven design tools, generative design, and machine learning models that can analyze user data and automate design tasks. Topics include neural networks, natural language processing, and AI-based recommendation systems. The course emphasizes how AI can augment human creativity, streamline design processes, and improve user experiences through personalized design solutions.

6. **Mini Project**

   This project-based course allows students to apply the skills and concepts learned in a practical setting. Students identify a real-world problem, develop a user-centered design solution, and create a working prototype or proof of concept. The project emphasizes interdisciplinary collaboration, rapid prototyping, and iterative testing to refine the solution based on user feedback. The mini project serves as a foundation for students' larger thesis work.

Year 2

Semester III

1. **Design Strategy and Business Innovation**

   This course focuses on the intersection of design and business strategy, emphasizing how design can drive innovation and create competitive advantages. Topics include strategic foresight, design-led innovation, and the development of new business models. Students learn to align design activities with business objectives, create value propositions, and position innovative products in the market. Case studies and project work illustrate how companies have used design strategy to disrupt industries and create successful products.

2. **Advanced Prototyping and Digital Fabrication**

   This course explores advanced techniques in digital prototyping and fabrication, including 3D printing, CNC machining, and laser cutting. Students learn to create high-fidelity prototypes of their design concepts using digital tools and understand the transition from prototype to production. The course emphasizes the importance of prototyping in validating design ideas, refining user interactions, and testing functional aspects of products. Practical sessions include hands-on work with digital fabrication equipment and software.

3. **Innovation and Intellectual Property Management**

   This course covers the strategic management of intellectual property (IP) in the context of innovation. Topics include patents, trademarks, copyrights, and trade secrets. Students learn about the role of IP in protecting innovative ideas, licensing strategies, and the commercialization of new technologies. The course emphasizes the importance of developing an IP strategy that aligns with business goals, providing students with the skills needed to navigate complex legal frameworks and secure competitive advantages.

4. **Elective III: Design Thinking in Healthcare**

   This elective focuses on applying design thinking to solve challenges in the healthcare sector. Students learn about patient-centered design, the role of technology in healthcare innovation, and strategies for improving healthcare services and devices. The course emphasizes the importance of empathy in understanding patient needs and designing solutions that enhance the patient experience, reduce costs, and improve outcomes.

5. **Thesis Work - Part I**

   In this course, students begin their thesis project, focusing on identifying a research problem, conducting a literature review, and developing a research methodology. The thesis should address a significant challenge in design thinking and technology management, such as improving user experiences through digital innovation or developing strategies for managing technological change. Students work closely with a faculty advisor to refine their research questions and prepare for data collection and analysis.

6. **Internship (4 weeks)**

   This course involves a four-week internship in a design or technology-driven organization. The internship provides hands-on experience in applying design thinking and technology management principles to real-world projects. Students gain insights into industry practices, work on live projects, and build professional networks, helping them to bridge the gap between academic learning and industry needs.

Semester IV

1. **Elective IV: Sustainable Design Practices**

   This elective explores advanced sustainable design practices, focusing on creating products and services that minimize environmental impact and promote social responsibility. Topics include cradle-to-cradle design, biomimicry, and regenerative design strategies. Students learn to apply sustainable design principles throughout the product lifecycle, from material selection and manufacturing to end-of-life disposal and recycling. Case studies highlight innovative approaches to sustainability in various industries.

2. **Elective V: Virtual Reality in Design**

   This elective focuses on the use of virtual reality (VR) in the design process, exploring how VR can create immersive environments for user testing, virtual prototyping, and design visualization. Students learn to develop VR applications, design user interfaces for VR experiences, and evaluate the impact of VR on user interaction and engagement. The course emphasizes the potential of VR to transform industries such as architecture, education, and entertainment by offering new ways to visualize and interact with design concepts.

3. **Thesis Work - Part II (Final Defense)**

   This course involves completing the thesis project, including data analysis, interpretation of results, and writing the final thesis report. The project culminates in a thesis defense, where students present their research findings to a panel of faculty members. The thesis should demonstrate a deep understanding of design thinking and technology management principles, offering new insights or solutions to industry-relevant challenges. The defense emphasizes the ability to communicate complex ideas clearly and effectively.

4. **Seminar**

   This course involves presenting research findings, discussing recent developments in design and technology management, and analyzing industry case studies. Students develop skills in public speaking and technical communication, preparing them to present complex information to diverse audiences. The seminar encourages peer feedback and fosters discussion on emerging trends in design, technology, and innovation.

5. **Comprehensive Viva**

   The comprehensive viva is an oral examination that assesses students' overall understanding of the concepts and skills learned throughout the program. It covers topics such as design thinking, strategic technology management, user experience design, and innovation strategy. The viva tests students’ ability to integrate knowledge from various courses and apply it to solving real-world challenges, preparing them for leadership roles in design and innovation sectors.

B. TECH. COMPUTER SCIENCE AND ENGINEERING

(INTERNATIONAL ENGINEERING PROGRAM)

I Year I Semester

S. No.	Course Code	Course	Hours/Week			
			L	T	P/D	C
1	HS	English – I	2	-	-	2
2	HS	Finance for Engineers	3	-	-	3
3	BS	Mathematics – I	3	1	-	4
4	BS	Engineering Physics – I	3	1	-	4
5	BS	Engineering Chemistry	3	1	-	4
6	HS	English Language Communication Skills Lab	-	-	2	1
7	BS	Engineering Physics - I Lab	-	-	2	1
8	BS	Engineering Chemistry Lab	-	-	2	1
9	ES	Introduction to Programming Lab	-	-	2	1
Total						**21**

I Year II Semester

S. No.	Course Code	Course	Hours/Week			
			L	T	P/D	C
1	HS	English – II	3	-	-	3
2	BS	Mathematics – II	3	1	-	4
3	BS	Engineering Physics – II	3	1	-	4
4	OE	Open Elective – I	3	-	-	3
5	ES	Problem Solving with Programming	3	-	-	3
6	BS	Engineering Physics - II Lab	-	-	2	1
7	ES	Problem Solving with Programming Lab	-	-	2	1
Total						**19**

II Year I Semester

S.No.	Course Code	Course	Hours /Week			
			L	T	P/D	C
1	CS	Discrete Mathematical Structures – I	3	1	-	4
2	ES	Microprocessors and Microcontrollers	3	1	-	4
3	ES	Smart System Design	3	-	-	3
4	ES	Data Structures	3	1	-	4
5	ES	Digital Logic Design	3	1	-	4
6	ES	Microprocessors and Microcontrollers Lab	-	-	2	1
7	ES	Data Structures Lab	-	-	2	1
Total						**21**

II Year II Semester

S. No.	Course Code	Course	Hours /Week			
			L	T	P/D	C
1	BS	Mathematics – III	3	1	-	4
2	CS	Computer Organization and Architecture	3	1	-	4
3	CS	Object Oriented Programming Concepts	3	1	-	4
4	CS	Operating Systems	3	-	-	3
5	CS	Theory of Computation	3	1	-	4
6	OE	**Open Elective – II**	3	-	-	3
7	CS	Object Oriented Programming Concepts Lab	-	-	2	1
8	CS	Operating Systems Lab	-	-	2	1
						24

III Year I Semester

S. No.	Course Code	Course	Hours /Week			
			L	T	P/D	C
1	BS	Probability and Statistics	3	1	-	4
2	CS	Computer Networks	3	-	-	3
3	CS	Design and Analysis of Algorithms	3	1	-	4
4	PE	**Professional Elective – I** Artificial Intelligence Distributed Systems Foundations of IoT Principles of Programming Languages	3	-	-	3
5	CS	Database Management Systems	3	-	-	3
6	CS	Discrete Mathematical Structures – II	3	1	-	4
7	CS	Computer Networks Lab	-	-	2	1
8	CS	Design and Analysis of Algorithms Lab	-	-	2	1
9	CS	Database Management Systems Lab	-	-	2	1
Total						**24**

III Year II Semester

S. No.	Course Code	Course	Hours /Week			
			L	T	P/D	C
1	OE	**Open Elective – III**	3	-	-	3
2	PE	**Professional Elective – II** Network Programming Java Programming R Programming Security in IoT Ethical Hacking	3	-	-	3
3	CS	Cryptography and Network Security	3	-	-	3
4	CS	Software Engineering	3	1	-	4
5	CS	Web Technologies	3	-	-	3
6	CS	Compiler Design	3	-	-	3
7	CS	Professional Elective - II Lab	-	-	2	1
8	CS	Web Technologies Lab	-	-	2	1
9	CS	Compiler Design Lab	-	-	2	1
Total						**22**

IV Year I Semester

S. No.	Course Code	Course	Hours /Week			
			L	T	P/D	C
1	CS	Machine Learning	3	-	-	3
2	OE	**Open Elective – IV**	3	-	-	3
3	PE	**Professional Elective – III** Neural Networks and Deep Learning Data Mining Scripting Languages Distributed IoT Systems	3	-	-	3
4	PE	**Professional Elective – IV** Advanced Algorithms Big Data Analytics Cloud Computing Software Testing Methodologies	3	-	-	3
5	CS	Machine Learning through Python Lab	-	-	2	1
6	CS	Capstone Phase – I	-	-	-	4
Total						**17**

IV Year II Semester

S. No.	Course Code	Course	Hours /Week			
			L	T	P/D	C
1	PE	**Professional Elective – V** Ad hoc & Sensor Networks Natural Language Processing Software Project Management Image Processing	3	-	-	3
2	CS	Capstone Phase - II / Practice School	-	-	-	9
Total						**12**

Syllabus

ENGLISH I

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1) Compile effective paragraphs and essays.
2) Compile technical and non -technical terminology.
3) Sketch flawless grammar usage.
4) Identify purpose and audience of a given text.
5) Restate scanning and skimming and build critical thinking.

UNIT I

History

Museum brochures, should we teach History? Working out meaning from content, Academic vocabulary, Grammar for writing: stating opinions, linking contrasting sentences, critical thinking: analyze different opinions, write an introduction and write a balanced opinion essay, parts of speech, verb and verb forms

UNIT II

Environment

Our changing planet, what are the causes of deforestation and what are its effects on the natural environment? (Natural science journal-reading for main ideas), Scanning to find information, topic vocabulary, cause-effect paragraphs, linking word or phrase, topic sentences, tenses, phrasal verbs.

UNIT III

Health and Fitness

Skim a leaflet-keep fit! It's easier than you might think, read the essay –tackling obesity, understand key vocabulary, verbs and nouns, collocations, giving reasons, organization of an essay, write supporting sentences to a problem-solution essay, articles, punctuation, simple, compound, complex sentences, and concord.

UNIT IV

Discovery and Invention

Read the magazine article-the magic of mimicry, making inferences from the text, scanning to predict content-the world of tomorrow, understanding prefixes, making predictions, understand an issue by finding reasons and evidence to support ideas, common errors, advantage-disadvantage essay, speech and voice.

UNIT V

Economics

Skimming and scanning, synonyms, describing graphs-noun phrases and verb phrases, understand and interpret visual information, writing an explanatory paragraph describing a graph and explaining the data, information transfer techniques.

UNIT VI

The Brain

Tricks played by the brain, mind control, previewing, medical language, understanding technical vocabulary, critical thinking, write a process paragraph, one word substitution, writing e-mail, note making

TEXTBOOK

1. Carolyn Westbrook, "Unlock Reading and Writing Skills 3 - B1 English Profile", Cambridge University Press.

REFERENCE BOOKS

1. Raymond Murphy, "Murphy's Essential English Grammar" with CD, Cambridge University Press.
2. V R Narayanaswami, "Strengthen your English", Orient Longman.
3. "A Hand Book of English for Engineers", BSP.
4. M. Ashraf Rizvi, "Effective Technical Communication", Tata McGraw Hill.

FINANCE FOR ENGINEERS

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Estimate the cash flows in a business process.
2. Create value maps using price-benefit to customers.
3. Construct Break even chart and calculate the BEP.
4. Apply various techniques in estimating the time value of money.
5. Analyze the income and profit & loss statement of various organizations.

UNIT I

Cash Flow

The Life Line of Business - Estimate Revenue - Cost of Goods - Operating Expenses - Gross Profit and Net Profit - Revenue and Profit - Cost and Profit.

Increasing Profit

Black-Box Model - Strategies for Increasing Revenue -Strategies for Manufacturing Cost - Strategies for Decreasing Operating Expenses.

UNIT II

Value-Price-Cost

Terminology, Key Drivers, Economic Value to Customer, Value Maps-Construction of Value Maps - Price and Benefit to Customer - Price and Cost of Goods Sold - Value Maps and Profit Maximization.

UNIT III

Break-Even Analysis
Break-Even Point, Cost Volume Profit Analysis-Construction of Break Even Point-Assumptions of Break Event Point, Calculation of Break Even Point.

UNIT IV
Life Cycle Costing
Different Life Cycle Cost Contributors. Time Value of Money-Need of Time Value of Money-Techniques of TVM: Discounting Technique and Compounding Technique, Selecting an Appropriate Product.

UNIT V
Balance Sheet and Income Statement
Basic Principles, The Balance Sheet, The Income Statement, Construction of the Balance Sheet and Income Statement, Key Ratios.

UNIT VI
Cash Flow Statement and Connections
Cash Flow Statement, Balance Sheet Connections. Sales Cycle, Expense Cycle, Investment Cycle, Asset Purchase & Depreciation Cycle.

TEXTBOOKS

1. Robert N. Anthony, David F. Hawkins and Kenneth A. Mechant: Accounting-Text and Cases, 12/e TMH, 2008.
2. Narayanaswamy, R., Financial Accounting: A Managerial Perspective, PHI 2008.

REFERENCE BOOKS

1. Gokul Sinha: Financial Statement Analysis, PHI, 2009.
2. Ambrish Gupta: Financial Accounting Management an Analytical Perspective, Pearson Education.
3. Jawaharlal: Accounting for Management, HPH, 2008.
4. Stice & Stice: Financial Accounting Reporting & Analysis. Cengage, 7/e, 2008.
5. Horngren: Financial Accounting, Pearson, 2009.

MATHEMATICS - I

COURSE OUTCOMES

At the end of the course the student should be able to:

1. Understand the concepts of limit and continuity of a function.
2. Recognize the importance of differentiability of a function and also understand the applications of differentiation.
3. Interpret the definite integral geometrically as the area under a curve
4. Apply the techniques of integration to solve improper integrals and also evaluate the integration numerically.
5. Solve the differential equations of first order and first degree with suitable methods and apply these methods to various real world problems.

UNIT I

Functions, Limits and Continuity

Functions and Their Graphs - Combining Functions; Shifting and Scaling Graphs - Trigonometric Functions - Exponential Functions - Inverse Functions and Logarithms. Limit of a function and limit laws – one sided limits – Continuity - Limits Involving Infinity; Asymptotes of Graphs

UNIT II

Derivatives and Applications

The Derivative as a Function - Differentiation Rules - Derivatives of Trigonometric Functions - The Chain Rule - Implicit Differentiation - Derivatives of Inverse Functions and Logarithms - Inverse Trigonometric Functions - Related Rates - Linearization and Differentials - Extreme Values of Functions - Monotonic Functions and the First Derivative Test - L'Hôpital's Rule - Applied Optimization - The Mean Value Theorems – Graphical representation – Newton Raphson Method – Antiderivatives.

UNIT III

Integrals

Integration - Estimating with Finite Sums - Sigma Notation and Limits of Finite Sums - The Definite Integral – Integrals of Transcendental Functions - The Fundamental Theorem of Calculus - Indefinite Integrals and the Substitution Method - Definite Integral Substitutions and the Area between Curves.

UNIT IV

Techniques of Integration and Applications

Integration by Parts - Trigonometric Integrals - Trigonometric Substitutions - Integration of Rational Functions by Partial Fractions - Numerical Integration - Improper Integrals.

UNIT V

First Order Differential Equations

First Order Differential Equations - Integrals as General and Particular Solutions - Slope Fields and Solution Curves - Separable Equations and Applications: Newton's law of cooling – Laws of Natural Growth and Decay - Linear Equations – Bernoulli Equation - Exact Equations.

UNIT VI

Mathematical Models and Numerical Methods

Population Models - Acceleration-Velocity Models - Numerical Approximation: Euler's Method - Modified Euler Method - Runge-Kutta Method

TEXT BOOKS

1. Thomas' Calculus: Early Transcendentals, Joel R. Hass, Davis, Christopher E. Heil, Maurice D. Weir, Pearson publications.
2. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers, Delhi.

REFERENCES

1. Elementary Differential Equations, C. Henry Edwards, David E. Penney, Prentice Hall.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", Cl-Engineering.
3. Erwin kreyszig, "Advanced Engineering Mathematics", John wiley & sons, 605 Third Evenue, New York.

ENGINEERING PHYSICS - I

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Acquire conceptual understanding of fundamentals related to mechanics.
2. Interpret the important concepts and phenomena linked to waves and oscillations.
3. Analyze the intensity variation of light due to interference and diffraction and its significance.
4. Formulate and solve the engineering problems in mechanics and optics.
5. Examine the physical significance of Maxwell's equations as well as explore them.

UNIT I

Motion of Particle

Elements of vectors, Equations of motion-freely falling body and body projected upwards, Projectile motion-horizontal and oblique projection, Force, Newton's laws of motion, Work done-constant and varying force, Kinetic and potential energy, Work-energy principle, Conservative and non-conservative forces, Conservation of mechanical energy

UNIT II

System of Particles and Rotational Motion

Equilibrium of rigid body, Center of mass, Moment of inertia, Parallel and Perpendicular axes theorems, Angular quantities, Types of motion–translational, rotational and rolling motion, Rotational kinetic energy, Conservation of linear and angular momentum, Universal law of gravitation

UNIT III
Waves and Oscillations
Introduction, Free oscillations, Simple harmonic oscillator-equation of motion and its solution, Characteristics and energy of simple oscillator, Torsional pendulum-rigidity modulus of wire, Damped and Forced oscillations-equations of motion and their solutions, Sharpness of resonance, Quality factor, Electrical analogy of forced oscillator

UNIT IV
Interference and Diffraction
Interference: Conditions for sustained interference of light, Young's double slit experiment, Interference in thin films, Newton's rings by reflected light.
Diffraction: Distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction at a single slit and double slit (qualitative), N-slits-diffraction grating, Resolving power and Dispersive power of grating

UNIT V
Laser
Characteristics of laser, Absorption and emission of radiation, Einstein's coefficients and relation between them, Lasing action, Types of lasers - He-Ne laser and semiconductor laser, Applications of lasers

UNIT VI
Electrodynamics
Introduction to electrostatics, Coulomb's law, Gauss law of electrostatics, Introduction to magnetostatics, Gauss law of magnetostatics, Biot-Savart law, Time varying electric and magnetic fields-Faraday's laws of electromagnetic induction, Lenz's law, Ampere's law, Displacement current, Differential form of Maxwell's equations, Physical significance of Maxwell's equations, Electromagnetic waves - wave equation, Electromagnetic energy density, Poynting theorem

TEXT BOOKS
1. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley & Sons (P) Ltd., Tenth Edition – 2013.
2. R.K. Gaur & S.L. Gupta, "Engineering Physics", Dhanpat Rai Publications (P) Ltd., Eighth Edition – 2001 (Reprint – 2008).

REFERENCE BOOKS
1. Douglas C. Giancoli, "Physics – Principles with Applications", Prentice Hall, Sixth Edition – 2005.
2. Matthew N.O. Sadiku, "Principles of Electromagnetics", Oxford University Press, Fifth Edition – 2010.
3. M.N. Avadhanulu and P.G. Kshirsagar, "A Text book of Engineering Physics", S. Chand & Company Ltd., Tenth Revised Edition – 2013.

ENGINEERING CHEMISTRY

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Predict atomic structure, chemical bonding or molecular geometry based on accepted models
2. Illustrate the concept of chirality, stereochemical and compare various types of chromatography-spectroscopic methods
3. Explain the basics of electrochemistry and different types of electro chemical cells
4. Utilize the softening techniques of hard water
5. Identify the importance of various engineering materials

UNIT I

Periodic properties and Chemical bonding

Properties of elements, electronic configurations, atomic and ionic sizes, ionization energies, electronegativity, oxidation states, polarisability.

Chemical bonding-VBT-Definition, principle, overlapping of orbitals, molecular shapes.

Crystal field theory-Energy level splitting of d-orbitals for tetrahedral and octahedral complexes.

Molecular orbital theory- Molecular diagrams of homo and hetero diatomic molecules, bond order and magnetic properties.

UNIT II

Organic Reactions and Stereochemistry

Introduction to organic chemical reactions, types of reactions-addition, substitution, and elimination reactions.

Stereochemistry

Introduction to stereoisomers, configurations and chirality, enantiomers and diastereomers.

UNIT III

Free Energy in chemical equilibria: Concept of Gibbs free energy, electrode potentials, electrochemical series, EMF of cell, Nernst equation, numerical problems, types of electrodes, metal–metal ion electrode, gas electrode and ion selective electrode-glass electrode and fluoride ion electrode. Applications of electrode potential - Energy storage cells-Lithium ion and Ni-Cd Cells, fuel cells-H_2-O_2 and CH_3OH-O_2 fuel cell.

Corrosion - Definition, control methods-electroplating and anodizing

UNIT IV

Spectroscopic techniques and applications

Introduction, Principles of spectroscopy and selection rules, Beer-Lambert's law, and vibrational electronic spectroscopy (Fluorescence) and their applications in medicine.

Chromatography-Introduction, principles and applications of thin layer chromatography and gas chromatography.

UNIT V

Water Chemistry

Drinking water quality parameters-WHO guidelines, BIS guidelines, alkalinity, dissolved oxygen and hardness of water- representation, types and units of hardness, determination of hardness by EDTA method, problems. boiler troubles- caustic embrittlement, boiler corrosion, scale and sludge formation, methods of softening of water - Zeolite process and problems, Ion-exchange process, brackish water - Electro dialysis and Reverse osmosis.

UNIT VI

Material Chemistry: Bio Polymers-Synthesis and applications of PHA, PLA

Lubricants-Definition, criteria for good lubricants, Properties-viscosity, surface tension, flash point and fire point.

Refractories-Characteristics of Refractories, Concept of Refractoriness (RUL & Segar cone test).

Fuels - Types and Characteristics of fuels (Liquid and gaseous fuels**),** Knocking-Octane number, anti-knocking agents and Cetane number. Gaseous fuels- CNG, LPG, Calorific values (Units), Dulong's formulae for NCV and GCV, numerical problems

TEXT BOOKS

1. Gurudeep Raj, "Advance Physical Chemistry", Krishna Prakasham Media, GOEL Publishing House.
2. K.Mukkanti and SS Dara,"A Text book of Engineering Chemistry",S Chand Publications.
3. C. Parameswara Murthy, CV Agarwal and Andra Naidu, "Text book of Engineering Chemistry", BS Publications, Hyderabad (2008).
4. Shashi Chawla, "A Text Book of Engineering Chemistry", Tata McGraw Hill Education Private Limited, New Delhi-2012.

REFERENCE BOOKS

1. Oleg Roussak and H.D. Gesser, "Applied Chemistry: A Textbook for Engineers and Technologists", Springer, 2nd Edition 2013.
2. P.C. Jain and Jain, "Engineering Chemistry"-Sixteenth Edition, Dhanpat Rai Publishing Company, New Delhi-2014.

ENGLISH LANGUAGE COMMUICATION SKILLS LAB

COURSE OUTCOMES

At the end of the course the student will develop ability to

1. Reproduce the sounds of language as per the rule of pronunciation
2. Build speaking abilities with proper body language.
3. Paraphrase the description of people, objects and place.
4. Evaluate the effectiveness in improving in speaking levels.
5. Build Telephone Etiquette by using language for assent and dissent and recall essentials of communication methods.

The **Language Lab** focuses on the production and practice of sounds of language and familiarises the students with the use of English in everyday situations and contexts.

Exercise I

History

Watch and understand a video about archaeology, watch the video and list the main ideas, using visuals to predict content.

Ice-Breaking activity and JAM session, word formation, speech sounds – speech mechanism diagram.

Exercise II

Environment

Watch and understand a video about global warming- Alaskan glaciers, watch the video and complete the diagram, using knowledge to predict content.

Situational English – Role-Play- Social etiquette: Expressions in Various Situations – Self-introduction and Introducing others – Greetings – Apologies – Requests –– Consonantal sounds.

Exercise III

Health and Fitness

Watch and understand a video about professional cyclists, watch the video and complete the notes, understand key vocabulary.

Descriptions- Narrations- Giving Directions and guidelines – Vowel sounds.

Exercise IV

Discovery and Invention

Watch and understand a video about the ASIMO robot, watch the video and number the main ideas, watch again and complete the sentences with a word or a number.

Oral Presentation – Non verbal communication – gestures – proxemics – facial expressions – Making power point presentation – advantages of PPT – dos and don’ts – using bullets – font size – colour contrast.

Exercise V

Economics

Watch and understand a video about an emerging economy, watch the video and use knowledge to predict content, watch again and complete the lecture notes.
Group Discussion – concept – types of group discussion – dos and don'ts – advantages.

Exercise VI
The Brain
Watch and understand a video about the brain, watch the video and complete the notes using one word for each gap, watch again and choose the correct word in the sentences below.
Reading Comprehension -Resume writing - cover letter.

TEXTBOOKS

a. Carolyn Westbrook, "Unlock Reading and Writing Skills 3 - B1 English Profile", Cambridge University Press.

REFERENCE BOOKS

1. Laxminarayana K, "English for Technical Communication", SciTech.
2. Sudha Rani D, "A Manual for English Language Laboratory", Pearson.
3. Sudha Rani D, "Advanced Communication Skills Laboratory", Pearson.

SUGGESTED SOFTWARE:

1. Cambridge Advanced Learners' English Dictionary with CD.
2. Grammar Made Easy by Darling Kindersley.
3. Punctuation Made Easy by Darling Kindersley.
4. Oxford Advanced Learner's Compass, 8th Edition.
5. DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
6. English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.

ENGINEERING PHYSICS - I LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Estimate the frequency of tuning fork and AC supply with the help of stretched strings
2. Analyze as well as compare the intensity distribution of interference and diffraction patterns
3. Draw the characteristics of electrical circuits and evaluate the dependent parameters
4. Explore and understand the applications of semiconducting devices
5. Develop skills in observation, interpretation, reasoning, predicting and questioning in order to realize new knowledge

List of Experiments: (Any Eight Experiments Compulsory)

1. Frequency of an AC supply using sonometer
2. Frequency of electrically driven tuning fork using Melde's apparatus

3. Rigidity modulus of a wire using torsional pendulum
4. Planck's constant using photocell
5. Radius of curvature of a plano-convex lens using Newton's rings setup
6. Wavelength of a source (sodium vapour lamp) using diffraction grating
7. Wavelength of a laser source using diffraction grating
8. Magnetic field along the axis of current carrying coil using Stewart and Gee's apparatus
9. Time constant of an R-C circuit (Charging and Discharging)
10. Resonant frequency and Quality factor - LCR circuit
11. Characteristics of a solar cell
12. Energy gap of the material of a p-n junction diode

TEXTBOOKS

1. Y.Aparna and K.Venkateswara Rao, "Laboratory Manual of Engineering Physics", VGS Publishers.

ENGINEERING CHEMISTRY LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Explain about the determination of alkalinity and hardness of water.
2. Examine the P^H, conductance and absorbance of copper in brass by using instrumental methods.
3. Make use of bleaching power to determine the amount of chlorine.
4. Utilize the viscometer, stalagnometer to find out the viscocity and surface tension of liquids.
5. Apply the TLC technique for the separation of mixture of compounds.

LIST OF EXPERIMENTS

1. Determination of alkalinity of water sample.
2. Estimation of hardness of water by EDTA method.
3. Determination of available chlorine in bleaching powder.
4. Determination of surface tension
5. Determination of viscosity
6. Determination of cell constant by Conductometry.
7. Determination of strength of acid by Conductometry
8. Potentiometry - Redox titration
9. Determination of strength of acid by pH metry
10. Determination of amount of Cu^{+2} in Brass sample by Colorimetry
11. Determination of Rf factor by Thin layer chromatography
12. Synthesis of Polymer (Urea – Formaldehyde resin) / Drug (Asprin)

INTRODUCTION TO PROGRAMMING LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Design algorithms to solve simple problems
2. Sketch flow charts to the algorithms.
3. Acquire syntactic familiarity with C programming language.
4. Write programs with decision-making and iterative control structures.
5. Develop programs using arrays, strings and string manipulations.

Week: 1

Problem solving Techniques: Algorithm, Properties of Algorithm, Algorithm development approaches, Flow chat development.

a) Creating a new flow charts for solving scientific problems

Assignment:

Creating a new flow charts for solving scientific problems.

Week: 2

Programming environment of C in Linux

a) Basic Commands of Linux
b) vi Editor Usage
c) Compiling and Executing a C Program

Assignment:

1. Create a new subdirectory called CSE2018.
2. Change your current working directory to CSE201811.
3. Display a listing of all the files in the working directory.

Week: 3.

a) Introduction to C Programming: Identifiers, Basic datatypes, I/O functions.

Programs

a) Write a C program to convert a string to an unsigned long integer
   Test Data and Expected Output :
   Input an unsigned number: 25
   Output: 25

b) Write a C program to convert a string to a double.
   Expected Output :
   Output= 4.00
c) Write a program in C that reads a forename, surname and year of birth and display the names and the year one after another sequentially

Expected Output :

Input your firstname: Tom
Input your lastname: Davis
Input your year of birth: 1982
Tom Davis 1982

d) Demonstration on I/O functions and variations.

Assignment:

1. Write a C program to print a block F using hash (#), where the F has a height of seven characters and width of six and five characters.

   Expected Output:

```
######
#
#
#####
#
#
#
```

2. Write a C program to print a big 'C'.

   Expected Output:

```
  ######
 ##    ##
#
#
#
#
#
 ##    ##
  ######
```

Week: 4

a) Operators:

Programs

a) Write a C program to integral quotient and remainder of a division.
b) Write a C program that accepts two item's weight (floating points' values) and number of purchase (floating points' values) and calculate the average value of the items.
   Test Data :
   Weight - Item1: 15
   No. of item1: 5
   Weight - Item2: 25
   No. of item2: 4
   Expected Output:
   Average Value = 19.444444

c) Write a C program to check Least Significant Bit (LSB) of a number is set or not.
d) Write a C program to convert decimal to binary number system using bitwise operator.
e) Demonstration on special operator.

Assignment

1. Write a C program to convert specified days into years, weeks and days.
   Note: Ignore leap year.

   Test Data :
   Number of days : 1329
   Expected Output :
   Years: 3
   Weeks: 33
   Days: 3

2. Write a C program to read an amount (integer value) and break the amount into smallest possible number of bank notes.
   Test Data :
   Input the amount: 375
   Expected Output:
   There are:
   3 Note(s) of 100.00
   1 Note(s) of 30.00
   1 Note(s) of 20.00
   0 Note(s) of 10.00
   1 Note(s) of 5.00
   0 Note(s) of 2.00
   0 Note(s) of 1.00

3. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".
   Test Data :
   Input the first integer: 25
   Input the second integer: 35
   Input the third integer: 15
   Input the fourth integer: 46
   Wrong values

Week: 5

Expressions, Type conversion, precedence & associatively

Programs

a) Demonstration on expression evaluation.
b) Demonstration on type conversion.
c) Demonstration on precedence & associatively rules.

Assignment

Week: 6.

Decision making and branching statements simple if, if else.

Programs

a) Write a C program to check a given integer is positive even, negative even, positive odd or negative odd. Print even if the number is 0.
Test Data :
Input an integer: 13
Expected Output:
Positive Odd

b) Write a C program to check whether the given year is leap or not.

c) Write a C program to check whether the given number is even or odd.

d) Write a C program to read the age of a candidate and determine whether he/she is eligible for casting his/her own vote.
Test Data : 21
Expected Output :
Congratulation! You are eligible for casting your vote.

Assignment

1. If cost price and selling price of an item is input through the keyboard, write a program to determine whether the seller has made profit or incurred loss. Also determine how much profit he made or loss he incurred.
2. Write a program to calculate overtime pay of 10 employees. Overtime is paid at the rate of Rs. 12.00 per hour for every hour worked above 40 hours. Assume that employees do not work for fractional part of an hour.

Week: 7

If else ladder, nested if, switch-case statement

Programs

a) Write a C program that reads an integer between 1 and 12 and print the month of the year in English.
Test Data :
Input a number between 1 to 12 to get the month name: 8
Expected Output:
August

a) Write a C program to find the largest of three numbers.
Test Data : 12 25 52
Expected Output :
1st Number = 12, 2nd Number = 25, 3rd Number = 52
The 3rd Number is the greatest among three

b) Write a C program to check whether a character is an alphabet, digit or special character.
Test Data :
@
Expected Output :
This is a special character

c) Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
Test Data :
1
5
Expected Output :
The area is : 78.300000

d) Write a C program to create Simple Calculator using switch case.

Assignment

1. Write a C program to read the value of an integer m and display the value of n is 1 when m is larger than 0, 0 when m is 0 and -1 when m is less than 0.
   Test Data : -5
   Expected Output :
   The value of n = -1
2. Write a C program to find the eligibility of admission for a professional course based on the following criteria:

Marks in Maths >=65
Marks in Phy >=55
Marks in Chem>=30
Total in all three subject >=180
or
Total in Math and Subjects >=140
Test Data :
Input the marks obtained in Physics :65
Input the marks obtained in Chemistry :51
Input the marks obtained in Mathematics :72
Expected Output :
The candidate is eligible for admission.

3. An Insurance company follows following rules to calculate premium.
   (1) If a person's health is excellent and the person is between 25 and 35 years of age and lives in a city and is a male then the premium is Rs. 4 per thousand and his policy amount cannot exceed Rs. 2 lakhs.
   (2) If a person satisfies all the above conditions except that the sex is female then the premium is Rs. 3 per thousand and her policy amount cannot exceed Rs. 1 lakh.

(3) If a person's health is poor and the person is between 25 and 35 years of age and lives in a village and is a male then the premium is Rs. 6 per thousand and his policy cannot exceed Rs. 10,000.

(4) In all other cases the person is not insured.
Write a program to output whether the person should be insured or not, his/her premium rate and maximum amount for which he/she can be insured.

Week: 8

a) Decision making and looping statements while, do... while

Programs

a) Write a C program to print 3 numbers in a line, starting from 1 and print n lines. Accept number of lines (n, integer) from the user.
Test Data :
Input number of lines: 5
Expected Output:
1 2 3
4 5 6
7 8 9
10 11 12
13 14 15

b) Write a C program to print a number, it's square and cube in a line, starting from 1 and print n lines. Accept number of lines (n, integer) from the user.
Test Data :
Input number of lines: 5
Expected Output:
1 1 1
2 4 8
3 9 27
4 16 64
5 25 125

c) Write a program in C to display the first n terms of Fibonacci series.
Fibonacci series 0 1 1 2 3 5 8 13 .....
Test Data :
Input number of terms to display : 10
Expected Output :
Here is the Fibonacci series upto to 10 terms :
0 1 1 2 3 5 8 13 21 34

d) Write a program in C to check whether a number is a palindrome or not.
Test Data :
Input a number: 121
Expected Output :
121 is a palindrome number.

e) Programs on special operator

Assignment

1. Write a c program to find the perfect numbers within a given number of range.
   Test Data :
   Input the starting range or number : 1
   Input the ending range of number : 30
   Expected Output :
   The Perfect numbers within the given range : 6 28

2. Write a program to print out all Armstrong numbers between 1 and 300. If sum of cubes of each digit of the number is equal to the number itself, then the number is called an Armstrong number. For example, 153 = (1 * 1 * 1) + (5 * 5 * 5) + (3 * 3 * 3).
3. Write a program in C to make such a pattern like a pyramid with an asterisk.

```
   *
  * *
 * * *
* * * *
```

Week: 9

For loops, unconditional statements – go to break and continue.

Programs

a) Write a program in C to find the number and sum of all integer between 100 and 200 which are divisible by 9.
   Expected Output :
   Numbers between 100 and 200, divisible by 9 :
   108 117 126 135 144 153 162 171 180 189 198
   The sum : 1683

b) Write a C program to check whether a number is a Strong Number or not.
   Test Data :
   Input a number to check whether it is Strong number: 15
   Expected Output :
   15 is not a Strong number.

c) Write a program in C to convert decimal number to binary number.

d) Demonstration on unconditional statements.

Assignment:

1. Write a C program to print all numbers between 1 to 100 which divided by a specified number and the remainder will be 3.
   TestData :
   Inputan integer: 25
   Expected Output:
   3
   28
   53
   78

2. Write a C program to check whether a number is a Strong Number or not.
   Test Data :
   Input a number to check whether it is Strong number: 15
   Expected Output :
   15 is not a Strong number.

Week: 10

Arrays: single dimensional array

Programs

a) Write a program which performs the following tasks:
   − initialize an integer array of 10 elements in **main( )**
   − multiply each element of array by 3
b) Write a C program to put even and odd elements of array in two separate array.
c) Write a C program to search an element in an array.
d) Write a C program to delete an element from an array at specified position.
e) Write a C program to count total number of duplicate elements in an array

Assignment

1. Write a C program to read and print the elements of an array of length 5, before print, put the triple of the previous position starting from the second position of the array.
   For example, if the first number is 2, the array numbers must be 2, 6, 18, 54 and 162
   Test Data:
   Input the first number of the array: 5
   Expected Output:
   n[0] = 5
   n[1] = 15
   n[2] = 45
   n[3] = 135
   n[4] = 405

2. Maze Problem- Write a C program to check wheather there is a path form starting point to ending point.

Week: 11

a) Two-dimensional Arrey

Programs

a) Write a program to pick up the largest number from any 5 row by 5 column matrix.
b) Write a C program that uses functions to perform the following:
   i) Addition & Multiplication of 2 matrices

Assignment

1. The partially initialized array "table" can be viewed as a primitive spreadsheet, in which the last column and bottom row have been left blank. Write the code to fill in this row and column with the totals of each column, each row, and the grand total.

1	2	3	4	5	
2	4	6	8	10	
20	10	5	3	1	
3	6	9	12	15	

Week: 12

String Handling

Programs:

a) Write a C program to find length of a string.
b) Write a C program to copy one string to another string.
c) Write a C program to concatenate two strings.
d) Write a C program to compare two strings.
e) Write a C program to determine if the given string is a palindrome or not.
f) Write a C program to demonstrate all string handling functions.

Assignment:

1. Write a program in C to find maximum occurring character in a string.

Test Data :
Input the string : Welcome to Bheemaram
Expected Output :
The Highest frequency of character 'e'
appears number of times : 4

2. Write a program in C to read a sentence and replace lowercase characters by uppercase and vice-versa.

Test Data :
Input the string : This Is A Test String.
Expected Output :
The given sentence is : This Is A Test String.
After Case changed the string is: tHIS iS a tEST sTRING.

3. Write a program that replaces two or more consecutive blanks in a string by a single blank. For example, if the input is Grim return to the planet of apes!!

the output should be
Grim return to the planet of apes!!

Week: 13

b) Storage classes

Programs

- **a)** Write a C program to demonstrate the visibility level of auto variables.
- **b)** Write a C program to demonstrate the visibility level of static variables.
- **c)** Write a C program to demonstrate the visibility level of register variables.

Assignment

1. Output of following programs?

```
#include <stdio.h>
int main()
{
   static int i=5;
   if(--i){
      main();
      printf("%d ",i);
   }
}
#include <stdio.h>
int main()
{
  int x = 10;
  static int y = x;

  if(x == y)
    printf("Equal");
  else if(x > y)
    printf("Greater");
  else
    printf("Less");
  return 0;
}
#include <stdio.h>
int main()
{
   static int i=5;
   if (--i){
      printf("%d ",i);
      main();
   }
}
```

ENGLISH - II

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Understand and effectively apply the steps in the writing process.
2. Build unified, coherent and adequately developed paragraphs.
3. Adapt writing goals and styles to various audiences to achieve appropriate writing style and content.
4. Identify syntax.
5. Collect and process the information in a specific discipline and use editing and revising techniques to improve writing quality.

UNIT I

Introduction to Academic Writing

Introduction, types, features, responsive reading, reading with a purpose, critical reading and analysis, developing academic writing, academic honesty, plagiarism.

UNIT II

Elements of the Essay

Structure **-** crafting sentences, clauses and phrases, grammatical sentence types, rhetorical sentence types, writing longer sentences, punctuation, expletive constructions, Style-principles of plain style, Vocabulary-task analysis: direction words, choosing specific and concrete words, Evidence, Analysis, Sources-writing introductions and conclusions, pre-draft response, writing the draft, editing and proof reading.

UNIT III

Tertiary Essay Writing

Time management, choosing and narrowing topics, coherent and grammatically correct sentences, production of original and organized compositions, brainstorming, researching the topic, revising the plan.

UNIT IV

Compare and Contrast Essay

Setting, early thoughts develop clarity and focus, planning, significant differences; pose analytical questions, topic sentences and paragraph structures, sample essay.

UNIT V

Exploratory Essay

Value of exploratory writing, knots and questions, practicing exploratory writing, making meanings, organizing an exploratory essay, sample essay in exploratory form.

UNIT VI

Argumentative Essay

Organizing an argumentative essay, drafting a thesis statement, constructing a sentence outline, clarification strategies, metadiscourse and programmatic statements, transitional expressions, definitions, composing titles, comparing the argument essay and the exploratory essay, sample essay in argument form.

TEXT BOOKS

1. Matthew Parfitt.2016. "Writing in Response", Bedford/ St.martin's, Macmillan Education, Boston, Newyork.
2. Bailey.S. 2015."Academic Writing: A Hand book for International students", London and Newyork: Routledge.

REFERENCE BOOKS

1. Murray, N.2012."Writing Essays in English Language and Linguistics", Cambridge University Press.
2. Oshima ,A. & Hogue,A. 2005."Writing Academic English", Addison-Wesley, Newyork.
3. Craswell, G.2004."Writing for Academic Success," Sage Publications.
4. Jordan, R.R.1999." Academic Writing Course", London: Nelson/ Longman.

MATHEMATICS - II

COURSE OUTCOMES

At the end of the course the student should be able to:

1. Apply the methods of solving higher order linear differential equations to solve some real world problems.
2. Apply the Knowledge of Matrices, Eigenvalues and Eigen Vectors in problems involving Science and Engineering
3. Develop Fourier series for different types of functions.
4. Understand the notion of functions of several variables and discuss their maxima & minima.
5. Evaluate the double & triple integrals in a given region of integration by various techniques.

UNIT I

Linear Differential Equations of Higher Order

Introduction: Second-Order Linear Equations - General Solutions of Linear Equations - Homogeneous and Non homogeneous Equations with Constant Coefficients - Applications: Mass Spring Systems - Electrical Circuits.

UNIT II

Functions of Several Variables

Parametrizations of Plane Curves - Calculus with Parametric Curves - Polar Coordinates - Graphing Polar Coordinate Equations - Areas and Lengths in Polar Coordinates. - Functions of Several Variables - Limits and continuity - Partial derivatives - The Chain Rule - Tangent planes and

Differentials – Taylor's Formula for Two Variables - Extreme values and saddle points – Lagrange Multipliers.

UNIT III

Fourier Series

Definition of Fourier series - Dirichlet conditions - Fourier series of functions defined in $[0,2\pi]$ - Fourier series of Even and Odd functions - Half range Fourier sine and cosine series - Fourier series in arbitrary intervals.

UNIT IV

Multiple Integrals

Double and Iterated Integrals over Rectangles - Double Integrals over General Regions - Area by Double Integration - Double Integrals in Polar Form - Triple Integrals in Rectangular Coordinates – Triple Integrals in Cylindrical and Spherical Coordinates.

UNIT V

Linear Algebra I

Types of Matrices – Real and Complex Matrices - Rank of a Matrix - Linear Systems of Equations - Solutions of Linear Systems – Inverse of a Matrix: Gauss-Jordan method.

UNIT VI

Linear Algebra II

Symmetric, Skew-Symmetric, and Orthogonal Matrices – Eigen values, Eigen vectors – properties of Eigen values and Eigen vectors – Cayley-Hamilton theorem (without proof) – Inverse and Powers of a Matrix.

TEXT BOOKS

1. Thomas' Calculus: Early Transcendentals, Joel R. Hass, Davis, Christopher E. Heil, Maurice D. Weir, Pearson publications.
2. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers, Delhi.

REFERENCES

1. Elementary Differential Equations, C. Henry Edwards, David E. Penney, Prentice Hall.
2. Erwin kreyszig, "Advanced Engineering Mathematics", John wiley & sons, 605 Third Evenue, New York.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", Cl-Engineering.

ENGINEERING PHYSICS - II

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Understand and apply the fundamentals of quantum mechanics to microscopic particles
2. Recognize the role of defects in physical properties of crystals and analyze crystal structure using X-ray diffraction
3. Elucidate the basis for classification of dielectric and magnetic materials and their related concepts
4. Apply the knowledge acquired from basics of materials science to realize devices with better performance and smaller in size
5. Explore connections between theory and applications

UNIT I

Quantum Mechanics

Classical mechanics and its limitations, de Broglie hypothesis, Matter waves, Davisson-Germer experiment, Heisenberg’s uncertainty principle, Schrodinger time independent wave equation, Physical significance and properties of wave function, Particle in one dimensional box, Tunnelling effect (qualitative) – Applications

UNIT II

Band Theory of Solids

Introduction, Motion of electron in a periodic potential-Bloch theorem, Kronig-Penny model (qualitative)-origin of energy bands in solids, Velocity and effective mass of an electron, Classification of solids-conductors, semiconductors and insulators, Direct and indirect band gap of semiconductors

UNIT III

Crystallography

Introduction, Unit cell, Crystal systems and Bravais lattices, Crystal planes and Miller indices, Interplanar spacing of orthogonal crystal systems, Crystal defects-classification, Effect of crystal defects on physical properties, X-ray diffraction-Bragg’s law, Debye-Scherrer method, Applications of X-ray diffraction

UNIT IV

Dielectric Properties

Introduction, Polarization mechanisms-electronic, ionic, orientation and space charge polarizations (qualitative), Dielectric relaxation, Piezo-electricity-production and detection of ultrasonics by piezo-electric effect, Applications of ultrasonics, Pyro-electricity, Ferro-electricity-hysteresis, Applications of dielectric materials

UNIT V

Magnetic Properties

Introduction, Origin of magnetic moment, Classification and characteristics of magnetic materials, Domain theory of ferromagnetism-hysteresis, Soft and hard magnetic materials, Magnetostrictive effect, Applications of magnetic materials, Superconductivity-Meissner effect, Type I & II superconductors, High T_c superconductors, Applications

UNIT VI

Nanomaterials

Introduction, Surface area to volume ratio, Quantum confinement, Classification of nanomaterials (1D, 2D, 3D), Properties of nanomaterials, Types and properties of carbon nanotubes, Top-down fabrication - Ball milling method, Bottom-up fabrication - Sol-gel method, Characterization of nanomaterials: X-ray diffractometer (XRD)-Determination of particle size, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) and Atomic Force Microscope (AFM), Applications of various nanomaterials

TEXT BOOKS

1. M.N. Avadhanulu & P.G. Kshirsagar, “A Text book of Engineering Physics”, S. Chand & Company Ltd., Tenth Revised Edition – 2013.
2. P.K. Palanisamy, “Engineering Physics”, SciTech Publications, India (P) Ltd., Third Edition - 2013.

REFERENCE BOOKS

1. S.O. Pillai, “Solid State Physics”, New Age International (P) Ltd., Sixth Edition – 2010.
2. R.K. Gaur & S.L. Gupta, “Engineering Physics”, Dhanpat Rai Publications (P) Ltd., Eighth Edition – 2001 (Reprint – 2008).
3. A.J. Dekker, “Solid State Physics”, Mac Millan India Ltd.
4. B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath & J. Murday, “Textbook of Nanoscience and Nanotechnology”, Universities Press, First Edition – 2013.

PROBLEM SOLVING WITH PROGRAMMING

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Analyze and implement software development tools like algorithm, pseudo codes and programming structure.
2. Modularize the problems into small modules and then convert them into modular programs
3. Apply the pointers, memory allocation techniques and use of files for dealing with variety of problems.
4. Apply C programming to solve problems related to scientific computing.
5. Develop efficient programs for real world applications.

UNIT I

Pointers

Basics of pointers, pointer to array, array of pointers, void pointer, pointer to pointer- example programs, pointer to string.

Project: Simple C project by using pointers.

UNIT II

Structures

Basics of structure in C, structure members, accessing structure members, nested structures, array of structures, pointers to structures - example programs, Unions- accessing union members- example programs.

Project: Simple C project by using structures/unions.

UNIT III

Functions

Functions: User-defined functions, categories of functions, parameter passing in functions: call by value, call by reference, recursive functions. Passing arrays to functions, Passing strings to functions, passing a structure to a function.

Project: Simple C project by using functions.

UNIT IV

File Management

Data Files, Opening and Closing a Data File, Creating a Data File, Processing a Data File, Unformatted Data Files.

Memory Management

Memory Management: Dynamic memory allocation and deallocation functions:- malloc , calloc, realloc and free.

Project: Simple C project by using files.

UNIT V

Low-Level Programming, Register Variables, Bitwise Operations, Bit Fields

Pre-processor Directives

Additional Features of C, Enumerations, Command Line Parameters, More About Library Functions, Macros, The C Preprocessor. Pre-processor directives: Typedef, #define, #undef, #if,#endif,#elif, #ifdef, #ifndef, #error.

UNIT VI

Basic of C++ Programming:

Introduction to C++. Differences between C and C++, C++ Program Structure, Disadvantage of Conventional Programming, data types, variables, scope and life time of variables, operators, expressions, and control statements. Arrays, Strings, Functions. Basics concepts of OOPs

TEXT BOOKS

1. Computer Science: A Structured Programming Approach Using C- B. A. Forouzan and R.F. Gilberg, Third Edition, Cengage Learning'
2. B.W.Kernighan Dennis M. Ritchie, The C Programming Language, PHI/Pearson Education,ISBN:0-13-110362-8

REFERENCE BOOKS

1. "The spirit of C: an Introduction to Modern Programming" by Henry Mulish Cooper.
2. C Programming: A Modern Approach by K.N. King .
3. Let us C by Yashwant Kanetkar. 13th edition, BPB Publications
4. Computer science a structured programming approach using C by Pradeep K.Sinha, Priti Sinha, 3rd edition, Thomson publications.

ENGINEERING PHYSICS - II LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Realize the concept of forced oscillations with the help of electrical circuits
2. Analyze as well as compare the intensity distribution in optical phenomena and their related applications
3. Draw the characteristics of electrical circuits and evaluate the dependent parameters
4. Explore and understand the applications of semiconducting devices
5. Develop skills in observation, interpretation, reasoning, predicting and questioning in order to realize new knowledge

List of Experiments: (Any Eight Experiments Compulsory)

1. Frequency of electrically driven tuning fork using Melde's apparatus
2. Resonant frequency and quality factor - LCR circuit
3. Time constant of an R-C circuit (Charging and Discharging)
4. Magnetic field along the axis of current carrying coil using Stewart and Gee's apparatus
5. Resolving power of diffraction grating
6. Radius of curvature of a plano-convex lens using Newton's rings setup

7. Numerical aperture of an optical fiber
8. Bending losses of an optical fiber
9. Quantum states using PhET simulations
10. Planck’s constant using photocell
11. Energy gap of the material of a p-n junction diode

TEXT BOOKS

1. D.C. Tayal, “University Practical Physics”, Himalaya Publishing House.
2. Y.Aparna and K.Venkateswara Rao, “Laboratory Manual of Engineering Physics”, VGS Publishers.

PROBLEM SOLVING WITH PROGRAMMING LAB

COURSE OUTCOMES
At the end of the course, the students will develop ability to

1. Analyze and implement software development tools like algorithm, pseudo codes and programming structure.
2. Modularize the problems into small modules and then convert them into modular programs
3. Apply the pointers, memory allocation techniques and use of files for dealing with variety of problems.
4. Apply C programming to solve problems related to scientific computing.
5. Develop efficient programs for real world applications.

Week 1

1. Compute sum of the array elements using pointers !
2. Write a C program to find the sum of all elements of an array using pointers as arguments.
3. Write a C program to convert a Floating Point Number base(10) to binary number.

Week 2

1. Access Elements of an Array Using Pointer
2. C Program Swap Numbers in Cyclic Order Using Call by Reference
3. Find Length of the String using Pointer
4. Program to read integers into an array and reversing them using pointers

Week 3

1. Add Two Numbers Using Pointer !
2. Calculate Size of Pointer in C Programming
3. Difference between two float Pointers
4. Difference between two integer Pointers

Week 4 - Structures

1. write a C program for defining a structure of bank customer details.(account number , acc holder name, acctype, balance)
2. Write a C program to Demonstrate Elecricity Bill of One Year.
3. Write the Programs using structures and Unions

Week 5- Structures

1. Store Information(name, roll and marks) of a Student Using Structure
2. Add Two Distances (in inch-feet) System Using Structures
3. Add Two Complex Numbers by Passing Structure to a Function
4. Calculate Difference Between Two Time Period
5. Store Information of 10 Students Using Structure
6.

Week 6 - Functions

1. Write the programs using functions

2. Display all prime numbers between two Intervals
3. Check Prime and Armstrong Number by making function
4. Check whether a number can be expressed as the sum of two prime number
5.

Week 7 - Functions

1. Find sum of natural numbers using recursion
2. Calculate factorial of a number using recursion
3. Find G.C.D using recursion
4. Reverse a sentence using recursion
5.

Week 8 - Functions

1. Calculate the power of a number using recursion
2. Convert binary number to decimal and vice-versa
3. Convert octal Number to decimal and vice-versa
4. Convert binary number to octal and vice-versa

Week 9 - Files

1. Read name and marks of students and store it in file
2. Read name and marks of students and store it in file. If file already exists, add information to it.
3. Write members of arrays to a file using fwrite()
4. Write a C program which copies one file to another.
5. Program to Write a Sentence to a File
6. Program to Read a Line From a File and Display it

Week 10 – Memory Management

1. Find Largest Number Using Dynamic Memory Allocation
2. Store Information Using Structures with Dynamically Memory Allocation.
3. Write C++ Programs using Basic concepts Like data types,operators etc.
4. Write C++ programs using Loops and Conditional Statements.

Week 11 & 12

Project using C

DISCRETE MATHEMATICAL STRUCTURES - I

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Analyze the problem and identify the structures required to generate the mathematical solution.
2. Apply the mathematical logic, predicate rules to design an abstract system for theorem proof.
3. Apply counting techniques to solve the recurrence relations.
4. Solve problems involving recurrence relations and generating functions.
5. Apply the concepts of Graph Theory in solving practical engineering problems

UNIT I

Mathematical Logic

Statements and notations, Connectives, Well formed formulas, Truth Tables, tautology, equivalence implication, Normal forms.

Predicates

Predicative logic, Free and Bound variables, Rules of inference, Consistency, proof of contradiction.

UNIT II

Set Theory

Introduction, Sets and Elements, Subsets, Venn Diagrams, Set Operations, Power Sets, Partitions

Relations

Introduction, Product Sets, Relations, Pictorial Representatives of Relations, Composition of Relations, Types of Relations, Closure Properties, Equivalence Relations, compatibility and Partial Ordering Relations

UNIT III

Ordered Sets

Ordered Sets, Hasse Diagrams of Partially Ordered Sets, Supremum and Infimum, Isomorphic (Similar) Ordered Sets, Well-Ordered Sets, Lattices and its Properties

Functions: Introduction, Functions, One-to-One, Onto and Bijective Functions, Invertible Functions, Recursive Functions.

UNIT IV

Techniques of Counting

Introduction, Basic Counting Principles, Permutations, Combinations, The Pigeonhole Principle and its applications, The Inclusion–Exclusion Principle, Combinations with Repetitions, Binomial and Multinomial Theorems

UNIT V

Recurrence Relation

Generating Functions, Function of Sequences Calculating Coefficient of generating function, Recurrence relations, Solving recurrence relation by substitution and Generating functions.

UNIT VI

Graph Theory

Representation of Graph, Basic Concepts, Basic types of Graphs and their properties, types of paths, Isomorphism and Sub graphs, Multi graphs, Euler circuits, Hamiltonian graphs, Chromatic Numbers, DFS, BFS, Trees, Spanning Trees, Planar Graph, Prim's and Kruskal's Shortest Path

TEXT BOOKS

1. Seymour Lipschutz, Lipson Marc, "Discrete Mathematics", Tata Mcgraw Hill, ISBN-100070669120
2. Trembly J.P. and Manohar .P, "Discrete Mathematical Structures with Applications to computer Science", TMH,ISBN-10: 0074631136

REFERENCE BOOKS

1. Ralph. P.Grimaldi "Discrete and Combinational Mathematics- An Applied Introduction", 5th Edition Pearson Education,ISBN:9780201726343
2. BernandKolman, Roberty C. Busby, Sharn Cutter Ross, "Discrete Mathematical Structures", Pearson Education / PHI.
3. J.L. Mott, A. Kandel, T.P. "Discrete Mathematics for Computer Scientists and Mathematicians", Baker Prentice Hall.

WEB LINKS

1. http://nptel.iitm.ac.in
2. http://www.math.northwestern.edu/~mlerma/courses/cs310-05s/
3. http://highered.mheducation.com/sites/0073383090/student_view0/applications_of_discrete_mathematics.html
4. http://www.mhhe.com/math/advmath/rosen/r5/student/ch01/weblinks.html

MICROPROCESSORS AND MICROCONTROLLERS

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Outline the history of computing devices (remember)
2. Describe the architecture of 8086 microprocessor (understand)
3. Develop assembly level programs for microprocessor and microcontroller (apply)
4. Compare between microprocessors and microcontrollers (analyze)
5. Design and implement microcontroller-based embedded system (create)

UNIT I

Introduction: Evolution of Microprocessors, 8085 MPU architecture.

8086 Family Architecture: Organization of 8086 CPU, Concept of Memory Segmentation, Physical and logical addressing, Addressing Modes, Instruction set: Data transfer, arithmetic, logical, string and control transfer instructions.

UNIT II

Assembly Language Programming

Assemble directives, simple Assembly language Programming of 8086 ondata transfer, arithmetic, logical, string and branching. Procedures, macros, time delays, Assembly Language Development tools(Linker ,Loader Debugger etc)

UNIT III

Interfacing With 8086

8255 PPI, interfacing, interfacing of switches, LEDs, ADC, DAC and Stepper motor. Interrupt structure of 8086, 8259 PIC, need for DMA, 8257 DMA Controller.

UNIT IV

8051 Microcontroller

8051 Architecture, pin diagram, addressing modes, instruction set: data transfer, arithmetic, logical, control transfer instructions. Assembly language Programming.

UNIT V

8051 Microcontroller

Timers and counter, Programing Timers and counters I/O ports, Serial port, Interrupts and Interrupts Programing in Assembly Language

UNIT VI

Interfacing: LEDs, switches, LCD, 7 Segment display and keyboard

TEXT BOOKS

1. D.V. Hall, "Microprocessors and Interfacing", TMGH, 2nd Edition, 2006,
2. Muhammed Ali Mazidi, "The 8051 Microcontrollers and Embedded Systems", Pearson, New Delhi.

REFERENCE BOOKS

1. A.K. Ray and K.M. Bhurchandani, "Advanced Microprocessors and Peripherals", TMH, 2nd Edition, 2006.
1. Kenneth J Ayala, "The 8051 Microcontroller", Cengage Learning, 3rd Edition.
2. Brey, "Advanced Microprocessors", Prentice Hall of India, New Delhi.

SMART SYSTEM DESIGN

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Understand, illustrate and apply the system design process to address a need
2. Create a smart system design using system design principles.
3. Select appropriate sensors and actuators based on the design requirements
4. Estimate the power requirements for circuits
5. Implement a complete smart system using Arduino Microcontroller

UNIT I

Introduction to Systems Thinking

Definition of System, Design, User, Needs, Tasks and Environment. Relation between User, needs, tasks and environment. Need statement.

UNIT II

System Design

Introduction to Smart system design, Key elements of Smart system design, Architectural design – System structure and behavior,

Logical design-Abstract representation of data flow, inputs and outputs,

Physical design-Verification of input, output and process requirements.

UNIT III

Arduino Microcontroller

Introduction to Arduino controller, Block diagram, pin map, Arduino programming. Signal Processing and Conditioning: Rectifiers, Filters, Regulators, Amplifying signals using OP Amps.

UNIT IV

Sensors

Characteristics of Sensors – Static and Dynamic, Classification – Analog Sensors (Force, displacement, temperature, LDR), Digital Sensors (Photo sensors, proximity sensor),

UNIT V

Mechanical Drives

Gears, Belt and Chain Drives, Bearings. Selection of Mechanical

Electrical Actuation systems

Relays, Solenoids, Solid State Switches – Diodes, Transistors, Thyristors and Triacs, fundamentals of DC and AC Motors, Stepper motor. Speed, position and direction control of motors.

UNIT VI

Project Testing and validation –Defining the test protocol. Product validation. Product delivery. Product Documentation

TEXT BOOKS

1. Clarence de Silva, "Sensors and Actuators. CRC Press. 2016.
2. W. Bolton, " Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering. Pearson Education Asia.

REFERENCE BOOKS

1. D. Patranabi. Sensors and Transducers. PHI Learning. 2003.
2. Alciatore and Histand. Introduction to Mechatronics and Measurements. Tata McGraw Hill. 2012.

DATA STRUCTURES

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Explain how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms.
2. Compare and contrast the benefits of dynamic and static data structures implementations.
3. Develop and Evaluate programs that use arrays, records, linked structures, stacks, queues, trees and graphs.
4. Demonstrate different methods for traversing trees.
5. Design and implement an appropriate hashing function for an application.
6. Discuss the computational efficiency of the principal algorithms for sorting, searching and hashing.

UNIT I

Basic Concepts of Data Structures: Data objects and Structures, Algorithm Specification-Introduction, Recursive algorithms, Data Abstraction, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega and Theta notations, Complexity Analysis Examples, Introduction to Linear and Non-Linear data structures.

Representation of single, two-dimensional arrays, sparse matrices-array and linked representations.

UNIT II

Linear list ADT-array representation and linked representation, Singly Linked Lists-Operations-Insertion, Deletion, Circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists-Operations- Insertion, Deletion.

Stack ADT, definition, array and linked implementations, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue ADT, definition, array and linked Implementations, Circular queues-Insertion and deletion operations.

UNIT III

Trees – definition, terminology, Binary trees-definition, Properties of Binary Trees, Binary Tree ADT, representation of Binary Trees-array and linked representations, Binary Tree traversals, Threaded binary trees, Priority Queues –Definition and applications, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap.

UNIT IV

Searching - Linear Search, Binary Search, Hashing-Introduction, hash tables, hash functions, Overflow Handling, Comparison of Searching methods.

Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Merge sort, Comparison of Sorting methods.

UNIT V

Graphs–Definitions, Terminology, Applications and more definitions, Properties, Graph ADT, Graph Representations- Adjacency matrix, Adjacency lists, Graph Search methods - DFS and BFS, Complexity analysis,

UNIT VI

Search Trees-Binary Search Tree ADT, Definition, Operations- Searching, Insertion and Deletion, Balanced search trees-AVL Trees-Definition and Examples only, B-Trees- Definition and Examples only, Red-Black Trees-Definitions and Examples only, Comparison of Search Trees.

TEXT BOOKS

1. Data structures, Algorithms and Applications in C++, 2nd Edition, Sartaj Sahni, Universities Press.
2. Data structures and Algorithms in C++, Adam Drozdek, 4th edition, Cengage learning.

REFERENCE BOOKS

1. Data structures with C++, J. Hubbard, Schaum's outlines, TMH.
2. Data structures and Algorithms in C++, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.
3. Data structures and Algorithm Analysis in C++, 3rd edition, M. A. Weiss, Pearson.
4. Classic Data Structures, D. Samanta, 2nd edition, PHI.

DIGITAL LOGIC DESIGN

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Discuss fundamental concepts in the design of digital circuits and systems.
2. Discuss and have a working knowledge of Boolean algebra and its application to combinational logic circuits.
3. Manipulate and design basic combinational operators (and, or, not, etc) and sequential circuits.
4. Manipulate and design combination of operators to form higher level functions (multiplexer, counter) and memory element (flip-flop).
5. Explain the basic components of the Von Neumann computer architecture.
6. Prepare and make professional presentations relevant to the course material.

UNIT I

Digital Systems and Binary Numbers

Digital Systems, Binary Numbers, Binary Numbers, Octal and Hexadecimal Numbers, Complements of Numbers, Complements of Numbers, Signed Binary Numbers, Arithmetic addition and subtraction

UNIT II

Concept of Boolean algebra

Basic Theorems and Properties of Boolean algebra, Boolean Functions, Canonical and Standard Forms, Minterms and Maxterms,

UNIT III

Gate level Minimization

Map Method, Two-Variable K-Map, Three-Variable K-Map, Four Variable K-Maps. Products of Sum Simplification, Sum of Products Simplification, Dont Care Conditions, NAND and NOR Implementation, Exclusive? OR Function

UNIT IV

Combinational Logic

Introduction, Analysis Procedure, Design Procedure, Binary Adder Subtractor, Decimal Adder, Binary Multiplier, Decoders, Encoders, Multiplexers, HDL Models of Combinational Circuits

UNIT V

Synchronous Sequential Logic

Introduction to Sequential Circuits, Storage Elements: Latches, Storage Elements: Flip?Flops, Analysis of Clocked Sequential Circuits, Mealy and Moore Models of Finite State Machines

UNIT VI

Registers and Counters

Registers, Shift Registers, Ripple Counters, Synchronous Counters, Ring Counter, Johnson Counter, Ripple Counter

TEXT BOOKS

1. Digital Design, 5/e, M.Morris Mano, Michael D Ciletti, PEA.
2. Fundamentals of Logic Design, 5/e, Roth, Cengage.

REFERENCE BOOKS

1. Digital Logic and Computer Design, M.Morris Mano, PEA.
2. Digital Logic Design, Leach, Malvino, Saha, TMH.
3. Modern Digital Electronics, R.P. Jain, TMH.

MICROPROCESSORS AND MICROCONTROLLERS LAB

COURSE OUTCOMES

1. Write assembly level programs on arithmetic operations using various addressing modes.
2. Apply the concepts of assembly level programming on sorting and code conversions.
3. Design interfacing of various I/O devices to microprocessor.
4. Apply the concept of serial communication for transmission of serial data.
5. Verify the ports, timers, and interrupts operation in 8051 microcontrollers.
6. Design and implement microcontroller-based embedded system.

LIST OF EXPERIMENTS

I. Microprocessor 8086

1. Introduction to Assembler.
2. Arithmetic operation – Multi byte Addition and Subtraction, Multiplication and Division – Signed and unsigned Arithmetic operation, ASCII – arithmetic operation.
3. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
4. By using string operation and Instruction prefix: Move Block, Reverse string, Sorting, Inserting, Deleting, Length of the string, String comparison.
5. DOS/BIOS programming: Reading keyboard (Buffered with and without echo) – Display characters, Strings.

II. Interfacing

1. ADC/DAC 2. Stepper Motor 3. Traffic Light 4. Keyboard

III. Microcontroller 8051

1. Programming on arithmetic operations
2. Reading and writing on a parallel port.
3. Timer in different modes
4. Serial communication implementation.
5. Interfacing: switches, LEDs, LCD.

DATA STRUCTURES LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms.
2. Compare and contrast the benefits of dynamic and static data structures implementations.
3. Develop and Evaluate programs that use arrays, records, linked structures, stacks, queues, trees and graphs.
4. Demonstrate different methods for traversing trees.
5. Design and implement an appropriate hashing function for an application.
6. Discuss the computational efficiency of the principal algorithms for sorting, searching and hashing.

Write a C++ programs to implement recursive and non recursive i) Linear search ii) Binary search

Write a C++ programs to implement

i. Bubble sort
ii. Selection sort
iii. Quick sort
iv. insertion sort

Write a C++ programs to implement the following using an array.

1. Stack ADT b) Queue ADT

Write a C++ programs to implement list ADT to perform following operations

a) Insert an element into a list.
b) Delete an element from list
c) Search for a key element in list
d) Count number of nodes in list

Write C++ programs to implement the following using a singly linked list.
Stack ADT b) Queue ADT

Write C++ programs to implement the deque (double ended queue)
ADT using a doubly linked list and an array.

Write a C++ program to perform the following operations:
a) Insert an element into a binary search tree.
b) Delete an element from a binary search tree.
c) Search for a key element in a binary search tree.

Write C++ programs for implementing the following sorting methods:
Merge sort

Heap sort

Write C++ programs that use recursive functions to traverse the given binary tree in
a)Preorder
b) inorder and
c) postorder.
Write a C++ program to perform the following operations
a)Insertion into a B-tree
b) Deletion from a B-tree

Write a C++ program to perform the following operations
a)Insertion into an AVL-tree
b) Deletion from an AVL-tree

Write a C++ program to implement all the functions of a dictionary (ADT)

MATHEMATICS – III

COURSE OUTCOMES
At the end of the course the student should be able to:
1. Find the Laplace and Inverse Laplace transforms of a given function and apply them to solve differential equations.
2. Recognize Irrotational and Solenoidal vector fields
3. Apply various integral theorems relating line, surface and volume integrals.
4. Understand the harmonic and analytic functions and also construct the analytic function.
5. Represent a given function in Taylor's & Laurent's series along a given path and evaluate certain real integrals using integral theorems.

UNIT I
Laplace Transforms
Definition - Existence - Laplace transforms of standard functions - First & Second Shifting theorems - Change of scale property - Laplace transform of Derivatives - Integrals- functions multiplied by t - divided by t - Laplace Transform of Periodic functions.

UNIT II
Inverse Laplace Transforms
Inverse Laplace transforms by partial fractions - Inverse Laplace transforms of Derivatives - Integrals - functions multiplied by s - divided by s - Convolution theorem - Applications of Laplace transforms to Ordinary Differential Equations.

UNIT III
Vector Differentiation

Vectors - The Dot Product - The Cross Product - Lines and Planes in Space - Cylinders and Quadric Surfaces - Arc Length in Space - Curvature and Normal Vectors of a Curve - Vector Fields – Directional Derivatives - Gradient – Divergence – Curl - Vector Identities (without proofs).

UNIT IV
Vector Integration
Integral of a vector valued function – Line Integrals of Scalar Functions: Work, Circulation, and Flux - Path Independence, Conservative Fields, and Potential Functions - Green's Theorem - Surface Integrals - Stokes' Theorem - Divergence Theorem. (All theorems without proof)

UNIT V
Complex Analysis I
Analyticity – properties – Cauchy - Riemann conditions - harmonic and conjugate harmonic functions, construction of analytic function. Line integral - Cauchy's integral theorem - Cauchy's integral formula - Generalized integral formula - applications.

UNIT VI
Complex Analysis II
Radius of convergence - Expansion in Taylor's series - Maclaurin's series - Laurent series - applications. Definitions - Singular point - Isolated singular point - pole of order m - essential singularity. Residues - Evaluation of residues - Residue theorem (without proof) – applications.

TEXTBOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John wiley & sons, 605 Third Evenue, New York.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", Cl-Engineering.

REFERENCE BOOKS

1. R.K.Jain, S.R.K. Iyengar, “Advanced engineering Mathematics", Narosa publishing house, New Delhi
2. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers, Delhi.
3. J. W. Brown and R.V. Churchill, “Complex Variables and Applications”, McGraw Hill.

COMPUTER ORGANIZATION AND ARCHITECTURE

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Illustrate register transfer language using micro operations.
2. Explain Computer arithmetic, processor organization & design of control unit.
3. Comprehend memory hierarchy & organization.
4. Discuss input output devices organization, modes of transfer, pipelining and parallel processing.
5. Apply inter connection structures, arbitration, synchronization and coherence concepts to design multiprocessor system..

UNIT I

Basic Structure of Computers: Functional units, Basic operational concepts

Digital Logic Circuits: Logic Gates, Boolean algebra, Sequential Circuits, basic Map simplifications, Combinational Circuits - Decoders, Multiplexers.

UNIT II

Data Representation: Data Types, Complements, Fixed Point Representation, Floating Point Representation. Register Transfer and Microoperations: Register Transfer, Bus and Memory Transfers, Arithmetic Microoperations, Logic Microoperations, Shift Microoperations, Arithmetic Logic Shift Unit.

UNIT III

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle.

Central Processing Unit: Register Organization, Instruction Formats, Addressing Modes.

UNIT IV

Computer Arithmetic: Addition, Subtraction, Multiplication and Division Algorithm.

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access.

UNIT V

Pipelining: Arithmetic pipeline, Instruction pipeline, RISC Pipelining.

UNIT VI

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

TEXT BOOKS

1. Carl Hamacher, ZvonkoVranesic and SafwatZaky, “Computer Organization”, FifthEdition,McGraw Hill, 2002.
2. M. Morris Mano, “Computer System Architecture”, 3rd Edition, PHI / Pearson, 2006.

REFERENCE BOOKS

1. William Stallings, “Computer Organization and Architecture”, 7th Edition, PHI / Pearson, 2006.
2. David A Patterson, “Computer Architecture and Organization”, TMH.

WEB LINKS

1. http://nptel.iitm.ac.in
2. http://computerscience.jbpub.com/ecoa/2e/student_resources.cfm

OBJECT ORIENTED PROGRAMMING CONCEPTS

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. List all OOP features to design object oriented applications, and execute straight forward programs using a high level language.
2. Discuss the principles and practice of object oriented analysis and design in the construction of robust, maintainable programs which satisfy their requirements.
3. Analyze implementation, compilation, testing and run C++ programs comprising more than one class, to address a particular software problem.
4. Classify effective use of applications through inheritance, Polymorphism, Exception Handling.
5. Expertise in writing applications using templates and File Handling.
6. Learning and implementing advanced concepts like Iterators, Vectors and containers.

UNIT I

Introduction

Review of C++, data types and size supported by C++, keywords, variables, scope and life time, different types of operators, expressions, Conditional and Control statements. Arrays, strings and its handling and functions.

UNIT II

OOP Basics

Introduction to Object Oriented Programming, Class Definition, Objects, Class Members, Access Controls, Class Scope, Constructors and destructors, Inline functions, static data members and static member functions, this pointer, friend functions, dynamic memory allocation and deallocation :new and delete.

UNIT III

Polymorphism, Static Binding, Runtime Binding, Function Overloading, Operator Overloading. Virtual Functions, Pure Virtual Functions, Abstract Class.

UNIT IV

Inheritance

Inheritance basics, Protected Data with Private Inheritance, Types of Inheritances : Single Inheritance, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Multipath Inheritance, Virtual Base Classes, Constructors, Destructors, Inheritance, Object as a Class Member, Abstract Classes, Qualifier Classes And Inheritance, Constructor In Derived Class, Pointers and Inheritance, Advantages of Inheritance, Disadvantages of Inheritance

UNIT V
Exception Handling
Introduction to Exception Handling, Try, Throw and Catch, Multiple Catch Statements, Catching Multiple Exceptions. Files and streams in C++, Streams I/O.

UNIT VI
Generic Programming- Function Templates and class templates, Standard Template Library, Container Classes , Types Of Containers, Container Adaptors, Iterators.

TEXT BOOKS
1. Problem solving with C++, The OOP, Fourth edition, W.Savitch, Pearson education
2. Mastering C ++, Venugopal, Rajkumar, Ravi kumar TMH
3. C++ How To Program by Harvey Deitel, Paul Deitel, Publisher: Pearson

REFERENCE BOOKS
1. The Complete Reference, C++, 4ed, Herbert Schildt, TMH
2. Object Oriented Programming C++ , Joyce Farrell, Cengage
3. The C++ Programming Language (4th Edition) by Bjarne Stroustrup,
   Addison-Wesley ISBN 978-0321563842

OPERATING SYSTEMS

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Understand the functions and services of an operating system that are provided to user and system.
2. Apply various cpu scheduling algorithms and recognize classic synchronization problem to avoid dead locks.
3. Apply the concepts of memory management to solve the issues in real time application
4. Analyze various disk scheduling algorithms.
5. Summarize the full range of considerations in the design of file systems and security issues

UNIT I

Computer system overview-basic elements, Instruction execution, operating system overview-objectives and functions, Evolution of OS. Process description and control - process states, process description, process control; Process and threads, Types of Threads.

UNIT II

Principles of concurrency - critical section, mutual exclusion, semaphores, monitors message passing, Readers/Writers problem. Scheduling: Types of schedulers–CPU scheduling algorithms.

UNIT III

Memory management requirements, partitioning, paging, and segmentation, Address translation, paging levels, Virtual memory, Page replacement algorithms.

UNIT IV

Deadlocks – prevention- avoidance – detection

I/O management and disk scheduling–I/O devices, organization of I/O functions, I/O buffering, disk scheduling, RAID. Memory mapped I/O,DMA, Interrupt handlers, device drivers, power management

UNIT V

File management–file and file system, file architecture, file organization and access, directories, file sharing, record blocking, Secondary storage management.

UNIT VI

Computer Security Concepts - Threats, Attacks, and Assets, Intruders, Malicious Software Overview–Trojan Horses, Viruses, Worms, Spyware, Rootkits and Bots, Access control, security maintenance-Firewalls, Antivirus, Code Signing, Intrusion Detection, Explore Java Security

TEXT BOOKS

2. William Stallings, “Operating Systems – internals and design principle”, Prentice Hall India, 8th Edition, 2014.
3. Silberschatz, Peter Galvin, “Operating System Concepts”, 9th Edition, 2013,

REFERENCE BOOKS

1. Andrew S. Tannenbaum& Albert S. Woodhull, “Operating System Design and Implementation”, Prentice Hall India, 3rd Edition, 2009.
2. Gary Nutt, “Operating System - A Modern Perspective”, Pearson Education Asia, 3rd Edition 2003.
3. Harvey .M. Deitel, “Operating Systems”, 3rd Edition, 2003.
4. Ida M.Flynn, Ann MclverMcHoes, “Understanding Operating Systems”, 7th Edition , Thomson Learning ,2014

WEB LINKS

1. http://nptel.ac.in/courses/106108101/
2. http://williamstallings.com/OperatingSystems/OS7e-Student/
3. http://williamstallings.com/OS/OS6e.html

THEORY OF COMPUTATION

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Apply grammars and languages to design the automata.
2. Analyze the lemma’s, identity rules for regular languages
3. Design deterministic, non-deterministic and push down automata’s and turing machines
4. Analyze normal forms, ambiguity grammars and simplification of grammars.
5. Interpret different types of Chomsky hierarchy of languages and their capabilities

UNIT I

Fundamentals

Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automation and non deterministic finite automaton, transition diagrams.

UNIT II

Finite Automata

NFA with Î transitions, acceptance of languages. Conversions and Equivalence: Equivalence between NFA with and without Î transitions, NFA to DFA conversion

Minimisation

Minimisation of FSM, equivalence between two FSM’s, Finite Automata with output- Moore and Mealy machines.

UNIT III

Regular Languages

Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets (proofs not required).

UNIT IV

Grammar Formalism

Chomsky hierarchy of languages, Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion.

Context free grammar: Context free grammar, derivation trees, sentential forms. Right most and leftmost derivation of strings. Ambiguity in context free grammars. Minimisation of Context Free Grammars

UNIT V

CFG Normal Forms

Chomsky normal form, Greiback normal form, Enumeration of properties of CFL (proofs omitted)

Push Down Automata

Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state.

UNIT VI

Turing Machine

Turing Machine, definition, model, design of TM, recursively enumerable languages, types of Turing machines (proofs not required).

Computability Theory

Linear bounded automata and context sensitive language, Posts Correspondence problem.

TEXT BOOKS

1. Hopcroft H.E. and Ullman J.D, “Introduction to Automata Theory Languages and Computation”, Pearson Education.
2. Sipser, “Introduction to Theory of Computation”, 2nd Edition Thomson

REFERENCES BOOKS

1. Daniel I.A. Cohen, “Introduction to Computer Theory”, John Wiley.
2. John C Martin, “Introduction to languages and the Theory of Computation”, TMH.
3. Theory of Computer Science – Automata languages and computation -Mishra and Chandrashekar

WEB LINKS

1. http://nptel.ac.in/courses/106104028/
2. http://www.comp.nus.edu.sg/~sanjay/cs4232.html
3. http://www.cs.virginia.edu/~robins/cs3102/

OBJECT ORIENTED PROGRAMMING CONCEPTS LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Design, compile, test and execute straightforward programs using a high level language.
2. Discuss the principles and practice of object oriented analysis and design in the construction of robust, maintainable programs which satisfy their requirements.
3. Analyze implementation, compilation, testing and run C++ programs comprising more than one class, to address a particular software problem.
4. Illustrate Inheritance and Polymorphism .
5. Classify effective use of applications through inheritance, Polymorphism, Exception Handling.

Week 1

1. Write a C++ program to find Factorial of a given number using for, while, do-while.
2. Write a C++ program to check given number is Armstrong Number or not.
3. Write a C++ Program to display Pyramid of numbers.

Week 2

1. Write a C++ program that prompts the user for an integer and then prints out all prime numbers up to that integer.
2. Write a C++ program to multiply two given matrices.
3. Write a C++ Program to generate Fibonacci series upto given number.

Week 3

1. Write a C++ program using class.
2. Write a C++ program for sorting a given list of names in ascending order using class.
3. Write a C++ program using static data member and member functions.
4. Write a C++ program to implement friend functions.
5. Write a C++ program to implement Friend class.

Week 4

1. Write a C++ program using inline Functions.
2. Write a C++ program using this operator.
3. Write a C++ program to implement constructor and destructors.
4. Write a C++ Program to implement copy constructor.
5. Write a C++ program to implement parameterized constructor.

Week 5

1. Write a C++ program using new and delete operators.
2. Write a C++ program to implement static polymorphism
3. Write a C++ Program to implement Runtime Polymorphism.
4. Write a C++ program to implement operator overloading using Assignment Operator (=)
5. Write a C++ program to implement operator overloading using Relational Operators (<,>)

Week 6
1. Write a C++ program to implement operator overloading using addition Operator (+)
2. Write a C++ program to swap to numbers using Function Overloading
3. Write a C++ program to implement Virtual Functions.
4. Write a C++ program to implement pure Virtual Functions.

Week 7
1. Write a C++ program to implement Multiple Inheritance using Student Information System
2. Write a C++ program to implement Multilevel Inheritance using Library Information System.
3. Write a C++ program using Hierarchical Inheritance.

Week 8
1. Write a C++ program to implement Hybrid inheritance
2. Write a C++ program to implement Constructors under Inheritance
3. Write a program to implement Virtual Base Class.

Week 9
1. Write a C++ program to handle divide by zero exceptions.
2. Write a C++ program to handle multiple exceptions.
3. Write a C++ program to implement flow of execution of try/catch blocks.

Week 10
1. Write a C++ program to copy the contents one file to another file
2. Write a C++ program to display file information in reverse order.
3. Write a C++ program to implement streams.

Week 11
1. Write a C++ program to implement Function Templates.
2. Write a C++ program to implement Class Template
3. Write a C++ program to swap to numbers using function templates.

Week12
1. Write a C++ program to create simple calculator using class template.
2. Write a C++ program to implement containers.
3. Write a C++ program to implement Iterators.

OPERATING SYSTEMS LAB

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Execute various system calls in operating system.
2. Apply synchronization techniques to processes
3. Analyze the memory management and disk scheduling Algorithms.
4. Develop programs for page replacement and dead locks conditions.
5. Implement the file Allocation technique

Week 1

Implementation of

a) Basic Unix Commands: man, list, date, calendar, echo, banner, who, tty, binary calculator, clear, manipulation (tput) .

b) Directory Related Commands: pwd, mkdir, cd, rmdir.

Week 2

Implementation of

a) File Related Commands: cat ,sort ,cp ,my , rm ,wc ,lp ,pg ,df ,free, filters and pipe.

b) Communication Through UNIX Commands: mesg, write, wall, mail, reply.

Week 3

a) Write a program to implement System Calls--(Fork, Exec, Sleep….)

b) Create a process in UNIX environment.

c) Write a program to illustrate exec.

d) Create child with sleep.

e) Write a program to demonstrate signal handling in UNIX (Kill).

Week 4

Implement CPU Scheduling algorithms

a) First Come First Serve.

b) Shortest Job First.

Week 5

Implement CPU Scheduling algorithms

a) Round Robin.

b) Priority.

Week 6

Producer Consumer Problem Using Semaphore

Implement the solution for Bounded Buffer (Producer-Consumer) Problem Using Inter Process Communication Technique – Semaphores.

Week 7

Memory Management Scheme

a) Write a Program to implement Memory Management scheme like Paging.
b) Write a Program to implement Memory Management scheme like Segmentation.

Week 8

Implementation of Contiguous allocation techniques:

a) Worst-Fit
b) Best-Fit
c) First-Fit

Week 9

Simulate all Page Re-Placement Algorithms.

Week 10

Simulate Banker's algorithm for Deadlock Avoidance.

Week 11

Simulate all Disk scheduling algorithms

Week 12

Simulate file storage allocation techniques:

a) Contiguous (Using Array)
b) Linked –List (Using Linked List)
c) Indirect Allocation (Indexing)

PROBABILITY AND STATISTICS

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Understand the concepts of probability axioms, Conditional Probability and Baye's theorem.
2. Define and explain the different statistical distributions and the typical phenomena that each distribution often describes.
3. Examine the significant difference by testing the hypotheses concerning small and large samples.
4. Construct the best curve by using the method of Least Squares.
5. Use linear regression analysis to develop an empirical model of experimental data.

UNIT I

Probability

Sample space – events – Probability – The axioms of probability – Some Elementary theorems - Conditional probability – Baye's theorem.

UNIT II

Random Variables and Distributions

Discrete and continuous Random Variables – Distributions – Distribution function – Binomial, Poison and Normal distributions - Sampling distribution: sample – population – statistic - parameter – standard error.

UNIT III

Testing of Hypothesis-I

Estimation: Point estimation – Interval estimation, Test of Hypothesis: Null Hypothesis – Alternative Hypothesis – Type1 and Type2 errors – One tailed and two tailed tests – Critical Region – level of significance. Large Sample Tests: Test for single mean and difference of means, test for single proportion, difference of proportions.

UNIT IV

Testing of Hypothesis-II

Student t-distribution – F distribution - χ^2-distribution, Small Sample Tests: Test of significance for single mean and difference of means, Test for equality of variances (F-test), χ^2-test for goodness of fit.

UNIT V

Curve Fitting

Principle of least squares - working procedure for fitting curves - fitting of straight line – parabola – exponential curve – power curve.

UNIT VI

Correlation and Regression

Correlation – Correlation co-efficient – Karl Pearson's coefficient of Correlation – Spearman's Rank correlation coefficient – Regression – Regression equation of X on Y – Regression equation of Y on X (only linear).

TEXT BOOKS

1. Richard Arnold Johnson, Irwin Miller and John E.Freund, "Miller and Freund's Probability and Statistics for Engineers", Prentice Hall PTR.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand and Sons.

REFERENCE BOOKS

1. Sheldon P. Gordon, Contemporary Statistics: A Computer Approach, McGraw Hill..
2. Kishore S. Trivedi, Probability Statistics with Reliability, Queuing and Computer Science Applications, Prentice Hall.
3. Iyengar TKV, MVSN Prasad, S. Ranganatham, Gandhi and B. Krishna, "Probability and Statistics," S Chand.
4. M. R. Spiegel, J. Schiller, Probability and Statistics, Schaum Series.

COMPUTER NETWORKS

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Illustrate of the working principle of different protocols at different layers and contemporary issues in networking.
2. Install and configure workstations, servers and inter-networking devices such as switches and routers.
3. Analyze the requirements for a given organizational structure , select the most appropriate networking architecture and build a network of sub-netting of various routing mechanisms.
4. Expertise in the areas of maintenance and security issues of individual networks.
5. Analyze and design the topological and routing strategies for an IP based networking infrastructure

UNIT I

Introduction – network architecture –network topologies- network design. Reference models- The OSI Reference Model- The TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models

Physical layer: Transmission media, Introduction to Encoding.

UNIT II

Datalink Layer: Channelization, Multiplexing, Framing, error detection and correction, flow control-sliding window protocol, Medium access control sub layer, Basic structure of a switch, circuit switching and packet switching, Ethernet, 802.11/WiFi, WiFi-Direct, Bluetooth, NFC, RFID.

UNIT III
Network layer –Routing algorithms- Unicast, Multicast, Broadcast, Intra domain and Inter domain routing, Source based tree and group shared tree. Internetworking- Internet Protocols (IPv4 and IPv6).

UNIT IV
Transport layer - Elements of transport protocol-Congestion control – Performance issues-The Internet's Trans-mission Control Protocol (TCP)- Remote Procedure Call (RPC)- – Implementation semantics of RPC -client-server applications- The Real-time Transport Protocol(RTP) - Multimedia applications- Congestion control and resource allocation.- congestion control in TCP –UDP – Quality of service in IP.

UNIT V
Application layer - Domain name server-World wide web-Hyper text transfer protocol-Presentation formatting and data compression- Network security- crypto graphic tools- the problems of key distribution – General authentication techniques.

UNIT VI
Network applications and the protocols - File transfer protocol - email and the Web, multimedia applications such as IP telephony and video streaming- Overlay networks like peer-to-peer file sharing and content distribution networks- Web Services architectures for developing new application protocols.

TEXT BOOKS

1. Andrew S. Tanenbaum, David J Wetherall, *Computer Networks*, 5th Edition, Pearson Edu, 2010.
2. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", Sixth Edition, Pearson Education, 2013.

REFERENCE BOOKS

1. William Stallings, "Data and Computer Communications", Eighth Edition, Pearson Education, 2011
2. Nader F. Mir, "Computer and Communication Networks", First Edition, Pearson Education, 2007.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach ", McGraw Hill Publisher, 2011
4. Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw-Hill, 2004.

WEB LINKS:

1. http://nptel.ac.in/video.php?subjectId=106105081.
2. http://wps.pearsoned.com/ecs_kurose_compnetw_6/216/55463/14198700.cw/

DESIGN AND ANALYSIS OF ALGORITHMS

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Design algorithms for various computing problems
2. Analyze the time and space complexity of algorithms
3. Critically analyze the different algorithm design techniques for a given problem
4. Modify existing algorithms to improve efficiency.
5. Demonstrate polynomial and non polynomial problems

UNIT I

Introduction-Algorithm definition, Algorithm Specification, Performance Analysis-Space complexity, Time complexity, Randomized Algorithms.

Divide and conquer- General method, applications – Binary search, Merge sort, Quick sort, Strassen's Matrix Multiplication.

UNIT II

Greedy method- General method, applications- Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees, Single source shortest path problem.

UNIT III

Dynamic Programming- General Method, applications- Chained matrix multiplication, All pairs shortest path problem, Optimal binary search trees, 0/1 knapsack problem, Reliability design, Traveling sales person problem.

UNIT IV

Disjoint set operations, union and find algorithms, AND/OR graphs, Connected Components and Spanning trees, Bi-connected components Backtracking-General method, applications The 8-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles.

UNIT V

Branch and Bound- General Method, applications-0/1 Knapsack problem, LC Branch and Bound solution, FIFO Branch and Bound solution, Traveling sales person problem.

UNIT VI

NP-Hard and NP-Complete problems- Basic concepts, Non-deterministic algorithms, NP – Hard and NP- Complete classes, Cook's theorem.

TEXT BOOKS

1. Fundamentals of Computer Algorithms, 2nd Edition, Ellis Horowitz, Sartaj Sahni and S. Rajasekharan, Universities Press.
2. Design and Analysis of Algorithms, P. H. Dave, H. B. Dave, 2nd edition, Pearson Education.

REFERENCE BOOKS

1. Algorithm Design: Foundations, Analysis and Internet examples, M. T. Goodrich and R. Tomassia, John Wiley and sons.
2. Design and Analysis of Algorithms, S. Sridhar, Oxford Univ. Press
3. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson Education.
4. Foundations of Algorithms,, R. Neapolitan and K. Naimipour, 4th edition, Jones and Bartlett Student edition.
5. Introduction to Algorithms, 3rd Edition, T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, PHI

ARTIFICIAL INTELLIGENCE

(Professional Elective - I)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Apply the problem space, knowledge to design an effective production system.
2. Enhance the knowledge representation and can design logic by applying knowledge rules.
3. Apply, analyze, design and evaluate the expert systems.
4. Apply reasoning to construct traceable and non traceable problems.
5. Analyze and understand the computational trade-offs involved in applying different AI techniques and models.

UNIT I

Introduction: Attitude towards Intelligence, Knowledge and Human Artefacts, Overview of AI Application Areas.

Predicate Calculus: Introduction, Propositional Calculus, Predicate Calculus, Inference Rules to produce Calculus Expression, Application: A Logic Based Financial Advisor

UNIT II

Structures and Strategies For State Space Search: Introduction, Graph Theory, Strategies for State Space Search, Using the state Space to represent reasoning with the predicate calculus

Heuristic Search: Introduction, An algorithm for Heuristic Search, Admissibility, Monotonicity and Informedness, Heuristic in games, Complexity issues

UNIT III

Control and Implementation of State Space Search: Introduction, Recursion Based Search, Pattern Directed Search, Production Systems, Blackboard Architecture for problem solving.

Knowledge Representation: Issues, AI Representational systems, Conceptual Graphs, Explicit Representation, Agent Based and Distributed Problem Solving Expert Systems Genetic Algorithms and ML

UNIT IV

Strong Method Problem Solving: Introduction, Overview of Expert System, Rule Based Expert System, Model, Case Based and Hybrid Systems, Planning
Reasoning in Uncertain Situations: Introduction, Logic based abductive Inference, Abduction – Alternate Logic, The stochastic Approach to Uncertainty

UNIT V
Machine Learning: Introduction, Framework for Symbol based Learning, ID3 Decision Tree Induction Algorithm, Knowledge and Learning, Unsupervised Learning.

UNIT VI
Understanding Natural Language: Role of Knowledge in Language Understanding, Symbolic analysis, Syntax, Syntax and Knowledge with ATN Parsers, Natural Language Applications

TEXT BOOKS

1. George F Lugar, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Fourth Edition, Pearson Education
2. Rich and Knight, Artificial Intelligence, McGraw Hill Publication

DISTRIBUTED SYSTEMS

(Professional Elective - I)

COURSE OUTCOMES
The students will be able to

1. Accomplish the fault and it's tolerance.
2. Design the distributed file systems through shared variable, object based and bus based multi processors.
3. The design and usage of distributed file systems in the real world.
4. Recognize the feasibilities and the impossibilities in managing resources.
5. Identify the problems in developing distributed applications.

UNIT I
Introduction to Distributed Systems: Distributed systems: Goals Hardware Concepts Software - design Communication distributed systems: Layered Protocol: ATM Networks client server model - remote procedure call - group communication.

UNIT II
Synchronization: Clock synchronization-mutual exclusion-election atomic transactions - dead locks. Process and Processors: Threads-System models processor allocation - scheduling fault tolerance.

UNIT III
Real time distributed systems, Distributed file systems: File system design and implementation - trends in distributed file systems.

UNIT IV

Shared Memory: Introduction - bus based multi processors ring based multiprocessors switched.

UNIT V

Multiprocessors - NUMA comparison of shared memory systems - consistency models - page based distributed shared memory.

UNIT VI

Shared variable distributed shared memory; object based distributed shared memory, Case studies: MACH and CHORUS

TEXT BOOKS

1. Andrew S.Tanenbaum: "Distributed Operating System", Prentice Hall International Inc.1995,ISBN:0-13-031358-0
2. George Coulouris, Jean Dollimore and Tim Kindberg "Distributed Systems: Concepts and Design" edition – Wesley Pearson Education 2001,ISBN:-10:0273760599

REFERENCE BOOKS

1. George Coulouris , Jean, Dollimore Tim Kindberg), Gordon Blair, " Distributed Systems: Concepts and Design" (5th Edition) ,edition – Wesley 2011,ISBN:10:0132143011
2. Paolo Sivilotti," Introduction to Distributed Systems", 2005,ISBN:0321349601

FOUNDATIONS of IoT

(Professional Elective - I)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Illustrate the key components that make up an IoT system.
2. Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack.
3. Explain the role of big data, cloud computing and data analytics in an IoT system.
4. Understand where IoT fits within the broader industry and future trends.
5. Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.

UNIT I

What is IoT? Overview, Importance, Definition, Elements of IoT, Technology and Business Drivers, IoT Trends and Implications.

UNIT II

Solution Patterns for the IoT, Product – Customer Relationship, Elements of Smart, Connected Devices, Overview of Applications

UNIT III
Connectivity and Networks - The Edge of IoT, Connecting, securing and interacting with things from the cloud. Protocols - Application Layer – MQTT, CoAP, XMPP, AMQP and MAC 802.15.4. Wireless technologies.

UNIT IV
The cloud, Key technologies, Design goals, Implementation Issues

UNIT V
IoT Applications, Realizing IoT applications, Business case

UNIT VI
IoT Applications - Creating a new IoT application, Develop a IoT System from idea to market

Sample Project - “IoT weather station”: Students will build a small IoT device that integrates with temperature sensor, light sensor and rain sensor. The device creates a website where a user is able to read temperature, light, and rain data. This project enables students to implement a small IoT system and learn how to write programs on embedded devices.
http://www.instructables.com/id/Esay-IoT-Weather-Station-With-Multiple-Sensors/. 2.

TEXTBOOKS

1. Foundational Elements of an IoT Solutions: The Edge, The Cloud
2. Application Development, Joe Biron and Jonathan Follett

REFERENCE BOOKS

1. Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, by Francis daCosta, ISBN: 978-1-4302-5740-0, 2013
2. Architecting the Internet of Things, by Dieter Uckelmann, Mark Harrison and Florian Michahelles, ISBN: 978-3-642-19157-2, 2011
3. McKinsey&Company, "The Internet of Things: Mapping the value beyond the hype", McKinsey Global Institute, 2015

PRINCIPLES OF PROGRAMMING LANGUAGES

(Professional Elective - I)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Apply the building blocks to model a programming languages.
2. Apply data types, syntax and semantics, sub programming and blocks, ADT's.
3. Obtain the model and design the programming constructs of various programming languages.
4. Design the syntaxes for various kinds of programming languages.
5. Know the various design and functional issues of programming languages.

UNIT I

Preliminary Concepts

Reasons for studying, concepts of programming languages, Programming domains, Language Evaluation Criteria, influences on Language design, Language categories, Programming Paradigms: Imperative, Object Oriented, functional Programming, Logic Programming. Programming Language Implementation, Compilation and Virtual Machines, Programming environments.

UNIT II

Syntax and Semantics

General Problem of describing Syntax and Semantics, formal methods of describing syntax, BNF, EBNF for common programming languages features, parse trees, ambiguous grammars, attribute grammars, Denotation semantics and axiomatic semantics for common programming language features.

UNIT III

Data Types

Introduction, primitive, character, user defined, array, associative, record, union, pointer and reference types, design and implementation uses related to these types. Names, Variable, concept of binding, type checking, strong typing, type compatibility, named constants, variable initialization. Expressions and Statements: Arithmetic relational and Boolean expressions, Short circuit evaluation mixed mode assignment, Assignment Statements, Control Structures: Statement Level, Compound Statements, Selection, Iteration, Unconditional Statements, guarded commands.

UNIT IV

Subprograms and Blocks

Fundamentals of sub-programs, Scope and lifetime of variable, static and dynamic scope, Design issues of subprograms and operations, local referencing environments, parameter passing methods, overloaded sub-programs, generic sub-programs, parameters that are sub-program names, design issues for functions user defined overloaded operators, co routines.

UNIT V

Abstract Data Types

Abstractions and encapsulation, introductions to data abstraction, design issues, language examples, C++ parameterized ADT, object oriented programming in small talk, C++, Java, C#, Ada 95, Concurrency: Subprogram level concurrency, semaphores, monitors, massage passing, Java threads, C# threads. Exception handling: Exceptions, exception Propagation, Exception handler in Ada, C++ and Java. Logic Programming Language: Introduction and overview of logic programming, basic elements of prolog, application of logic programming.

UNIT VI

Functional Programming Languages

Introduction, fundamentals of FPL, LISP, ML, Haskell, application of Functional Programming Languages and comparison of functional and imperative Languages. Scripting Language: Pragmatics, Key Concepts, Case Study: Python – Values and Types, Variables, Storage and Control, Bindings and Scope, Procedural Abstraction, Data Abstraction, Separate Compilation, Module Library.

TEXT BOOKS

1. Robert W. Sebesta, “Concepts of Programming Languages”, 8th Edition, Pearson Education, 2008.
2. D. A. Watt, “Programming Language Design Concepts”, Wiley Dreamtech, 2007.

REFERENCE BOOKS

1. A.B. Tucker and R.E. Noonan, “Programming Languages”, 2nd Edition, TMH.
2. K. C Louden, “Programming Languages”, 2nd Edition, Thomson, 2003.

DATABASE MANAGEMENT SYSTEMS

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Comprehend the basic concepts of DBMS in comparison of File Systems and design Entity Relationship Models.
2. Identify the constraints to be used on different relation models.
3. Apply various Normal Form that need be used on data base tables.
4. Analyse various concurrent execution and recoverability techniques to be used on database tables.
5. Compare various indexing methods to define storage techniques.

UNIT I

Introduction: Data base System VS file System, View of Data, Data Abstraction, Instances and Schemas, data Models, Database Languages and Data base System Structure.

Data base design and ER diagrams – Beyond ER Design Entities, Attributes and Entity sets Relationships and Relationship sets, Additional features of ER Model, Concept Design with the ER Model

UNIT II

Introduction to the Relational Model- Enforcing Integrity constraints, Querying relational data, Logical data base Design, Introduction to Views, Destroying /altering Tables and Views.

Relational Algebra – Selection and projection set operations, renaming, Joins, Division, Examples of Algebra overviews, Relational calculus, Tuple relational Calculus, Domain relational calculus.

UNIT III

Introduction to Schema Refinement - Problems Caused by redundancy, Decompositions- Problem related to decomposition, Functional Dependencies- Reasoning about FDS, Normal Forms - FIRST, SECOND, THIRD Normal forms - BCNF - Properties of Decompositions - Loss less join Decomposition, Dependency preserving Decomposition, Schema Refinement in Data base Design - Multi valued Dependencies - FOURTH Normal Form.

UNIT IV

Transaction Concept- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability- Recoverability – Testing for serializability.

UNIT V

Lock –Based Protocols – Timestamp Based Protocols - Validation- Based Protocols.

Recovery and Atomicity – Log - Based Recovery – Recovery with Concurrent Transactions – Buffer Management

UNIT VI

Overview of Storage and Indexing: Data on External Storage – File Organization and Indexing – Hash Based Indexing – Tree base Indexing

TEXT BOOKS

1. Raghurama Krishnan, Johannes Gehrke“ Data base Management Systems” TATA McGrawHill 3rd Edition.
2. Silberschatz, Korth “Data base System Concepts” McGraw hill, V Edition.

REFERENCES

1. Peter Rob and Carlos Coronel “Data base Systems design, Implementation, and Management” 7^{th} Edition.
2. ElmasriNavrate “Fundamentals of Database Systems” Pearson Education

WEB LINKS:

1. http://nptel.iitm.ac.in
2. http://highered.mheducation.com/sites/0072465638/student_view0/index.html

DISCRETE MATHEMATICAL STRUCTURES - II

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Apply the mathematical logic, predicate rules to design an abstract system for theorem proof.
2. Apply mathematical foundations, algorithmic principles in modelling and design in computer based system.
3. Apply the concepts of graph theory in solving practical engineering problems.
4. Develop the ability to solve problems involving recurrence relations and generating functions.
5. Visualize and simplify situations using graphs and trees as tools.

UNIT I

Groups – Permutation groups, Lagrange’s theorem, Normal subgroups, Factor groups, Fundamental theorem of finite Abelian groups

UNIT II

Rings: Integral Domains, Ideals and factor rings Polynomial rings, factorization of polynomials, unique factorization domains, Euclidean domains

UNIT III

Fields, Vector spaces, Linear independence, splitting fields, irreducible polynomials Algebraic extension of fields, Finite fields

UNIT IV

Sylow theorems, Finite simple groups, Symmetry groups, generators and relations.

UNIT V
Introduction to algebraic coding theory, Linear codes, Reed-Solomon codes.

UNIT VI
Introduction to Galois theory, fundamental theorem of Galois theory, Solvability of polynomials by radicals, Insolvability of a quintic.

TEXTBOOKS
1. Contemporary Abstract Algebra, Joseph A. Gallian, 4th Edition, Narosa publishing house

REFERENCE BOOKS
1. Dr.S.K. PUNDIR (Author), Discrete Mathematical Structures, jai prakash nath & co

COMPUTER NETWORKS LAB

COURSE OUTCOMES
At the end of the course, the student will develop ability to
1. Demonstrate of the working principle of different protocols at different layers.
2. Develop an effective error correction & error detection techniques for effective communication of data over a network.
3. Develop an efficient routing algorithm for a given network architecture.
4. Gain working knowledge of datagram, Internet Socket programming, design and develop effective applications.
5. Familiarize with simulation tool NS2 and networking models.

Week1
1. Familiarization with Networking cables (CAT5, UTP) Connectors (RJ45,T-connector),Switches, and Routers.
2. Program to implement Bit Stuffing in Framing.

Week2
1. Program to implement Byte Stuffing in Framing.
2. Programs to implement error detection (Single Parity and 2D Parity).

Week3
1. Program to implement Cyclic Redundancy Check (CRC) .

Week4
1. Program to implement Hamming Code.

Week5
1. Implementation of Routing algorithms (Distance Vector Routing algorithm and Link State Routing Algorithm).

Week6

1. Implementation of Stop and Wait Protocol and Sliding Window Protocol

Week7

1. Connection oriented Client server applications with TCP

Week8

1. Connection less Client server applications with UDP

Week9

1. Simulate using Ns2 which consist of a three nodes point-to-point network with duplex links between them. Set the queue size vary the bandwidth and find the number of packets dropped and plot graphs using XGRAPH.

Week10

1. Simulate using Ns2 which consist of a four no de point-to-point net work, and connect the links as follows: n0-n2, n1-n2 and n2-n3. Apply TCP agent betweenn0-n3and UDPn1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP and plot graphs using XGRAPH.

Week11

1. Simulate using Ns2 which consist of the transmission of ping messages over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion and plot graphs using XGRAPH..

Week 12

a. Design TCP iterative Client and server application to count the number of vowels presenting iven input sentence
b. Design TCP client and server application to transfer file

Week 13

Client server applications using Multi protocol server

Week 14

Implement a chat and mail server

DESIGN AND ANALYSIS OF ALGORITHMS LAB

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Use notations to find time-complexity of algorithms for simple problems.
2. Discuss greedy method and dynamic programming.
3. Apply Backtracking strategy for simple problems.
4. Analyze the complexities of simple and hard problems.
5. Develop intractable problems using approximation algorithms

LIST OF EXPERIMENTS

1. Write C programs to implement the following:
   a) Prim's algorithm.
   b) Kruskal's algorithm.
2. Write a C program to find optimal ordering of matrix multiplication. (Note: Use Dynamic programming method).
3. Consider the problem of eight queens on an (8x8) chessboard. Two queens are said to attack each other if they are on the same row, column, or diagonal.
4. Write a C program that implements backtracking algorithm to solve the problem i.e. place eight non-attacking queens on the board.
5. Write a C program to find the strongly connected components in a digraph.
6. Write a C program to implement file compression (and un-co mpression) using Huffman's algorithm.
7. Write a C program to implement dynamic programming algorithm to solve all pairs shortest path problem.
8. Write a C program to solve 0/1 knapsack problem using the following:
   a) Greedy algorithm.
   b) Dynamic programming algorithm.
9. Write a C program to solve 0/1 knapsack problem using the following:
   a) Backtracking algorithm.
   b) Branch and bound algorithm.
10. Write a C program that uses dynamic programming algorithm to solve the optimal binary search tree problem.
11. Write a C program for solving traveling sales persons problem using the following:
    a) Dynamic programming algorithm.
    b) The back tracking algorithm.
12. Write a C program for solving traveling sales persons problem using Branch and Bound.

DATABASE MANAGEMENT SYSTEMS LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Design Entity Relationship diagrams for different relational models.
2. Build the Queries in SQL and apply various Integrity Constraints on the databases.
3. Apply normalization to remove anomalies from databases.
4. Develop the concepts of views on relational models.
5. Develop the concepts of Packages, cursors and Triggers on database tables

Recommended Systems/Software Requirements:

1. Intel based desktop PC
2. Mysql /Oracle latest version Recommended

1. Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.
2. Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS,UNION, INTERSET, Constraints.
   Example: Select the roll number and name of the student who secured fourth rank in the class.
3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
4. Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date)
5. Creation of simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)
6. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in

PL/SQL block

1. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.
2. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE- APPLICATION ERROR.
3. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.
4. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.
5. Program development using creation of package specification, package bodies, private objects, package variables and cursors and calling stored packages.

6. Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.
7. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers

Roadway Travels Database

The student is expected to practice the designing, developing and querying a database in the context of example database “Roadway travel”. Students are expected to use “Mysql” database.

"Roadway Travels" is in business since 1997 with several buses connecting different places in India. Its main office is located in Hyderabad. The company wants to computerize its operations in the following areas:

- Reservations
- Ticketing
- Cancellations

RESERVATIONS

Reservations are directly handled by booking office. Reservations can be made 60 days in advance in either cash or credit. In case the ticket is not available, a wait listed ticket is issued to the customer. This ticket is confirmed against the cancellation.

CANCELLATION AND MODIFICATIONS

Cancellations are also directly handed at the booking office. Cancellation charges will be charged.

Wait listed tickets that do not get confirmed are fully refunded.

Task 1: E-R Model

Analyze the problem carefully and come up with the entities in it. Identify what data has to be persisted in the database. This contains the entities, attributes etc.

Identify the primary keys for all the entities. Identify the other keys like candidate keys, partial keys, if any.

Example: **Entities:**

1. BUS
2. Ticket
3. Passenger

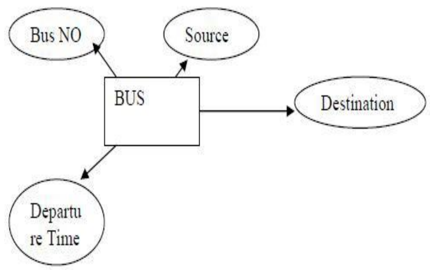
PRIMARY KEY ATTRIBUTES

1. Ticket ID (Ticket Entity)
2. Passport ID (Passenger Entity)

Apart from the above mentioned entities you can identify more. The above mentioned are few.

Task 2: Concept Design with E-R Model

Relate the entities appropriately. Apply cardinalities for each relationship. Identify strong entities and weak entities (if any). Indicate the type of relationships (total / partial). Try to incorporate generalization, aggregation, specialization etc wherever required.



Example: E-r diagram for bus

Task 3: Relational Model

Represent all the entities (Strong, Weak) in tabular fashion.Represent relationships in a tabular fashion. There are different ways of representing relationships as tables based on the cardinality. Represent attributes as columns in tables or as tables based on the requirement. Different types of attributes (Composite, Multivalued, and Derived) have different way of representation.

Example: The passenger tables look as below. This is an example. You can add more attributes based on your E-R model.

Passenger

Name	Age	Sex	Address	Passport ID

Task 4: Normalization

Database normalization is a technique for designing relational database tables to minimize duplication of information and, in so doing, to safeguard the database against certain types of logical or structural problems, namely data anomalies. For example, when multiple instances of a given piece of information occur in a table, the possibility exists that these instances will not be kept consistent when the data within the table is updated, leading to a loss of data integrity. A table that is sufficiently normalized is less vulnerable to problems of this kind, because its structure reflects the basic assumptions for when multiple instances of the same information should be represented by a single instance only.

Task 5: practicing DDL, DML commands
In this task you will learn Creating databases, How to create tables, altering the database, dropping tables and databases If not required. You will also try truncate, rename commands etc.

Example for creation of a table. CREATE TABLE Passenger (Passport id INTEGER PRIMARY KEY, Name CHAR (50) NULL,
Age Integer, Sex Char;

Note: Detailed creation of tables is given at the end. Practicing DML commands
DML commands are used to for managing data within schema objects. Some examples:
• SELECT - retrieve data from the a database
• INSERT - insert data into a table
• UPDATE - updates existing data within a table
• DELETE - deletes all records from a table, the space for the records remain

Few more Examples of DML commands:
Select * from Bus; (selects all the attributes and display) UPDATE BUS SET Bus No = 1 WHERE BUS NO=2;

Task 6: Querying
In this week you are going to practice queries (along with sub queries) using ANY, ALL, IN, Exists, NOT EXISTS, UNION, INTERSECT, Constraints etc.

Practice the following Queries:
1. Display unique PNR_no of all passengers.
2. Display all the names of male passengers.
3. Display the ticket numbers and names of all the passengers.
4. Display the source and destination having journey time more than 10 hours.
5. Find the ticket numbers of the passengers whose name start with ‘A’ and ends with ‘H’.
6. Find the names of passengers whose age is between 30 and 45.
7. Display all the passengers names beginning with ‘A’
8. Display the sorted list of passengers names
9. Display the Bus numbers that travel on Sunday and Wednesday
10. Display the details of passengers who are traveling either in AC or NON_AC(Using only IN operator)

Task 7: Querying (continued…)
You are going to practice queries using Aggregate functions (COUNT, SUM, AVG, and MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.
• Write a Query to display the Information present in the Passenger and cancellation tables.

Hint: Use UNION Operator.

• Write a Query to display different travelling options available in British Airways.
• Display the number of days in a week on which the 9W01 bus is available.
• Find number of tickets booked for each PNR_no using GROUP BY CLAUSE. **Hint:** Use GROUP BY on PNR_No.
• Find the distinct PNR numbers that are present.
• Find the number of tickets booked in each class where the number of seats is greater than 1.

Hint: Use GROUP BY, WHERE and HAVING CLAUSES.
• Find the total number of cancelled seats.
• Write a Query to count the number of tickets for the buses, which travelled after the date '14/3/2009'. **Hint:** Use HAVING CLAUSES.

Tables
BUS
Bus No: Varchar: Pk Source :Varchar Destination :Varchar

Passenger
PNR_No : Numeric(9) : PK Ticket_No: Numeric (9) Name: Varchar(15)
Age :int (4)
Sex:Char(10) : Male / Female
PPNO: Varchar(15)

Reservation
PNR_No: Numeric(9) : FK Journey_date :datetime(8) No_of_seats :int (8) Address :Varchar (50) Contact_No: Numeric (9) -->Should not be less than 9 and Should not accept any other character other than Integer
Status: Char (2) : Yes / No

Cancellation
PNR_No: Numeric(9) : FK Journey_date :datetime(8) No_of_seats :int (8) Address :Varchar (50) Contact_No: Numeric (9) -->Should not be less than 9 and Should not accept any other character other than Integer
Status: Char (2) : Yes / No

Ticket
Ticket_No: Numeric (9): PK Journey_date :datetime(8) Age : int (4)
Sex: Char(10) : Male / Female
Source :Varchar Destination : Varchar Dep_time : Varchar

Task -8: A Course Project need to be developed before the end of the course.

NETWORK PROGRAMMING

(Professional Elective - II)

COURSE OUTCOMES

At the end of the course the student should be able to

1. Get familiar with the variety of interfaces and frameworks for writing network applications.
2. Analyze various interfaces, STREAMS, sockets, and remote procedure call libraries.
3. Apply the basic steps and underlying mechanisms of writing programs using the client-server model.
4. Using socket system calls (socket, bind, listen, connect etc.).
5. Understand Streams and TLI System Calls

UNIT I

IPC

Introduction, File and record locking, Pipes, FIFOs, streams and messages, Message queues, Semaphores, Shared memory. REMOTE LOGIN: Terminal line disciplines, Pseudo-Terminals, Terminal modes, Control Terminals, RPC Transparency Issues.

UNIT II

Introduction to Network Programming

OSI model, standards, TCP and UDP, TCP connection establishment and termination, Buffer sizes and limitations, Standard Internet services, Protocol usage by common internet applications.

UNIT III

Sockets

Address structures, Value – result arguments, Byte ordering and manipulation functions and related functions. Elementary TCP sockets – socket, connect, bind, listen, accept, fork and exec functions, concurrent servers, close function and related functions.

UNIT IV

TCP Client Server Example

Introduction, TCP Echo server and client functions, Normal startup and Termination, Signal handling, Server process termination, Crashing and Rebooting of server host, Shutdown of server host. I/O Multiplexing: I/O Models, select function, Batch input, shutdown function, poll function, TCP Echo server.

UNIT V

Elementary UDP Sockets

Introduction, recvfrom and sendto functions, UDP Echo server and client functions, Lost datagrams, , Lack of flow control with UDP, determining outgoing interface with UDP, TCP and UDP echo server using select.

UNIT VI

System V Transport Layer Interface Introduction Overview Transport Endpoint Addresses, Elementary TLI Functions Advanced TLI Functions, Streams, TLI Implementation Stream Pipes, Passing File Descriptors , Asynchronous I/O Out-of-Band Data.

TEXT BOOKS

1. W.Richard Stevens, Network Programming, Sockets API, Volume I, 3rd Edition, PHI, 2010.
2. W.Richard Stevens, Network Programming, Volume II, 1st Edition, PHI, 2009.

REFERENCE BOOKS

1. Choudhury D. Roy, Networks and Systems Paperback – Jun 2013
2. W. Richard Stevens, Unix Network Programming, Volume 1: The Sockets Networking API (3rd Edition)

JAVA PROGRAMMING

(Professional Elective - II)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. List all OOP features to design object oriented applications, and execute straight forward programs using a high level language.
2. Discuss the principles and practice of object oriented analysis and design in the construction of robust, maintainable programs which satisfy their requirements.
3. Analyze implementation, compilation, testing and run java programs comprising more than one class, to address a particular software problem.
4. Classify effective user interface applications through AWT controls and swings.
5. Examine use of members of classes in the Java API
6. Summarize the framework and architecture for MVC's

UNIT I

Object Oriented Thinking

OOP Principles, Java buzzwords, data types, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion, concepts of classes, objects, constructors, methods, access specifiers, garbage collection.

UNIT II

Inheritance

Super class, Sub class, Types of inheritance's using final with inheritance, polymorphism- method overriding, Dynamic Method dispatch, abstract classes, Interfaces, variables in interface and extending interfaces. Overloading methods, parameter passing, recursion. Packages Defining, Creating and Accessing a Package, importing packages.

UNIT III

Exception Handling

Need for Exceptional Handling, try, catch, throw, throws and finally, built in exceptions, creating own exception. Streams- File Input Stream, File Output Stream, Data Input Stream, Data Output Stream, Scanner, File Reader, File Write. Byte Array, Char Array.

UNIT IV

Multi Threading

Differences between multithreading and multitasking, thread life cycle, creating threads, synchronizing threads, daemon threads, thread groups. Event Handling: Events, Event sources, Event classes, Event Listeners, handling mouse events, keyboard events, Adapter classes, inner classes.

UNIT V

AWT Controls

Labels, button, text components, check box, check box groups, choices, lists, menu bar layout manager types – boarder, grid, flow, card and grib bag. limitations of AWT, MVC architecture, components, containers

UNIT VI

Swings

Introduction exploring swing- J Applet, J Frame and J Component, Icons and Labels, text fields, buttons – The J Button class, Check boxes, Radio buttons, Combo boxes, Tabbed Panes, Scroll Panes, Trees, and Tables. JDBC Concepts With Simple Programs.

TEXT BOOKS

1. Java 7 Programming - Black Book, By Kogent Learning Solutions Inc., Freamtech Publications
2. Herbert schildt “Java the complete reference”, 7th Edition, TMH,ISBN:0072263857

REFERENCE BOOKS

1. Y. Daniel Liang “Introduction to Java programming” 6th Edition, pearson education, ISBN:10:0132221586
2. R.A. Johnson-An introduction to Java programming and object oriented application development, Thomson, ISBN:-10:0619217464
3. Head First Java 2nd Edition by Kathy Sierra, Oreilly Publication
4. T.Budd “Understanding OOP with Java” updated Edition, Pearson education, ISBN:10:0201612739

R PROGRAMMING

(Professional Elective - II)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Establish an efficient scientific computing environment
2. Use available R packages and associated Open Source software to meet given scientific objectives
3. Design and write efficient programs using R (and similar high-level languages) to perform routine and specialized data manipulation/management and analysis tasks.
4. Document, share, and collaborate on code development using a suite of Open Source standards and tools
5. Document analytical workflow using R, markdown languages, and version control

UNIT I

Basic fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments.

UNIT II

Use of R as a calculator, functions and matrix operations, missing data and logical operators.

UNIT III

Conditional executions and loops, data management with sequences, Data management with repeats, sorting, ordering, and lists.

UNIT IV

Vector indexing, factors, Data management with strings, display and formatting.

UNIT V

Data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings, data frames. Data frames, import of external data in various file formats, statistical functions, compilation of data.

UNIT VI

Graphics and plots, statistical functions for central tendency, variation, skewness and kurtosis, handling of bivarite data through graphics, correlations, programming and illustration with examples.

TEXT BOOKS

1. Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R By Christian Heumann, Michael Schomaker and Shalabh, Springer, 2016
2. The R Software-Fundamentals of Programming and Statistical Analysis -Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, Springer 2013

REFERENCE BOOKS

1. A Beginner's Guide to R (Use R) By Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, Springer 2009
2. R Programming for Data Science, Roger D. Peng

SECURITY IN IoT

(Professional Elective - II)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Identify vulnerabilities and attacks related to the Internet of Things
2. Describe countermeasures for Internet of Things devices
3. Compare and contrast the threat environment based on industry and/or device type
4. Discuss the security issues in agriculture, Healthcare, Cities, homes and transportation.
5. Create secure system using cryptographic algorithms and security features and protocol

UNIT I

Introduction to IoT Security – Vulnerabilities, Attacks and Countermeasures. Information Assurance. Attack types. New security threats and vulnerabilities. Fault Trees and CPS. Countermeasures to thwart attack. Threat Modelling.

UNIT II

Security Management & Cryptology - Security Controls - Authentication, Confidentiality, Integrity; Access Control, Key Management and Protocols, Cipher – Symmetric Key Algorithms, Public Private Key Cryptography; Attacks – Dictionary and Brute Force, Lookup Tables, Reverse Look Tables, Rainbow Tables, Hashing – MDS, SHA256. SHA 512, Ripe MD, WI, Data Mining

UNIT III

Attack Surface and Threat Assessment – Embedded Devices – UART, SPI, I2C, JTAG, Attacks – Software and cloud components, Firmware devices, Web and Mobile Applications.

UNIT IV

IoT Protocol Built-in Security Features – Transport Layer, SSL/TLS and DTLS, Kerberos, Cloud security for IoT

UNIT V

Case Studies and Discussion: Smart Agriculture, Cities, Grid, Healthcare, Homes, Supply Chain, and Transportation

UNIT VI

Application of Security Concepts to Create IoT system

TEXTBOOKS

1. Practical Internet of Things Security, Brian Russell & Drew Van Duren – 2016
2. Security and the IoT ecosystem, KPMG International, 2015

REFERENCES

1. Internet of Things: Privacy & Security in a Connected World, Federal Trade Comission, 2015
2. “Internet of Things: IoT Governance, Privacy and Security Issues” by European Research Cluster

ETHICAL HACKING

(Professional Elective - II)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Understand the core concepts related to malware.
2. Understand hardware and software vulnerabilities and their causes
3. understand ethics behind hacking and vulnerability disclosure
4. Exploit the vulnerabilities related to computer system.
5. Illustrate networks using state of the art tools and technologies

UNIT I

Introduction to Ethical Disclosure

Ethics of Ethical Hacking, Ethical Hacking and the legal system, Proper and Ethical Disclosure.

UNIT II

Penetration Testing and Tools

Using Metasploit, Using Back Track Live CD Linux Distribution.

UNIT III

Exploits

Programming Survival Skills, Basic Linux Exploits, Advanced Linux Exploits, Shellcode Strategies, Writing Linux Shellcode, Basic windows Exploits.

UNIT IV

Vulnerability Analysis

Passive Analysis, Advanced Static Analysis with IDA Pro, Advanced Reverse Engineering, Client-side browser exploits, Exploiting Windows Access Control Model for Local Elevation Privilege.

UNIT V

Intelligent Fuzzing with Sulley, From Vulnerability to Exploit.

UNIT VI

Malware Analysis

Collecting Malware and Initial Analysis, Hacking Malare.

TEXT BOOKS

1. Shon Harris, Allen Harper, Chris Eagle and Jonathan Ness, Gray Hat Hacking: The Ethical Hackers' Handbook, TMH Edition
2. Jon Erickson, Hacking: The Art of Exploitation, SPD

CRYPTOGRAPHY AND NETWORK SECURITY

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Identify the security issues in the network and resolve it.
2. Compare and contrast different IEEE standards and electronic mail security.
3. Explain the concept of digital signature and its applications.
4. Analyze and compare various cryptography techniques.
5. Design new strategies to secure data communication.

UNIT I

Introduction

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs.

Finite Fields:

Groups, Rings, Fields-Modular arithmetic-Euclid's algorithm-Finite fields- Polynomial Arithmetic logarithms. – DoS Attacks.

UNIT II

Conventional Encryption

Principles, Conventional encryption algorithms (DES, 3DES, AES), cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC.

UNIT III

Number theory

Prime numbers- Fermat's and Euler's theorem-Testing for primarily -The Chinese remainder theorem- Discrete logarithms. Public key cryptography: principles, **public key cryptography algorithms:** D-H, RSA, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service.

UNIT IV

Email privacy

Pretty Good Privacy (PGP) and S/MIME.

IP Security: **Overview of IP:** Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

UNIT V

Web Security

Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).

Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3.

UNIT VI

System Level Security

Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

TEXT BOOKS

1. William Stallings, "Cryptography & Network Security", Pearson Education, 4th Edition, 2010.
2. William Stallings and Lawrie Brown, "Computer Security: Principles and Practice", PHI, 2008

REFERENCE BOOKS

1. Charlie Kaufman, Radia Perlman, Mike Speciner, "Network Security, Private communication in public world", PHI, 2nd edition, 2002.
2. Bruce Schneier, Neils Ferguson, "Practical Cryptography", Wiley Dreamtech India Pvt Ltd, 2003. Douglas R Simson "Cryptography – Theory and practice", CRC Press, 1995.

Web Links

1. www.williamstallings.com/Security2e.html
2. http://nptel.iitm.ac.in

SOFTWARE ENGINEERING

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Comprehend advantages and disadvantages of current software life cycle models
2. Build a qualitative software requirement specification document for a project
3. Evaluate the best methods to plan, analyze, design, test, measure, and manage software projects
4. Implement testing methods at each phase of SDLC
5. Analyze and Apply project management techniques for a case study

UNIT I

Why Software Engineering? What Is Software Engineering, How Successful Have We Been, What Is Good Software, Who Does Software Engineering, A Systems Approach, An Engineering Approach, Members of the Development Team, How Has Software Engineering Changed?

Planning and Managing the Project: Tracking Progress, Project Personnel, Effort Estimation, Risk Management, The Project Plan

UNIT II

Modeling the Process and Life Cycle: The Meaning of Process, Software Processes: Models: Waterfall Model, Incremental Model and Spiral Model ,

Agile Software Development:

Agile Software Development: Coping with Change, The Agile Manifesto:Values and Principles. Agile methods: SCRUM and Extreme Programming. Plan-driven and agile development. Agile project management, Scaling agile methods

Tools and Techniques for Process Modeling

UNIT III

Capturing the Requirements: The Requirements Process, Requirements Elicitation, Types of Requirements, Characteristics of Requirements, Modeling Notations, Prototyping Requirements, Requirements Documentation, Validation and Verification,

UNIT IV

Designing the Architecture: The Design Process, Decomposition and Views, Modeling Architectures, Architectural Styles and Strategies, Achieving Quality Attributes, Documenting Software Architectures, Architecture Design Review

Designing the Modules: Design Methodology, Design Principles, Object-Oriented Design, Representing Object-Oriented Designs in the UML, Object-Oriented Design Patterns, Other Design Considerations, Object-Oriented Measurement, Design Documentation.

UNIT V

Writing the Programs: Programming Standards and Procedures, Programming Guidelines, Documentation, the Programming Process.

Testing the Programs: Software Faults and Failures, Testing Issues, Unit Testing, Integration Testing, Testing Object-Oriented Systems, Test Planning, Automated Testing Tools, When to Stop Testing.

Testing the System: Principles of System Testing, Function Testing, Performance Testing, Reliability, Availability, and Maintainability, Acceptance Testing, Installation Testing, Automated System Testing, Test Documentation, Testing Safety-Critical Systems.

UNIT VI

Delivering the System: Training, Documentation

Maintaining the System: The Changing System, The Nature of Maintenance, Maintenance Problems, Measuring Maintenance Characteristics, Maintenance Techniques and Tools, Software Rejuvenation.

Evaluating Products, Processes, and Resources: Approaches to Evaluation, Selecting an Evaluation Technique, Assessment vs. Prediction, Evaluating Products, Evaluating Processes,

TEXT BOOKS:

1. Shari Lawrence P Fleeger and Joanne M. Atlee, “Software Engineering: Theory and Practice”, 4th Edition, Pearson Education.

REFERENCES BOOKS:

1. Roger S Pressman, “Software Engineering: A Practitioner's Approach”, 6th Edition, TMH.
2. Ian Sommerville, “Software Engineering” 7th Edition, TMH.
3. PedryczWitold and Peters James F, “Software Engineering”, John Wiley.
4. Hans van Vliet, “Software Engineering: Principles and Practice”, 3rd Edition, TMH.

WEB LINKS:

1. http://wps.prenhall.com/esm_pfleeger_softengtp_4/

WEB TECHNOLOGIES

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Create a website using HTML5 and add dynamic functionality to it by using JavaScript, CSS & XHTML.
2. Implement three tier architecture using servlets and JSP.
3. Organizing JSP for Dynamic Web Development Applications.
4. Apply JDBC knowledge to make connection to various connections.
5. Build dynamic websites on real world problems.

UNIT I

HTML 5.0, CSS and XML.

Basic Tags of HTML, Tables, div, span, Forms, Media Tags.

Controlling Page Layout, Backgrounds, borders, colours, and text, Transformations and Animations

XML Elements, XML DTD and Schema.

UNIT II

JavaScript and JQuery

JavaScript Essential Syntax: Declaring variables and arrays, Using operators and expressions, Loops and decision-making constructs, JavaScript Functions, Alert, confirmation and prompt boxes, Regular expressions, JavaScript Objects, Event-handling.

jQuery introduction, The jQuery ready Function, jQuery Selectors, jQuery and DOM, jQuery and Events, jQuery UI: jQuery UI overview, Animation and special effects, the amable widgets.

UNIT III

AJAX and Angular JS

Overview of AJAX, Creating an XML Http Request object, Interacting with a server, Handling XML and JSON. Angular JS Introduction, Expressions and Data Biding, Working with Directives, Controllers and Forms

UNIT IV

JDBC and Servlets

JDBC Drivers, Connections, Statements and Result Set

Servlet Life Cycle, Servlet Types, Session Management JDBC-Servlet.

UNIT V

JSP and Beans

JSP Life Cycle, JSP Elements, implicit Objects, JDBC-JSP.

Bean Creation, JDBC-Bean ,Introspection.

UNIT VI

Struts and Hibernate

Struts Introduction, Struts Flow of Execution, Struts Elements, Struts Tag Library and Validations
Advantages of Hibernate compared to JDBC, ORM (Object Relational Mapping)
Configuration xml file and Mapping xml file along with dtds. Hibernate architecture
Installation and Directory Structure Hibernate Data Types. Application using Hibernate.

TEXT BOOKS

1. Web Programming, building internet applications, Chris Bates 2nd edition, WILEY Dreamtech.
2. Java Server Pages –Hans Bergsten, SPD O'Reilly.

REFERENCE BOOKS

1. Programming world wide web-Sebesta, Pearson

COMPILER DESIGN

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Illustrate the different phases of a compiler, and implement practical aspects of automata theory
2. Apply the syntax and semantic rules to design an error free compiler.
3. Interpret storage organisation and allocation strategies for dynamic storage system
4. Analyse the knowledge of different phases in designing a compiler
5. Apply code Generation and optimization techniques

UNIT I

Introduction to Compilers

Cousins of the compiler, Phases of a compiler, Analysis of the source program, grouping of phases, Compiler writing tools.

Lexical Analysis

Role of the lexical analyzer, Input Buffering, Specification of tokens, Recognition of tokens, A Language for specifying lexical Analyzers, Finite automata- Regular Expression to DFA, Optimization of DFA-based pattern matchers.

UNIT II

Syntax Analysis

The role of a parser, Context-free grammars, writing a grammar, Parsing, Ambiguous grammar, Elimination of Ambiguity, Classification of parsing techniques, Top Down Parsing, Backtracking, Recursive Descent parsing, FIRST and FOLLOW, LL(1) Grammar, Non-Recursive descent parsing, Error recovery in predictive parsing.

UNIT III

Bottom Up Parsing – Shift Reduce Parsing, Operator Precedence Parsing, LR Parsers – Model of an LR Parsers, SLR parsing, CLR parsing, LALR parsing, Error recovery in LR Parsing.

UNIT IV

Syntax Directed Translation

Syntax-directed definition, Syntax directed translation schema, S-attributed definitions, L-attributed definitions, Attribute grammar, S-attributed grammar, L-attributed grammar.

Semantic Analysis

Type Checking, Type systems, Equivalence of type expressions, Type Conversion.

UNIT V

Intermediate Code Generation

Construction of syntax trees, Directed acyclic graph, three address codes.

Runtime Environments

Storage organization, Storage-allocation strategies, Symbol tables, Activation record.

UNIT VI

Code Optimization

The principal sources of optimization, Basic blocks and Flow graphs, data-flow analysis of flow graphs.

Code Generation

Issues in the design of a code generator, Target machine, Next-use information, A simple code generator, Code-generation algorithm.

TEXT BOOKS

1. Alfred V.Aho, Ravi Sethi and Jeffry D. Ullman "Compiler Principles, Techniques and Tools"16th Indian Reprint, Pearson Education Asia, ISBN No.81-7808-046-X.,2004.
2. D.M.Dhamdere "Compiler Construction", 2nd Edition " Mac Mellon India Ltd", ISBN No.0333 -90406-0,1997

REFERENCE BOOKS

1. Donovan,"Systems programming", Mc. Graw Hill.
2. Leland L. Beck, "System Software – An Introduction to Systems Programming" Addison Wesley.

WEB LINKS

1. books.google.co.in Computers Programming General
2. www.amazon.com Books Computers and Technology
3. http://nptel.iitm.ac.in
4. https://www.tutorialspoint.com/compiler_design/
5. https://www.geeksforgeeks.org/compiler-design-tutorials/

NETWORK PROGRAMMING LAB

(Professional Elective – II Lab)

Week1.
To write a C program for implementing Client-Server chat using TCP.

Week2.
To write a C program for implementing chat program using UDP.

Week3.
To write a C program for printing the client address at the server end

Week4.
To write a C program for implementing the simple TCP client server where the server acts as a Date-Time server.

Week5.
To write a C program for transferring a file using TCP.

Week6.
To write a C program for the simulation of sliding window protocol.

Week7.
To simulate shortest path routing algorithm

Week8.
To write a C program for the simulation of Domain Name System

Week9.
To write a C program for developing E-mail application.

Week10.
To write a C program for implementing Client-Server chat using TCP.

Week11
Design TCP iterative Client and server application to reverse the given input sentence

Week12.
Design TCP iterative Client and server application to reverse the given input sentence

Week13.
Design TCP iterative Client and server application to reverse the given input sentence.

Week14.
Design TCP client and server application to transfer file

JAVA PROGRAMMING LAB
(Professional Elective – II Lab)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Design, compile, test and execute straightforward programs using a high level language.
2. Discuss the principles and practice of object oriented analysis and design in the construction of robust, maintainable programs which satisfy their requirements.
3. Analyze implementation, compilation, testing and run java programs comprising more than one class, to address a particular software problem.
4. Illustrate synchronization using multithreading.
5. Classify effective user interface applications through AWT controls and swings.
6. Program and examine use of members of classes in the Java API.

Week 1

1. Write a Java program that prints all real solutions to the quadratic equation ax2 + bx + c = 0. Read in a, b, c and use the quadratic formula. If the descriminent (b2 - 4ac) is negative, display a message stating that there are no real solutions.
2. The Fibonacci sequence is defined by the following rule:

The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursive functions to print the nth value in the Fibonacci sequence.

Week 2

1. Write a Java program that prompts the user for an integer and then prints out all prime numbers up to that integer.
2. Write a Java program to multiply two given matrices.
3. Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use StringTokenizer class of java.util)

Week 3

1. Write a Java program that checks whether a given string is a palindrome or not. Ex: MADAM is a palindrome.
2. Write a Java program for sorting a given list of names in ascending order.
3. Write a Java program to make frequency count of words in a given text

Week 4

5. Write a Java program that reads a file name from the user, and then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes.
6. Write a Java program that reads a file and displays the file on the screen, with a line number before each line.
7. Write a Java program that displays the number of characters, lines and words in a text file.

Week 5

1. Write a Java program that:
   i. Implements stack ADT.
   ii. Converts infix expression into Postfix form
   iii. Evaluates the postfix expression

Week 6

1. Develop an applet that displays a simple message.
2. Develop an applet that receives an integer in one text field, and computes its factorial Value and returns it in another text field, when the button named “Compute” is clicked.

Week 7

Write a Java program that works as a simple calculator. Use a grid layout to arrange Buttons for the digits and for the +, -,*, % operations. Add a text field to display the result.

Week 8

1. Write a Java program for handling mouse events.

Week 9

1. Write a Java program that creates three threads. First thread displays “Good Morning” Every one second, the second thread displays “Hello” every two seconds and the third thread displays “Welcome” every three seconds.
2. Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication.

Week 10

Write a program that creates a user interface to perform integer divisions. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num2 is displayed in the Result field when the Divide button is clicked. If Num1 or Num2 were not an integer, the program would throw a Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception Display the exception in a message dialog box.

Week 11

1. Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green. When a radio button is selected, the light is turned on, and only one light can be on at a time No light is on when the program starts.
2. Write a Java program that allows the user to draw lines, rectangles and ovals.

Week12

1. A demonstration of the Progress Monitor toolbar. A timer is used to induce progress.
2. This example also shows how to use the UI Manager properties associated with progress monitors.
3. Sample Swing application that manages several internal frames. This is the main class for working with the Site Frame and Page Frame classes.

R PROGRAMMING LAB
(Professional Elective – II Lab)

1. Write a R program using Arithmetic Operators.
2. Write a R program using Relational Operators.
3. Write a R program using Logical Operators.
4. Write a R program using Assignment Operators.

Conditional Statements.

1. Write a R Program using If conditional statement.
2. Write a R program using Switch Statement.

Loops

3. Write a R programs using For,while,Repeat
4. Write a R program to get the first 10 Fibonacci numbers.
5. Write a R program to get all prime numbers up to a given number
6. Write a R program to find the maximum and the minimum value of a given vector.
7. Write a R program to read the .csv file and display the content.
8. Write a R program to create a simple bar plot of five subjects marks.
9. Write a R program to create bell curve of a random normal distribution.
10. Write a R program to create a list of heterogeneous data, which include character, numeric and logical vectors. Print the lists.

Arrays

11. Write a R program to convert a given matrix to a 1 dimensional array.
12. Write a R program to create an array of two 3x3 matrices each with 3 rows and 3 columns from two given two vectors
13. Write a R program to create an array of two 3x3 matrices each with 3 rows and 3 columns from two given two vectors. Print the second row of the second matrix of the array and the element in the 3rd row and 3rd column of the 1st matrix.

DataFrame

14. Write a R program to create an empty data frame.
15. Write a R program to create a data frame from four given vectors.
16. Write a R program to get the structure of a given data frame.
17. Write a R program to extract first two rows from a given data frame.
18. Write a R program to sort a given data frame by multiple column(s).
19. Write a R program to create inner, outer, left, right join(merge) from given two data frames.
20. Write a R program to compare two data frames to find the elements in first data frame that are not present in second data frame.
21. Write a R program to call the (built-in) dataset airquality. Remove the variables 'Solar.R' and 'Wind' and display the data frame.
    Matrix

22. Write a R program to find row and column index of maximum and minimum value in a given matrix.
23. Write a R program to rotate a given matrix 90 degree clockwise rotation.

Vector

24. Write a R program to create a vector of a specified type and length. Create vector of numeric, complex, logical and character types of length 6.
25. Write a R program to add two vectors of integers type and length 3.
26. Write a R program to multiply two vectors of integers type and length 3.
27. Write a R program to find Sum, Mean and Product of a Vector.
28. Write a R program to find Sum, Mean and Product of a Vector, ignore element like NA or NaN.
29. Write a R program to find the minimum and the maximum of a Vector.
30. Write a R program to sort a Vector in ascending and descending order.
31. Write a R program to find common elements from multiple vectors.
32. Write a R program to reverse the order of given vector.

List

33. Write a R program to Add 10 to each element of the first vector in a given list.
    Sample list: (g1 = 1:10, g2 = "R Programming", g3 = "HTML").
34. Write a R program to get the length of the first two vectors of a given list.
    Sample list: (g1 = 1:10, g2 = "R Programming", g3 = "HTML")
35. Write a R program to get the length of the first two vectors of a given list.
    Sample list: (g1 = 1:10, g2 = "R Programming", g3 = "HTML")

Factors

36. Write a R program to create an ordered factor from data consisting of the names of months.
37. Write a R program to extract the five of the levels of factor created from a random sample from the LETTERS (Part of the base R distribution.)
38. Write a R program to create a factor corresponding to height of women data set, which contains height and weights for a sample of women.

SECURITY IN IOT LAB

(Professional Elective – II Lab)

List of experiments

1. Study on IoT Development Kit
2. Controlling the LED with different patterns using GPIO Interface
3. Reading basic analog sensor data and display it on the computer via UART interface
4. Reading the data using digital sensors via SPI interface
5. Reading the data using digital sensors via I2C interface
6. Study on JTAG debug port
7. Sensor data hashing using standard hashing methods
8. IoT sensor data encryption and decryption using standard encryption methods
9. Uploading the sensor data to remote cloud server
10. Reading the control data from cloud and controlling onboard interfaces.
11. Reading the data from remote cloud and display on display devices.
12. Smart cities – weather station
13. Smart cities – traffic light controls

ETHICAL HACKING LAB

(Professional Elective – II Lab)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Understand the core concepts related to malware.
2. Understand hardware and software vulnerabilities and their causes
3. Understand ethics behind hacking and vulnerability disclosure
4. Exploit the vulnerabilities related to computer system.
5. Illustrate networks using state of the art tools and technologies

1. Working with Trojans, Backdoors and sniffer for monitoring network communication
2. Denial of Service and Session Hijacking using Tear Drop, DDOS attack.
3. Penetration Testing and justification of penetration testing through risk analysis
4. Password guessing and Password Cracking.
5. Wireless Network attacks , Bluetooth attacks
6. Firewalls, Intrusion Detection and Honeypots
7. Malware–Keylogger, Trojans, Keylogger countermeasures
8. Understanding Data Packet Sniffers
9. Windows Hacking –NT LAN Manager, Secure 1 password recovery
10. Implementing Web Data Extractor and Web site watcher.
11. Email Tracking.
12. Configuring Software and Hardware firewall.

13. Firewalls, Packet Analyzers, Filtering methods.

TEXT BOOKS

3. Shon Harris, Allen Harper, Chris Eagle and Jonathan Ness, Gray Hat Hacking: The Ethical Hackers' Handbook, TMH Edition
4. Jon Erickson, Hacking: The Art of Exploitation, SPD

WEB TECHNOLOGIES LAB

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Create a website using HTML5 and add dynamic functionality to it by using JavaScript, CSS & XHTML.
2. Implement three tier architecture using servlets and JSP.
3. Organizing JSP for Dynamic Web Development Applications.
4. Apply JDBC knowledge to make connection to various connections.
5. Build dynamic websites on real world problems.

Week 1

Design the following static web pages required for an online book store web site. HOME PAGE: The static home page must contain three frames.

Top frame: Logo and the college name and links to home page, Login page, Registration page, Catalogue page and Cart page (the description of these pages will be given below). Left frame: At least four links for navigation, which will display the catalogue of respective links. For e.g.: When you click the link “CSE” the catalogue for CSE Books should be displayed in the Right frame. Right frame: The pages to the links in the left frame must be loaded here. Initially this page contains

Week 2

Design a web page using CSS (Cascading Style Sheets) which includes the following:

1. Use different font, styles: In the style definition you define how each selector should work font, color etc.). Then, in the body of your pages, you refer to these selectors to activate the styles.
2. Set a background image for both the page and single elements on the page.
3. Control the repetition of the image with the background-repeat property. As background-repeat: repeat Tiles the image until the entire page is filled, just like an ordinary background image in plain HTML.
4. Define styles for links asA: link A: visited A: active A: hover Example: <style type="text/css"> A:link {text-decoration: none} A:visited {text-decoration: none} A:active {text-decoration: none} A: hover {text-decoration: underline; color: red;} </style>

Week 3

Write an XML file which will display the Book information which includes the following: 1) Title of the book
2) Author Name
3) ISBN number
4) Publisher name
5) Edition
6) Price

Write a Document Type Definition (DTD) to validate the above XML file. Display the XML file as follows. The contents should be displayed in a table. The header of the table should be in color GREY. And the Author names column should be displayed in one color and should be capitalized and in bold. Use your own colors for remaining columns. Use XML schemas XSL and CSS for the above purpose. Note: Give at least for 4 books. It should be valid syntactically. Hint: You can use some xml editors like XML-spy.

Week 4

Create a simple XMLHttpRequest, and retrieve data from a TXT file.

Create an XMLHttpRequest to retrieve data from an XML file and display the data in an HTML table.

How a web page can communicate with a web server while a user type characters in an input field.

Week 5

Write an AngularJS application for User Registration and Login.

Write an AngularJS application to develop Forms

Write AngularJS and java script applications for form Validation

Week 6

Demonstrates the jQueryhide() method, hiding the current HTML element.

Demonstrates the jQueryclick() event.

Demonstrates a simple use of the jQueryanimate() method.

Demonstrates that you can manipulate multiple CSS properties with the jQueryanimate() method.

Week 7

Install a database (Mysql) with port no (3306) username is root and password is root.

Create a table which should contain at least the following fields: name, password, email-id, phone number (these should hold the data from the registration form).

Installing JDBCDriver to JAVA.

Write a java program to connect to that database and extract data from the tables and display them. Experiment with various SQL queries(DML and DDL).

Use Prepared Statements to store the data into the above the Table.

Week 8

Install APACHE TOMCAT web server.
While installation assign port number 8080 to APACHE Tomcat.
Demonstration of (Generic and HTTP)Servlet Execution.
User Authentication : Assume four users user1, user2, user3 and user4 having the passwords pwd1, pwd2, pwd3 and pwd4 respectively. Write a serve let for doing the following.
1. Create a Cookie and add these four user id's and passwords to this Cookie.
2. Read the user id and passwords entered in the Login form (week1) and authenticate with the values (user id and passwords) available in the cookies.
If he is a valid user(i.e., user-name and password match) you should welcome him by name(user-name) else you should display " You are not an authenticated user ".

Week 9
Installing JDBC Drivers into Tomcat.
Design a three tired architected program which involves User Interface to read the details of a Student ,and a Servlet to read the form details and store it into a Student Table.

Week 10
Doing the pre-requisite for executing a JSP.Demonstation of JSP
Write JSP Script which accepts user name and nick name from user. At first visit, display message "Hello user name" and for next successive requests, display "Hello nick name". Use username if visit count is odd and nick name if visit count is even. (use declaration scripting elements)
Write JSP code to generate department wise monthly attendance reports of employee
Write a JSP which does the following job: Insert the details of the 3 or 4 users who register with the web page using registration form. Authenticate the user when he submits the login form using the user name and password from the database.

Week 11
Create a Employee Bean which will be used in JSP page, Get the value of java Bean variable using <jsp:getProperty> tag.
Create a JDBC Bean which takes the name of the table and display the content of the table in a tabular format using JSP.

Week 12
Using Struts Design an Drop Down Box for Choosing Different Search Engines and Year of Creation.
Demonstrate a program on iterations in Struts.

Week 13
Store the details of a student into a Table using Hibernates and Annotations.
Design a Web Application using Hibernates.

COMPILER DESIGN LAB

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Gain Knowledge of powerful compiler generation tools
2. Apply the tools to design the compiler and expose the different parsing paradigms
3. Analyse the code optimization techniques
4. Design the symbol table
5. Apply the syntax and semantic rules to design an error free compiler

1. Programs using Lex Tool
   a. Lex specification to demonstrate different regular expressions.
   b. Lex specification to print two digit numbers in words.
   c. Lex specification to check the validity of given date.

2. Programs using Lex Tool
   a. Lex specification to convert given octal number into decimal equivalent.
   b. Lex specification to count no of vowels, consonants, characters, words and lines in a file.

3. Programs using Yacc Tool
   a. Yacc specification to demonstrate different grammars.
   b. Yacc specification to find sentence validity.
   c. Yacc specification to evaluate expressions using precedence.

4. Programs using Yacc Tool
   a. Yacc specification to convert binary numbers to decimal numbers
   b. Yacc specification to check the validity of given date.

5. Program to find all meaningful words and generate the tokens for the given input program.
6. Implementing lexical analyzer using C.
7. Implementing Symbol Table for given HLL.
8. Implementing Shift reduce parser.
9. Implementing Simple LR parser.
10. Implementing LALR Parser.
11. Write a program to generate machine code for restricted programming expressions.
12. Experiments on code optimization of programming expressions.

MACHINE LEARNING

COURSE OUTCOMES

At the end of the course the student will be able to

1. Understand the different machine learning types and how to design a learning system
2. Apply effectively neural networks and genetic algorithms for appropriate applications
3. Use Bayesian techniques and derive effectively learning rules.
4. Apply the different machine learning algorithms in the learning problems.
5. Understand issues related to practical application of machine learning technologies

UNIT I

Introduction to Machine Learning, types of learning, Linear Regression– Decision Trees Learning - Problem ,Bias ,Variance Trade off, over fitting, Regularization, Variants of Gradient Descent. Hypothesis space and inductive bias, evaluation, cross-validation, Logistic, Regression.

UNIT II

Neural Networks and Genetic Algorithms- Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics –Genetic Algorithms – Genetic Programming – Models of Evolution and Learning,

UNIT III

Bayesian and Computational Learning- Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm, support vector machine

UNIT IV

Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probably Learning – Sample Complexity for Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT V

Instant Based Learning and Learning Set of Rules -K- Nearest Neighbour Learning – Locally Weighted Regression – Radial Basis Functions – Case-Based Reasoning – Sequential Covering Algorithms – Learning Rule Sets – Learning First Order Rules – Learning Sets of First Order Rules – Induction as Inverted Deduction – Inverting Resolution.

UNIT VI

Analytical Learning and Reinforced Learning-Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches.

FOCL Algorithm – Reinforcement Learning –Task – Q-Learning – Temporal Difference Learning.

TEXT BOOKS

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (INDIAN EDITION), 2013.
2. Ethem Alpaydin, “Introduction to Machine Learning”, 2nd Ed., PHI Learning Pvt. Ltd., 2013.

REFERENCE BOOKS

1. T. Hastie, R. Tibshirani, J. H. Friedman, “The Elements of Statistical Learning”, Springer; 1st edition, 2001.

NEURAL NETWORKS AND DEEP LEARNING

(Professional Elective - III)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Identity the role of neural networks in engineering.
2. Implement the back propagation algorithms.
3. Examine the auto associative and bidirectional associative memory applications.
4. Apply neural networks to particular applications, and to know what steps to take to improve performance.
5. Recognize the knowledge of sufficient theoretical background to be able to reason about the behaviour of neural networks.

UNIT I

Introduction

Definition of ANN-Biological Neural Networks-Applications of ANN-Typical Architectures-Setting the weights-Common Activation functions-Development of Neural Networks-McCulloch-Pitts Neuron

UNIT II

Simple Neural Nets for Pattern Classification

General discussion-Hebb net–Perceptron-Adaline–Back propagation neural net- Architecture-Delta Learning Rule Algorithm-Applications

UNIT III

Pattern Association

Training Algorithm for Pattern Association-Hetero associative memory neural network applications-Auto associative net-Iterative Auto associative net- Bidirectional Associative Memory-Applications

UNIT IV

Neural Nets Based on Competition

Fixed Weights Competitve Nets- Kohonen’s Self-Organizing Map – applications - Learning Vector Quantization – Applications - Counter Propagation Network- Applications.

UNIT V

Adaptive Resonance Theory And Neocognitron

Motivation–Basic Architecture-Basic Operation-ART1-ART2-Architecture-Algorithm-applications-Analysis Probabilistic Neural Net-Cascade Correlation

UNIT VI

Neocognitron

Architecture—Algorithm-Applications, Representation Learning
Multi Task Learning, Deep Reinforcement Learning

TEXT BOOK

1. LaureneV. Fausett, "Fundamentals of Neural Networks-Architectures, Algorithms and Applications", Pearson Education, 2011.
2. Yegnanarayana, Artificial Neural Networks, Prentice Hall India Learning Private Limited;

REFERENCE BOOKS

1. Martin T Hagan, Howard B Demuth, Mark H Beale, Neural Network Design – 2nd Edition, Martin Hagan publisher.
2. Author : Simon Haykin, Neural Networks : A Comprehensive Foundation – 2nd Edition,Prentice Hall

DATA MINING

(Professional Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Acquire the concepts of data processing.
2. Understand the different data mining techniques
3. Perform data mining tasks with relevant tools
4. Apply statistical tools to analyse data and understand their physical meanings and implications
5. Apply simulation methods and understand their role in analysing large data set.
6. Acquire a basic understanding of how the techniques learnt can be applied to data engineering applications.

UNIT I

Fundamentals Data Mining, Data Processing And Data Warehouses Data Mining – History – Strategies–Techniques–Applications–Challenges–Future-Types of Data–Data Warehouses – Data Processing - Quality Measure – OLAP – Sampling.

UNIT II

Data types, input and output of data mining algorithms - different Types of features – Concept Learning – Output of Data Mining Algorithms.
Pre processing In Data Mining– Steps – Discretization – Feature Extraction,
Selection and construction – Missing Data and Techniques for dealing it.

UNIT III

Introduction – Installation- Visualisation – filtering- selecting attributes- other popular packages. CLASSIFICATION TASK:Introduction – Decision trees – Naïve Bayes' classification- Artificial Neural Networks and Support Vector Machines.

UNIT IV

Model Evaluation Techniques

Accuracy Estimation- ROC-Lift Charts- Cost –Bagging and Boosting- Model Ranking Approach. ASSOCIATION RULE MINING:Concepts, Relevance, Functions of Association rule Mining – Apriori Algorithm- Strengths and Weaknesses of ARM- Applications.

UNIT V

Clustering and Estimation

Clustering Task: Introduction- Distance Measure – Types – KNN for clustering – validation - Strengths and Weaknesses of Algorithms – Applications.

Estimation Task: Scatter Plots and Correlation – Linear regression Models – Logistic regression – Regression Analysis - Strengths and Weaknesses of Estimation- Applications.

UNIT VI

Mining of Time Series

Fundamentals – Time series Models – Regression, Periodic Models - Strengths and Weaknesses of Time series Analysis – Applications. Text and Web Mining – Privacy, security and Ethical Issues in Data Mining.

TEXT BOOK

1. Shawkat Ali A B M, Saleh A. Wasimi, "Data Mining: Methods and Techniques", Third Indian Reprint, Cengage Learning, 2010.

REFERENCE

1. Soman K. P., Shyam Diwakar, Ajay V. "Insight into Data Mining Theory and Practice", Fifth Printing, PHI Learning, 2011.

SCRIPTING LANGUAGES

(Professional Elective - III)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Design and develop basic web application using PERL.
2. Apply the PHP program fundamentals to design and implement scripts for web based system.
3. Model, design applications using python.
4. Design the web application using advanced concepts of python.
5. Design and implement security issues through internet programming.

UNIT I

Introduction to PERL and Scripting Scripts and Programs, Origin of Scripting , Scripting Today, Characteristics of Scripting Languages, Web Scripting, and the universe of Scripting Languages. PERL- Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines, advance perl – finer points of looping, pack and unpack, file system, eval, data structures, packages, modules, objects, interfacing to the operating system, Creating Internet ware applications, Dirty Hands Internet Programming, security Issues.

UNIT II

PHP Basics- Features, Embedding PHP Code in your Web pages, Outputting the data to the browser, Data types, Variables, Constants, expressions, string interpolation, control structures Function, Creating a Function, Function Libraries, Arrays, strings and Regular Expressions.

UNIT III

Advanced PHP Programming PHP and Web Forms, Files, PHP Authentication and Methodologies -Hard Coded, File Based, Database Based, IP Based, Login Administration, Uploading Files with PHP, Sending Email using PHP.

UNIT IV

PHP Encryption Functions, the Mcrypt package, Building Web sites for the World –Translating Websites- Updating Web sites Scripts, Creating the Localization Repository, Translating Files, text, Generate Binary Files, Set the desired language within your scripts, Localizing Dates, Numbers and Times.

UNIT V

TCL Structure, syntax, Variables and Data in TCL, Control Flow, Data Structures, input/output, procedures , strings , patterns, files, Advance TCL-eval, source, exec and uplevel commands, Name spaces, trapping errors, event driven programs, making applications internet aware, Nuts and Bolts Internet Programming, Security Issues, C Interface. Tk-Visual Tool Kits, Fundamental Concepts of Tk, Tk by example, Events and Binding, Perl-Tk.

UNIT VI

Introduction to Python language, python-syntax, statements, functions, Built-in-functions and Methods, Modules in python, Exception Handling, Integrated Web Applications in Python – Building Small, Efficient Python Web Systems ,Web Application Framework.

TEXT BOOKS

1. David Barron,"The World of Scripting Languages", Wiley Publications.
2. Julie Meloni and Matt Telles, "PHP 6 Fast and Easy Web Development", Cengage Learning Publications.

REFERENCE BOOKS

1. Bayross and S.Shah, "PHP 5.1", The X Team, SPD.
2. Jason Gilmore, "Beginning PHP and MySQL", Apress Publications (Dreamtech), 3rd Edition.

WEB LINKS

1. eu.wiley.com/WileyCDA/Section/id-350340.html?filter...sort
2. www.apress.com/9781590598627.

DISTRIBUTED IoT SYSTEMS

(Professional Elective - III)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Create an IoT system architecture
2. Illustrate the concepts of Middleware for IoT
3. Build a sensor network.
4. Create appropriate program for IoT system
5. Implement (Design–Build–Test) an IoT system

UNIT I

System Design - Embedded system, creating system architecture, hands on the hardware; inputs, outputs and timers, maintaining the flow of activity; core embedded principles in the context of developing quick applications

UNIT II

Middleware for IoT - WSN, SCADA, RFID; Middleware solutions - event based, service oriented, VM based, agent based

UNIT III

Connectivity through Sensors - RFID Ecosystem, RFID Web applications for IoT; IoT connectivity through BlueTooth, WiFi and NFC.

UNIT IV

Building Sensor Network - Zigbee radio, antenna, buying an adapter, Xbee API Protocol, API and a sensor network Ins and Outs.

UNIT V

Software Development - Setting up the programming environment, identifying programming languages for selected hardware, coding to the device

UNIT VI

System Integration and Testing – Steps in creating a complete system with nodes and sensor network, Testing Protocol

Sample Project

"Home IoT system": Students will learn how to implement a voice-based home IoT system to control home appliance. In this project, students will get familiar with the latest Home IoT technology from Google, called Google Home. Google Home is a voice-activated speaker powered by the Google Assistant. Control devices using Google Home.

TEXT BOOKS

1. Beginning Sensor Networks with Arduino and Raspberry Pi, Charles Bell
2. Coulouris George, Dollimore jean, Kindberg Tim, Blair Gordon, "Distributed Systems", Pearson Education; Fifth edition (31 March 2017)

REFERENCES

1. Hwang, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things" Elsevier; First edition (2012)
2. Maciej Kranz, "Building the Internet of Things" Wiley 2016.

ADVANCED ALGORITHMS

(Professional Elective - IV)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Discuss various real world problems.
2. Illustrate the randomized algorithms.
3. Apply graph algorithms for solving complex real time problems.
4. Apply approximation of algorithms to define the solutions to the society problems.
5. Design models of real time problems using graph algorithms.

UNIT I

Review of first level portions – different paradigms – different problems from various domains.

UNIT II

Randomized Algorithms – Los vegas and Moute Carlo-Chernoff Bound – Probabilistic Amplification.

UNIT III

Typical randomised algorithms e.g. Min cut, Randomised Quick Sort, Randomised Selection, Primdity testing.

UNIT IV

Graph algorithms – Review – BFS, DFS, Topological Sort, Shortest paths – B-Trees, AVL Trees.

UNIT V

Graph Algorithms – MIS, Coloring problems, vertex cover, introduction to perfect graphs.

UNIT VI

Approximation algorithms – Ratio bound vertex cover, Set covering, Travelling Salesman problem, Subset sum.

TEXT BOOKS

1. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, "Introduction to Algorithms", The MIT
2. press, Cambridge, Massachusetts and McGraw Hill, 1990.

REFERENCES

1. H. S. Wilf, Algorithms and complexity, Prentice hall.

BIG DATA ANALYTICS

(Professional Elective - IV)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Identify Big Data and its Business Implications.
2. List the components of Hadoop and Hadoop Eco-System
3. Manage Job Execution in Hadoop Environment
4. Develop Big Data Solutions using Hadoop Eco System and analyze Infosphere BigInsights Big Data Recommendations.
5. Apply Machine Learning Techniques using R.

UNIT I

Introduction to Big Data and Hadoop

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

UNIT II

HDFS (Hadoop Distributed File System)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT III

Map Reduce

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

UNIT IV

Hadoop Eco System

Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

UNIT V

Hadoop Eco System

Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.

Big SQL : Introduction

UNIT VI

Data Analytics with R

Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

TEXT BOOKS

1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

REFERENCES

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)

CLOUD COMPUTING

(Professional Elective - IV)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Understand various service delivery models of a cloud computing architecture.
2. Understand the concepts of service oriented architecture.
3. Analyze the different workflows of service oriented architecture.
4. Understand the ways in which the cloud can be programmed and deployed.
5. Apply the grid computing in solving large scale scientific problems.

UNIT I

Systems Modeling, Clustering and Virtualization

Distributed System Models and Enabling Technologies, Computer Clusters for Scalable Parallel Computing, Virtual Machines and Virtualization of Clusters and Data centers.

UNIT II

Foundations

Introduction to Cloud Computing, Migrating into a Cloud, Enriching the 'Integration as a Service' Paradigm for the Cloud Era, the Enterprise Cloud Computing Paradigm.

UNIT III

Infrastructure as a Service (IAAS) & Platform and Software as a Service (PAAS / SAAS)

Virtual machines provisioning and Migration services, On the Management of Virtual machines for Cloud Infrastructures, Enhancing Cloud Computing Environments using a cluster as a Service.

UNIT IV

Secure Distributed Data Storage in Cloud Computing. Aneka, Comet Cloud, T-Systems, Workflow Engine for Clouds, Understanding Scientific Applications for Cloud Environments.

UNIT V

Monitoring, Management and Applications : An Architecture for Federated Cloud Computing, SLA Management in Cloud Computing, Performance Prediction for HPC on Clouds, Best Practices in architecting Cloud Applications in the AWS cloud, Building Content Delivery networks using Clouds, Resource Cloud Mashups.

UNIT VI

Governance and Case Studies: Organizational Readiness and Change management in the Cloud age, data Security in the Cloud, Legal Issues in Cloud computing, Achieving Production Readiness for Cloud Services.

TEXT BOOKS

1. Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms" Wiley, 2011.
2. Kai Hwang, Geoffery C.Fox, Jack J.Dongarra, "Distributed and Cloud Computing", Elsevier, 2012.

REFERENCE BOOKS

1. Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", Tata McGraw Hill, rp2011.
2. Gautam Shroff, "Enterprise Cloud Computing", Cambridge University Press, 2010.

SOFTWARE TESTING METHODLOGIES

(Professional Elective - IV)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Know the basic concepts of software testing and its essentials.
2. Performing functional testing using control flow and transaction flow graphs.
3. Know the basic techniques for deriving test cases and able to test a domain or an application and identifying the nice and ugly domains.
4. Write a path expression and reduce them very well when needed.
5. Apply appropriate software testing tools, techniques and methods for even more effective systems during both the test planning and test execution phases of a software development project.

UNIT I

Introduction

Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs.

Flow Graphs and Path Testing

Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT II

Transaction Flow Testing

Transaction flows, transaction flow testing techniques.

Dataflow testing: Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.
Domain Testing: Domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

UNIT III
Paths, Path Products and Regular Expressions: Path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection. **Logic Based Testing:** Overview, decision tables, path expressions, kv charts, specifications.

UNIT IV
State, State Graphs and Transition Testing: State graphs, good & bad state graphs, state testing, Testability tips.

UNIT V
Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools.

UNIT VI
Usage of JMeter and Winrunner tools for functional / Regression testing, creation of test script for unattended testing, synchronization of test case, Rapid testing, Performance testing of a data base application and HTTP connection for website access.

TEXT BOOKS
1. Baris Beizer, “Software Testing Techniques”, Dreamtech, 2nd Edition.
2. Dr.K.V.K.K. Prasad, “Software Testing Tools”, Dreamtech.

REFERENCE BOOKS:
1. Brian Marick, “The Craft of Software Testing”, Pearson Education.
2. Oreille, “Software Testing Techniques”, SPD.
3. Edward Kit, “Software Testing in the Real World”, Pearson.
4. Perry, “Effective Methods of Software Testing”, John Wiley.
5. Meyers, “Art of Software Testing”, John Wiley.

MACHINE LEARNING THROUGH PHYTHON LAB

COURSE OUTCOMES

At the end of the course the student will be able to

1. Analyse the learning techniques with this basic knowledge.
2. Apply effectively neural networks and genetic algorithms for appropriate applications.
3. Use bayesian techniques and derive effectively learning rules.
4. Determine which learning techniques are appropriate to a particular problem domain
5. Evaluate different machine learning techniques (e.g., robustness, sensitivity, specificity, advantages, limitations, etc.) by comparing and assessing their computational results

LIST OF EXPERIMENTS

1. **Python Basics:** Your first program, Types, Expressions and Variables, String Operations
2. **Python Data Structures:** Lists and Tuples, Sets, Dictionaries
3. **Python Programming Fundamental**: Conditions and Branching, Loops, Functions Objects and Classes
4. **Working with Data in Python:** Reading files with open, Writing files with open, Loading data with Pandas, Working with and Saving data with Pandas
5. **Regression:** – Introduction, Features and Labels, Training and Testing, Forecasting and Predicting, How to program the Best Fit Slope, How to program the Best Fit Line
6. Building A Logistic Regression in Python**, Give the input and predict the variables(desired target), Make visualizations, create dummy variables**
7. Kernels, Soft Margin SVM, and Quadratic Programming with Python
8. Take a data set and apply basic classification algorithm and test the accuracy using python
9. **Support Vector Machines** : Vector Basics, Support Vector Assertions, Constraint, Optimization with Support Vector Machine
10. Handling Non-Numerical Data for Machine Learning, K-Means with Titanic Dataset
11. Make Collaborative Filtering and Recommendation for a data set

ADHOC & SENSOR NETWORKS

(Professional Elective - V)

COURSE OUTCOMES:

At the end of the course the students will be able to

1. Apply the basic fundamentals to design ADHOC wireless system.
2. Illustrate Transport Protocols of ADHOC and sensor Networks
3. Develop and design security protocols of ADHOC wireless network.
4. Model an architecture for wireless sensor networks
5. Model and design WSNS and QoS of wireless sensor networking systems.

UNIT I

Ad Hoc Wireless

Introduction, Mobile Ad Hoc Networks, Technologies for Ad Hoc Network, Issues in Ad hoc wireless Networks, IEEE 802.11 Architecture and protocols. Protocol for AD HOC Wireless Networks Issues and classification of MAC protocol, other MAC protocols, Dynamic Source Routing (DBR), Adhoc Distance Vector (AoDV) routing, Routing Protocols, Multicasting Routing issues

UNIT II

Transport layer and Security protocols Issues in designing transport layer protocols, TCP over Ad Hoc Wireless Networks, Network Security Attacks, and Key management.

UNIT III

Wire Sensor Networks Basic Sensor Network Architectural Elements, Applications of Sensor Networks, Comparison with Ad Hoc Wireless Networks, Challenges and Hurdles. Architecture of WSNs Hardware components,

UNIT IV

Operating systems and execution environments, some examples of sensor nodes, Network Architecture, Sensor networks scenarios, Optimization goals and figures of merit, Design principles for WSNs.

UNIT V

Communication Protocols Physical Layer and Transceiver design considerations in WSNs, Fundamentals of (wireless) MAC protocol, Address and name management in wireless sensor networks, Localization and positioning

UNIT VI

Routing protocols Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless. Routing Strategies in Wireless Sensor Networks, QoS in wireless sensor networks, Coverage and deployment.

TEXT BOOKS

1. C Siva Ram Murty and BS Manoj, “Ad HOC Wireless Networks: Architectures and Protocols “, 2nd Ed, Pearson Education,ISBN:8131706885
2. Adleshein and Gupta, “Fundamentals of Mobile and Pervasive Computing”, TMH, 2005, ISBN:978-0-7645-4887-1

REFERENCE BOOKS

1. Mohamed Illayas, “Handbook of Ad Hoc wireless network”, CRC press,ISBN:0-8493-1332-5
2. Holger Karl, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley and Sons, ISBN:0470519231
3. Kazem Sohraby, Daniel Minoli, Taieb Znati, “Wireless Sensor Networks Technology, Protocols, and applications”, John Wiley and Sons,ISBN:978-0-471-74300-2

WEB LINKS

1. http://nptel.iitm.ac.in
2. www.pearsonhighered.com › ... › Wireless Communications

NATURAL LANGUAGE PROCESSING

(Professional Elective - V)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Understand the concept of natural language processing, its challenges and applications.
2. Comprehend the concepts word forms of the language by considering the concept of morphology analysis.
3. Perform syntax and semantics in natural language processing.
4. Design various NLP algorithms.
5. Implement N-Grams and probabilistic context free grammar.

UNIT I

Introduction

Natural Language Processing tasks in syntax, semantics, and pragmatics – Issues -Applications - The role of machine learning - Probability Basics –Information theory – Collocations -N-gram Language Models - Estimating parameters and smoothing - Evaluating language models.

UNIT II

Morphology and Part of Speech Tagging

Linguistic essentials - Lexical syntax- Morphology and Finite State Transducers - Part of speech Tagging - Rule-Based Part of Speech Tagging - Markov Models - Hidden Markov Models – Transformation based Models - Maximum Entropy Models. Conditional Random Fields

UNIT III

Syntax Parsing

Syntax Parsing - Grammar formalisms and treebanks - Parsing with Context Free Grammars-Features and Unification -Statistical parsing and probabilistic CFGs (PCFGs)-Lexicalized PCFGs.103

UNIT IV

Semantic Analysis

Representing Meaning–Semantic Analysis-Lexical semantics–Word-sense disambiguation-Supervised – Dictionary based and Unsupervised Approaches - Compositional semantics-Semantic Role Labeling and Semantic Parsing – Discourse Analysis.

UNIT V

Applications: Named entity recognition and relation extraction- IE using sequence labeling-Machine Translation (MT) - Basic issues in MT-Statistical translation-word alignment-phrase-based translation – Question Answering.

UNIT VI

Natural Language Generation and Machine Translation

Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation-Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.

TEXT BOOKS

1. Daniel Jurafsky and James H. Martin Speech and Language Processing (2nd Edition) Prentice Hall; 2 edition, 2008
2. Foundations of Statistical Natural Language Processing by Christopher D. Manning and Hinrich Schuetze, MIT Press, 1999

REFERENCES:

1. Pierre M. Nugues, An Introduction to Language Processing with Perl and Prolog: An Outline of Theories, Implementation, and Application with Special Consideration of English, French, and German (Cognitive Technologies)Softcover reprint, 2010
2. James Allen, Natural Language Understanding, Addison Wesley; 2 edition 1994 NLTK – Natural Language Tool Kit - http://www.nltk.or
3. Steven Bird, Ewan Kleinand Edward Loper Natural Language Processing with Python, O'Reilly Media; 1 edition, 2009
4. Roland R. Hausser, Foundations of Computational Linguistics: Human- Computer Communication in Natural Language, Paperback, MIT Press, 2011

SOFTWARE PROJECT MANAGEMENT

(Professional Elective - V)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Build the model from the conventional software product to the modern.
2. Discuss and evaluate the software architecture.
3. Acquire the knowledge of managing, economics for conventional, modern and future software projects.
4. Build the successful software projects that support organization's strategic goals.
5. Create project plans that address real-world management challenge

UNIT I

Conventional Software Management: The waterfall model, conventional software Management performance.

Evolution of Software Economics: Software Economics, pragmatic software cost estimation.

Improving Software Economics: Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections.

UNIT II

The Old Way and the New: The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.

Life Cycle Phases: Engineering and production stages, inception, Elaboration, construction, transition phases.

Artifacts of the Process: The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts.

UNIT III

Model Based Software Architectures: A Management perspective and technical perspective.

Work Flows of the Process: Software process workflows, Iteration workflows.

Checkpoints of the Process: Major mile stones, Minor Milestones, Periodic status assessments.

Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning.

UNIT IV

Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, evolution of Organizations.

Process Automation: Automation Building blocks, The Project Environment.

UNIT V

Project Control and Process Instrumentation: The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation.

UNIT VI
Tailoring the Process: Process discriminates.
Future Software Project Management: Modern Project Profiles, Next generation Software economics, modern process transitions.
Case Study: The command Center Processing and Display system- Replacement (CCPDS-R)

TEXT BOOKS
1. Walker Royce, "Software Project Management", Pearson Education, 2005.
2. Bob Hughes and Mike Cotterell, "Software Project Management", Tata McGraw Hill.

REFERENCE BOOKS
1. Joel Henry, "Software Project Management", Pearson Education.
2. Pankaj Jalote, "Software Project Management in Practice", Pearson Education, 2005.

IMAGE PROCESSING
(Professional Elective - V)

COURSE OUTCOMES
At the end of the course, the students will develop ability to
1. Acquire basics on digital image processing system and various formats of digital images
2. Explain various geometrical and radiometric errors and their correction procedures, and pre-processing methods for image.
3. Experiment image processing tools on various images, develop practical knowledge and skills about pattern recognition tools
4. Illustrate necessary knowledge to design and implement a prototype of an image processing and pattern recognition application.
5. Identify difficulties in current existing image and pattern recognition and propose new methods for it.

UNIT I
The Digitized Image and Its Properties: Applications of image processing, image function, image representation, sampling, quantization, color images.

UNIT II
Metrics: Metrics and topological properties of digital images, histograms, image quality, noise image.

UNIT III
Image Preprocessing: Pixel brightness transformation, position dependent brightness correction, gray scale transformation; geometric transformation, local pre-processing image smoothening, edge detectors, zero-crossing, scale in image processing, canny edge detection, parametric edge models, edges in multi spectral images.

UNIT IV

Image Segmentation: Threshold detection methods, optimal thresholding, multispectral thresholding, thresholding in hierarchical data structures;

UNIT V

Image Segmentation: Edge based image segmentation- edge image thresholding, edge relaxation, border tracing, border detection.

UNIT VI

Mathematical Morphology: Basic morphological concepts, four morphological principles, binary dilation, erosion, Hit or miss transformation, opening and closing; thinning and skeleton algorithms; Morphological segmentation -particles segmentation and watersheds, particle segmentation.

TEXT BOOKS

1. Millan sonka, Vaclav Hiavac, Roger Boyle, "Image Processing Analysis and Machine Vision", 3rd Edition, CL Engineering , 2013.
2. Rafel C. Gonzalez, Richard E. Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2008.

REFERENCE BOOKS

1. Julus T. Tou , Rafel C. Gonzalez, Addision, "Pattern Recognition Principles", 1st Edition, Wesley publishing company.
2. Earl Gose, Richard Johnsonbaugh, "Pattern Recognition and Image Analysis", 1st Edition, Prentice Hall of India Private limited, 2009.

PHILOSOPHY

(Open Elective - I)

COURSE OUTCOMES:

At the end of the course, the students will be develop ability to

1. Explain the core philosophical concepts and approaches.
2. Identify and distinguish Indian and Western Philosophy.
3. Describe and Distinguish the main divisions of philosophy.
4. Understand and explain the abstract philosophical concepts.
5. Understand the applications and implications of philosophical principles in real time situations.

UNIT I

Introduction to Philosophy, nature, scope and significance of philosophy, western philosophy, philosophic thought, history of philosophy, the Sophists and Socrates, Plato and Aristotle.

UNIT II

Introduction to Indian Philosophy, the ancient Vedas, the Upanishads, the epics and the treatises of the Heterodox and Orthodox systems, Buddhism, Advaitha, Jainism, and Sikhism

UNIT III

The classification of Philosophy - The main divisions of Philosophy, Logic, the Philosophy of mathematics, Philosophy of nature, philosophy and the special science, philosophy of art: ethics philosophy and theology, philosophy and Common Sense.

UNIT IV

Criticism (Epistemology), Ontology: Essence, Substance and Accident,.

UNIT V

Modern Philosophy: Political Philosophy, Religious Philosophy, Western or European Philosophy, Eastern Philosophy.

UNIT VI

Relevance of philosophy in modern world: Application of philosophical principles in modern India, its impact and usefulness.

TEXT BOOKS

1. Jacques Maritain, “An Introduction to Philosophy”, Rowman and Littlefield Pub Inc., 2005.
2. John Cottingham, “Western Philosophy: An Anthology”, 2ndEdition, Wiley-Blackwell, 2008.

REFERENCE BOOKS

1. SarvepalliRadha Krishnan and Charles A. Moore, “A Source Book in Indian Philosophy”, Princeton University Press.
2. Bertrand Russell, “A History of Western Philosophy”, Taylor and Francis Ltd.

DESIGN FOR SOCIAL IMPACT I

(Open Elective - I)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Understand the design process
2. Practice Team work and code of cooperation
3. Identify the real problems
4. Develop project concepts
5. Design low fidelity prototypes

UNIT I

Introduction: Basic definitions & Overview of the engineering design process - problem identification, analysis of the existing solutions, Idea generation, specifications and concept development, prototyping, failure analysis, detailed design, usability test, product delivery

UNIT II

Project management: Project charter- setting goals for the project, project time line- to manage the project, Teamwork- Team roles and responsibilities, good practices for teams, code of cooperation

UNIT III

Human Centered Design and Design Thinking: IDEO case studies, IDEO design tool kit, ideal wallet / Personal hydration design activity, partnership with the communities and NGOs, Prototyping- as a communication tool, learning to do low fidelity, rapid prototypes to get user feedback and develop specifications

UNIT IV

Problem Identification: Societal survey: Demographic, Ethnographic and Geographic, Data collection through Experiencing, Observation & Interaction, needs assessment, problem statement, persona development, stakeholder analysis, customer requirements

UNIT V

Market Survey: Detailed analysis of the existing products (Patents, Papers and commercial market), limitations of the available products

UNIT VI

Concept Generation: Design target specifications, Project concepts development and Low-fidelity design for mockup, 3D models, testing with users and community partner

TEXT BOOKS

1. Product Design & Development, Karl T. Ulrich, Steven D. Eppinger – Mc Graw Hill Irwin

REFERENCE BOOKS

1. World changing: A User's Guide for the 21st Century, Alex Steffen (2006). World changing: A User's Guide for the 21st Century, New York, Harry N. Abrams
2. This is Service Design thinking, Marc Stickdorn, Jakob Schneider and the co-authors (2011). The Netherlands, BIS Publishers

ESSENTIALS OF ENTREPRENEURSHIP

(Open Elective - I)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Describe the elements of the entrepreneurial mindset
2. Identify new opportunities at the intersection of technology and business
3. Develop innovative concepts that create win-win for the stakeholders
4. Design unique value proposition for the customers
5. Express business pitch effectively

UNIT I

Overview of Technology Entrepreneurship Overview, Importance, Definition - The Role and Promise of Entrepreneurship - Entrepreneurial Attributes and Characteristics - Entrepreneurial Style- Entrepreneurial Flow - Intrapreneurship vs. Entrepreneurship - Myths of Entrepreneurship

UNIT II

Opportunity Identification: Mindset in Opportunity Recognition - Sources of Opportunities – Societal, Economic & Technological Factors - Opportunity Recognition- Shaping – Framing - Effectuation - Assessment

UNIT III

Concept Generation & Design Thinking: Elements of Design Thinking - Concept Generation Techniques - Customer Centric Products and Services - Application of Lean Canvas

UNIT IV

Value Proposition: Unique Value Proposition - Value Proposition Canvas - Lean Canvas and its Elements - Crafting Value Proposition

UNIT V

Customer: Markets, Segmentation & Targeting – Personas - Estimating Market Size - Making a Business Case

UNIT VI

Intellectual Property& Elevator Pitch: Protecting Intellectual Property -Trade secrets, Patents, Trademarks, Copyrights - Typical Legal Issues in Startups - Elevator Pitch: Elements of Elevator Pitch - Pitching

TEXT BOOKS

1. Dorf, Richard C. and Byers, Thomas H. "Technology Ventures: From Idea to Enterprise." (2014)
2. Christensen, C. (2013). *The innovator's dilemma: when new technologies cause great firms to fail*. Harvard Business Review Press.
3. Furr, N., & Ahlstrom, P. (2011). *Nail it then scale it: the entrepreneur's guide to creating and managing breakthrough innovation* (No. 658.421 FUR. CIMMYT.).

REFERENCES

1. Christensen, Clayton M., The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail, Boston, Mass.: Harvard Business School Press, 1997.

FOUNDATIONS TO COGNITIVE SCIENCE

(Open Elective - I)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Appreciate the multidisciplinary nature of cognitive science
2. Recognize the different cognitive processes and phenomena in this field
3. Explore the impact of the knowledge categorization on the design process
4. Discover the influence of cognitive biases on the thought process
5. Understand the cognitive aspects of problem solving and decision making processes

UNIT I

Introduction to Cognition: Cognition and cognitive processes, Interdisciplinary nature, History of cognitive science and its permeation to engineering and business management, Structural organization of the brain and neural system

UNIT II

Attention and Perception: Sensation, Attention and Perception phenomena, Selective attention, Cross-modal attention, Priming, Visual and Auditory perception, Top down and Bottom-up processing, Neuroscience of perception, Gestalt psychology – principles and applications, Neuroscience of perception

UNIT III

Knowledge Representation: Human knowledge in representation, Categorization, Semantic networks, Schematic representation Working memory, Long-term memory, Encoding and retrieval, Encoding specificity principle, Recall, Recognition, Mind maps and Concept maps

UNIT IV

Decision Making: Strategies of decision-making, Affinity maps, Human decision-making process, Expected utility and benefits models, Satisficing, Heuristics in decision making Influence of cognition on consumer decision making.

UNIT V

Reasoning& Imperfection in Thinking: Different types of reasoning – Deductive, Inductive, Abductive, Reductive, Techniques in reasoning. Applications in Design – RGA and Laddering in consumer research. Cognitive biases, Fallacies, Mental blocks, Design fixation

UNIT VI

Problem Solving: Problem representation, Re-representing problems, Gestalt accounts of problem solving, Relationship between insight problems and other problems, Effects of instructions. Categorizing the problem, Methods of investigating problem solving / Problem solving approaches, Characterizing problem solving - Information processing approach, Analyzing well-defined problems, Interaction of the problem solver and the task environment, Factors influencing problem solving

TEXT BOOKS

1. Cognitive Psychology: Mind and Brain by E. E. Smith & S. M. Kosslyn
2. Cognition by M. W. Matlin& T. A. Farmer

REFERENCE BOOKS

1. Cognitive Psychology-A Student's Handbook by Michael W. Eysenck and Mark Keane.
2. Cognitive Psychology-Connecting Mind, Research, and Everyday Experience by Bruce Goldstein E.
3. Cognitive Psychology and its Implications by John R. Anderson.
4. Emerging Perspectives on Learning, Teaching and Technology by MichealOrey.

SUGGESTED BOOKS

1. How People Learn by J. D. Bransford, A. L. Brown & R. R. Cocking
2. Emotional Design: Why we Love (or Hate) Everyday Things by Norman, Donald A.
3. Conceptual Blockbusting-A Guide to Better Ideas by James L. Adams.

VISUAL COMMUNICATION AND COMPUTER ART

(Open Elective - I)

UNIT I

Shape and Space - Geometric and biomorphic shapes, positive and negative space, shape tools, anchor points, anchor point manipulation, fill and stroke, warp tool, layers

UNIT II

Line - Width, weight, texture, opacity and direction of line, dynamic, static, smooth, and angular lines, brush tool, pen tool, pencil tool, width tool

UNIT III

Text - Fonts and the type tools in Illustrator

UNIT IV

Color - Hue, value, saturation, and opacity, gradient panel and tool, mesh tool, opacity options

UNIT V

Texture - Implied vs. actual texture, pattern panel, symbol sprayer tool

UNIT VI

Content - Form, subject, and context, eraser tool and the effects menu

ENVIORNMENTAL STUDIES

(Open Elective - I)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Demonstrate an ability to integrate the many disciplines and fields that intersect with environmental concerns.
2. Paraphrase about components of eco-system and environmental cycles.
3. Prioritize the energy sources, sustainability and conservation of Bio-diversity
4. Recommend solutions to global environmental problems and formulate the waste management handling rules
5. Formulate the environmental impact assessment and create the environmental awareness by promoting environmental education.

UNIT I

Introduction to Environmental Studies and Ecosystem: Introduction to environment, multidisciplinary nature of environmental studies. Concept of Ecosystem – Structure (biotic and abiotic) and Functions of Ecosystem, Food Chain, Food web, Energy flow in an ecosystem, Bio-geochemical Cycles (Carbon, Nitrogen cycles), concept of Ecological Succession.

UNIT II

Biodiversity and Conservation: Level of Biological diversity– Definition, Genetic, Species and ecosystem – diversity, value of biodiversity - Conservation of Biodiversity (In-situ and Ex-situ). Biodiversity vs Bioproductivity, Biodiversity vs Biotechnology, Bioenergy.

UNIT III

Environmental Pollution and Climate Change: Introduction, sources, causes, consequences, Control measures of Air, Water and Soil Pollution.
Case studies: Air quality in Delhi, Ganga Action plan.

UNIT IV

Waste Management: Introduction-types of waste: solid – biomedical, electronic waste-disposal-landfills, pyrolysis, incineration, 3R's Principle, waste from wealth.
Mechanism of waste management – Case studies (composting, vermin technology, activated sludge process).

UNIT V

Human Communities and the Environment Global Issues: Population Growth -Consequences - Crazy Consumerism, Demographic Transition, Population Explosion, land-use change- Industry and uneven development, Exploitation of Resources - Deforestation, Global Warming – Causes – Effects - Carbon Sequestration, Acid Rains, Ozone Depletion, Carbon foot print, Protocols-Kyoto and Montreal.

UNIT VI

Environmental Impact Assessment (EIA)

Concept of EIA - methodology, Resettlement and rehabilitation of project affected persons; case studies.
Sustainable development – Case Studies - Rain water harvesting, Green Building Concept, Organic agriculture.

TEXT BOOKS:
1. Richard T. Wright, Dorothy F. Boorse., “Environmental Science”, Towards a sustainable Future12/E, PHI Learning Pvt. Ltd., M97, Ashok Goshal, Connaught circuit, New Delhi.
2. Erach Barucha, “Environmental Studies”, UGC-India, Pune.

REFERENCE BOOKS:
1. Gilbert M. Masters and Ela Wendell P, Introduction to “Environmental Engineering and Science”- LPE Pearson educations.
2. Henry J.G. and Heinke G.W., “Environmental Science and Engineering”, Prentice Hall of India, New Delhi.
3. M. Anji Reddy, “Text book of Environmental Science and Technology”, BS Publications (2010).
4. Benny Joseph, “Environmental Studies”, Tata McGraw Hill, New Delhi (2009).

MARKETING FOR ENGINEERS

(Open Elective - I)

COURSE OUTCOMES:

At the end of the course, the students will be develop ability to
1. Understand the concept of marketing and its environment.
2. Distinguish between product and service.
3. Exemplify marketing research process.
4. Evaluate different pricing decisions to design pricing strategies.
5. Create and analyze different marketing promotional tools.

UNIT I

Introduction to Marketing: Marketing Concept Vs Product Concept, Service Concept, Experience Concept, and Green Marketing - Creating Customer Value – Satisfaction and loyalty - Evolution of marketing concept - Marketing Environment – Customer value proposition - Distinctive characteristics of services – Customer relationship management
Cases: Mahindra Scooters – Santoor.

UNIT II

Marketing Research: Definition and Need for Marketing Research - Marketing Process Research - Segmentation and Market Entry – Target market selection – Positioning - Consumer buying decision process.
Case: (Segmentation) Zee TV, (Targeting) Kellogg’s - (Positioning), Dalda.

UNIT III

Product Management: Types of Products, Product line and Product mix, Product Life Cycle (PLC), New Product Development, Branding, Packaging, Labeling.

UNIT IV

Pricing strategy: Methods of Pricing, Factors influencing Pricing decision, Pricing cues, Price Sensitivity, Initiating Price Change, Price wars, Skimming, Penetration and Product mix pricing.
Cases: Coca Cola - I phone - Akash Tablet (lamb, Hair – page no: 112, 534, and 557).

UNIT V

Distribution and Promotion: Distribution Designing, Marketing Channel, Role of marketing channels, Channel design decisions, Retailing, Wholesaling, Logistics. Role of Marketing Communication, Marketing Communication Mix, Advertising, Public Relations, Sales Promotion Techniques.
Cases: Barista - Nano Car - Indigo - TESCO.

UNIT VI

Managing Personal Communication: Word of mouth, Personal selling, Designing Sales force, Direct Marketing Techniques, Internet Marketing, Tapping Global markets, Managing a Holistic Marketing Organization, Socially responsible Marketing, Rural Marketing, Rural Consumer Behaviour.
Case: Hero Motor Corp, Avon Cosmetics (lamb, Hair Page no: 446 and 497), Eureka, Home Shop (Arun – page no: 711 and 639).

TEXT BOOKS

1. Philip Kotler, Kevin Lane Keller, Abraham Koshy and Mithleshwar Jha, “Marketing Management”, Pearson Education, 13th Edition, 2009.
2. Joel R. Eans and Barry Berman, “Marketing Management”, Cengage, 2008.

REFERENCE BOOKS

1. Peter Chevton, “Key Marketing Skills”, Kogan Page, 2009.
2. V. S. Ramaswamy and S. Nama Kumari, “Marketing Management”, Macmillan, 4th Edition, 2009.
3. David Jobber and John Fathy, “Foundations of Marketing”, TMH, 2009.

PROJECT MANAGEMENT

(Open Elective - I)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Manage the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders.
2. Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders.
3. Adapt project management practices to meet the needs of stakeholders from multiple sectors of the economy
4. Describe a project life cycle, and can skillfully map each stage in the cycle
5. Apply project management practices to the launch of new programs, initiatives, products, services, and events relative to the needs of stakeholders.

UNIT I

Project Management Foundations

Introduction to project management, role of the project manager - Program management and portfolio management, Phases of project management.

UNIT II

Project sponsorship and the project office

Project organizational structures, Project Environment, Deliverables and Milestones, Projects and Companies, Project Life Cycles.

UNIT III

Collect Requirements Process

Project Scope Statement, Project Charter, Work Break Down Structure, The Network Diagram, Cost Estimation, Earned Value Management.

UNIT IV

Stakeholders register & management strategy

Risk management, quality management plan, human resources plan, communication management plan**,** procurement management, ethics.

UNIT V

Project Execution Phase

Monitoring and Controlling the Project, Quality Control, Project Change Control.

UNIT VI

Team Project (TP)

The Team Project is meant to help the students to apply what they learn in the course. This is a group project. Students should choose any professional project to study. **(Ref: Project charter)**

TEXT BOOKS

1. The Art & Science of Project Management – Warburton and Kanabar, RW, Press, 2013.
2. Harold R.Kerzner, “Project Management: A Systems Approach to Planning, Scheduling, and Controlling”, Wiley Publications, 11th Edition.

REFERENCE BOOKS

1. Prasanna Chandra, “Projects: Planning, Analysis, Selection, Financing, Implementation, and Review”, McGraw Hill Education, 8th Edition.
2. Erik Larson (Author) and Clifford Gray, “Project Management: The Managerial Process”, McGraw Hill Higher Education, 5th Revised Edition.
3. Garold (Gary) Oberlender**, “**Project Management for Engineering and Construction”, McGraw Hill Education, 3rd Edition.

PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Open Elective* - I*)

COURSE OUTCOMES:

At the end of the course, the students will be develop ability to

1. Solve the electrical circuits using electric circuit laws and network theorems
2. Describe the constructional details and working principle of electrical machines (Transformer & DC Machines)
3. Explain the principle and operation of alternators and its different applications
4. Differentiate between the types of rectifiers and diode characteristics
5. Explain the characteristics of semiconductor devices (Transistors) with CRO applications

UNIT I

Electrical circuits: Basic definitions, Types of Elements and their representation, Ohm's Law, Resistive networks, Kirchhoff's Laws, Inductive networks, capacitive networks, Series, Parallel circuits, Star to delta and delta to star transformations.

UNIT II

DC Machines and Transformers: Principle of operation of D.C. Generators, EMF equation, Types of D.C. Machines, Torque equation, applications, 3-point starter, Principle of Operation of Single phase transformers, EMF equation, Transformer losses, Efficiency and regulation.

UNIT III

AC machines: Principle of operation of Alternators, applications of synchronous motors; Principle of operation of Induction motors, Slip and torque characteristics and applications,

UNIT IV

Instruments and diode: Basic Principle of Indicating Instruments, P.M.M.C Instruments, M.I Instruments; P.N Junction diode, symbol, V-I Characteristics, Diode Applications, Half Wave Rectifier, Full wave and bridge Rectifiers, Problems on Rectifiers.

UNIT V

Transistors: Operation of PNP and NPN Transistor, Transistor configurations and Characteristics, Transistor as an amplifier, Applications; S.C.R Characteristics, Applications.

UNIT VI

Cathode Ray oscilloscope: Principle of C.R.T, Deflection, sensitivity, Electrostatic and magnetic deflection, Applications of CRO, Voltage, current and frequency measurement.

TEXT BOOKS

1. B. David V. Kerns, JR. J.David, Essentials of Electrical and Computer Engineering, Prentice Hall 2004, ISBN-10:0139239707.
2. V.K. Mehta, Principles of Electrical and Electronics Engineering, S.Chand & Co., 2010, ISBN-10:8121927293.

REFERENCE BOOKS

1. M.S.Naidu and S.Kamakshaiah, Introduction to Electrical Engineering, TMH publ., 2001, ISBN-10:0074622927.
2. Kothari and Nagrath, Basic Electrical and Electronics Engineering, TMH publications, 2009, ISBN-10:007014611X.
3. Elecrical Machines- Ashfaq Husain-Second Edition-Dhanpat Rai & Co.
4. Electronic devices and circuits By Salivahanan, The McGraw Hill Corporation

SOCIOLOGY

(Open Elective - II)

COURSE OUTCOMES

At the end of the course, the students will be develop ability to

1. Demonstrate the knowledge of core concepts of sociology.
2. Enrich their skill of social interaction through verbal and non-verbal communication.
3. Learn about socially acceptable behaviours in a group and use their sociological knowledge in the course of their lives.
4. Think critically about the causes and effects of various social issues.
5. Design and evaluate empirical sociological research**.**

UNIT I

Introduction to Sociology: Sociology - Meaning, Nature, Scope and significance, Basic Concepts of Society – Society, community, Role and Status, Norms and Value, Institution, Association. Social Groups - Meaning, Type of Groups – Primary, Secondary, In Group, Out Group, Reference Group.

UNIT II

Social Processes: Social Processes – Meaning, Socialization - Meaning, Socialization Theories.

Social Interaction: Social Interaction - Verbal - Non Verbal Communication, Forms of Social Interaction - Cooperation, Competition, Conflict, Accommodation, Exchange – Virtual Networking.

UNIT III

Social Control: Deviance and Conformity – Means and Agencies of Social Control.

Social Change: Theories and Factors of Social Change.

UNIT IV

Social Institutions: Marriage, Family, Kinship, Class, Caste, Religion, their function and features.

UNIT V

Social Research, Method and Techniques: Social Research – Definition, Steps in social research, Research Method, Observation method, Interview method, Questionnaire method, Case Study method, and Social Survey.

UNIT VI

Social Problems, Issues and Development Programmes: Social Problem – Meaning and Definition, Importance of the study of Social Problems; Social Issues – Equality of caste, Class gender, Communalism, Community Development Programmes, Women Empowerment.

TEXT BOOKS

1. Goode, W.J. and P.K.Hatt, "Methods in Social Research", McGraw Hill International, 1952.
2. Ahuja, Ram, "Social Problems in India", Rawat Publications, New Delhi, 2000.

REFERENCE BOOKS

1. Gisbert, "Fundamentals of Sociology", Orient Blackswan, New Delhi, 2010.
2. Thakur, Devender, "Research Methodology in Social Science", Delhi Deep and Deep Publication, 2003.

DESIGN FOR SOCIAL IMPACT II

(Open Elective - II)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Design the working prototype
2. Conduct Failure mode analysis
3. Perform validation and user test
4. Deliver the products to the partners
5. Learn leadership skills

UNIT I

Project management revisited: Critical path analysis, learning to use Gantt charts, risk analysis for project timeline, analyzing semester one lessons learned, planning for delivery.

UNIT II

Prototyping: Implementation of the best concept, Concept detailed sketch, functional decomposition and budget approval. High-fidelity design for proof of concepts, for components and required technology

UNIT III

Failure mode analysis: DFMEA, design for failure mode analysis, identify failure modes or potential modes and create plans to address in the design, detailed design of complete product

UNIT IV

Testing: Test plans, user testing, component tests, and system tests, addressing risk in design and project timeline, interaction with users, iterating using customer feedback, redesign product

UNIT V

Product delivery and support plan: Testing with users, field testing, user manual, user feedback - video record, maintenance agreement and support strategy for future batches

UNIT VI

Teamwork and leadership: Teaming skills, leadership styles and approaches, methods for resolving conflict, communication styles, roles and responsibilities, students assume leadership roles on teams

TEXT BOOKS

1. Product Design & Development, Karl T.Ulrich, Steven D.Eppinger – Mc Graw Hill Irwin

REFERENCE BOOKS

1. Design Thinking Methodology Book, Emrah Yayici, ArtBizTech
2. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Brown, Tim (2009). Change by Design, Harper Collins. ISBN: 9780061766084

BUSINESS MODELING AND VALIDATION

(Open Elective - II)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Apply strategies to create new products for blue oceans
2. Develop and test a hypothesis
3. Restate and pivot based on rapid experimentation
4. Apply strategic tools to identify an appropriate strategy to entrepreneurial success
5. Create business value canvas and structure opportunities based on the insights

UNIT I

Blue Ocean Strategy: Red Oceans vs Blue Oceans - Uncontested Market Space - Blue Ocean Strategy Framework – Raise, Reduce, Eliminate and Create - Blue Ocean Strategy Canvas - Applications

UNIT II

Elements of Lean Startup Methodology: Vision – Start, Define, Learn and Experiment - Steer – Leap, Test, Measure and Pivot - Accelerate – Batch, Grow, Adapt and Innovate.

UNIT III

Innovator's Hypothesis - Overview: Business Hypothesis - Business Experiments - Learning to Experiment to Test Simple, Fast, Cheap, Smart, Lean, Important Products or Services - Case Studies.

Unit IV

Innovator's Hypothesis – Method: The 5 × 5 × 5 approach - Exploring and Exploiting Experimentation - The 5 × 5 Portfolio Examples - Key Steps - Building Minimum Viable Product - Build-Measure-Learn Loop – Interviews - GOTB

UNIT V

Strategy Tools: Five Competitive Forces that Shape Strategy - Disruptive Innovation - Ansoff Matrix - Product Positioning - Adjacency Mapping

UNIT VI

Business Model Canvas: Definition of Business Model. Building Blocks. Business Model Canvas. Business Model Environment. Evaluating Business Models.

TEXT BOOKS

1. Maurya, A. (2012). Running lean: iterate from plan A to a plan that works. " O'Reilly Media, Inc.".
2. Schrage, M. (2014). The innovator's hypothesis: how cheap experiments are worth more than good ideas. MIT Press.

REFERENCE BOOKS

1. Kim, W. C., & Mauborgne, R. (2004). Blue ocean strategy. If you read nothing else on strategy, read thesebest-selling articles., 71.
2. Ries, E. (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Crown Books.
3. Porter, M. E. (2008). The five competitive forces that shape strategy. Harvard business review, 86(1), 25-40.
4. Osterwalder, A., &Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons.
5. Mullins, John W., The New Business Road Test, Second edition, Harlow, England: FT Prentice Hall, 2006

DESIGN COGNITION

(Open Elective - II)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Understand the different fronts at the interface between cognitive science and design/entrepreneurship
2. Identify user's needs, abilities, expectations etc. in design from a cognitive perspective
3. Explore the importance and role of analogical thinking and mental models in daily life
4. Understand the role of different cognitive tools in the design process
5. Realize the significance of cognition in the field of interaction design

UNIT I

Cognitive Design Process - Observing and Understanding Users

Descriptive and prescriptive design processes. Characteristics of a good design process.Double diamond design process, Case study and Exercises.Identifying Design Insights from Observations. Ethnographic Methods. Qualitative versus Quantitative research, Conceptual frameworks for cognition, Ethnographic studies of collaboration and communication, Affective aspects, Users – how to observe, data collection, interpreting and presentation Understanding the Socio-Cultural, Economic and Technological Influence.

UNIT II

User Journey

Modeling Users. User personas. Persona Analysis – Application of Affinity Maps. Lean Personas. Storyboards. User Goals.

UNIT III

Analogical Thinking

Importance of analogizing, Types of analogies, Design by Analogy. . TILMAG Method. Bio-mimicry, Generating own analogies, Expository and Aesthetic analogies

UNIT IV

Mental Models

Characteristics, Mental models in daily life, Constituent elements,Role of mental models in design, Building blocks – Affordances, Constraints, Mapping. Matching designer's and user's mental models.

UNIT V

Interaction Design

Introduction to Human-Computer Interaction (HCI), Brain-Computer Interfaces (BCI), Human Factors in engineering design, Neural Networks and Artificial Intelligence, Distributed and Embodied cognition

UNIT VI

User Centered approaches to Interaction Design

Degrees of user involvement, Participatory design. Co-create Process. Shared Mental Models.

TEXT BOOKS

1. Cognitive Psychology and Its Implications by John R. Anderson.
2. The Design of Everyday Things by Norman, Donald A.

REFERENCE BOOKS

1. An Introduction to the Study of mind by Jay Friedenberg and Gordon Silverman.
2. Applied Imagination-Principles and Procedures of Creative Problem Solving by Alex F. Osborn.
3. Mental Models-Aligning Design Strategy with Human Behavior by Indi Young.
4. Living with Complexity by Norman, Donald A.

SUGGESTED BOOKS

1. Emotional Design: Why we Love (or Hate) Everyday Things by Norman, Donald A.
2. Set Phasers on Stun: And Other True Tales of Design, Technology and Human Error by S. M Casey
3. Designing from Both Sides of the Screen: How Designers and Engineers Can Collaborate to Build Cooperative Technology by I. Ellen & W. Alan
4. *Universal principles of design : 125 ways to enhance usability, influence perception, increase appeal, make better design decisions, and teach through design*, by William Lidwell, Kritina Holden, and Jill Butler.
5. Observing the User Experience: A Practitioner's Guide to User Research by Mike Kuniavsky.
6. Cognition in the Wild by Edwin Hutchins.

7. Change by Design by Tim brown.
8. Don’t Make Me Think! by Steve Krug.
9. Handbook of Usability Testing-How to Plan, Design, and Conduct Effective Tests by Jeffrey Rubin and Dana Chisnell.

IMAGE MANIPULATION IN ADOBE PHOTOSHOP

(Open Elective - II)

UNIT I

Image Correction - Introduction to pixel selection, color balance and temperature correction, value correction, retouching skin, changing human form, using the image adjustment menu, the retouch tools, and the liquefy function in Photoshop

UNIT II

Image Combination and Separation - Advanced Pixel selection, subtraction of imagery, addition of imagery, layers

UNIT III

Image Distortion - Filters

UNIT IV

Creative Color - Layer modes, gradient tool, brush tool, image adjustment menu

UNIT V

Effective Black and White Imagery - Taking photographs, converting color photographs to aesthetically pleasing black and white photographs, image adjustment menu, and the burn and dodge tools

UNIT VI

Text Special Effects - Text tools, layers, masks, selection, and filters

ENGINEERING ETHICS

(Open Elective - II)

COURSE OUTCOMES:

At the end of the course, the students will develop ability to

1. Instill moral values that ought to guide ones profession
2. Identify risks and apply safety measures to reduce risk
3. Interpret their rights and responsibilities in their profession
4. Examine various global issues and resolve the situations as a professional
5. Examine the various code of ethics in various programs of Engineering

UNIT I

Scope and Aims of Engineering Ethics: Engineering Ethics, need of Engineering Ethics, professions and professionalism; Engineering as social experimentation, Engineers as responsible Experimenters; Code of Ethics, A balanced outlook on law.

UNIT II

Engineers Responsibility for Safety: Safety and risk, Assessment of safety and Risk, Risk-Benefit analysis and reducing Risk - study questions and case studies.

UNIT III

Rights to Engineers: Professional rights, whistle blowing, Employee rights – study questions and case studies.

UNIT IV

Global Issues: Multi corporations, Business Ethics, Environmental Ethics, Compute Ethics, weapon development- study questions and case studies.

UNIT V

Responsibilities of Engineers: Engineering as Managers, Promoting an ethical climate, Management of Conflict; Engineers as expert advisors in Planning and Policy making, Engineers as Moral leader – Leadership, Participation in Professional Societies. Leadership in communities, Principles of voluntary service.

UNIT VI

Sample Code of Conduct: Role of codes and its function, Limitation of Codes, Role of Law in Engineering, The problem of law in Engineering, code of Engineering Societies, Code of Ethics for Engineers – ASME, NSPE, IEEE.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005. (Reprint 2013)
2. Ibo Van de Poel and Lamber Royakkers "Ethics, Technology, and Engineering – An Introduction", John wiley publication, 2011.

REFERENCE BOOKS

1. Edmund G. Seebauer and Robert L. Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, 2014.
2. Caraline whitbeck, “Ethics in Engineering practice and Research”, Cambridge University Press, 2012

BUSINESS ANALYTICS

(Open Elective - II)

COURSE OUTCOMES:

At the end of the course, the students will be develop ability to

1. State the importance of Business Analytics
2. Explain the relationship between Business Analytics and statistics.
3. Explain the various analytical tools used in Business
4. Interpret the Data collected and Analyze for decision Making.
5. Solve business problems using statistical Methods.

UNIT I

Introduction to Business and data Analytics: Introduction to Data- Importance of Analytics- Data for Business Analytics –Big Data - Business Analytics in Practice. Data Visualization – Data Visualization tools, Data queries, Statistical methods for Summarizing data, Exploring data using pivot tables.

UNIT II

Descriptive Statistical Measures – Population and samples, Measures of location, Measures of Dispersion, Measures of variability, measures of Association.

UNIT III

Probability distribution and Data Modeling – Discrete Probability distribution, Continuous Probability distribution, Random sampling from Probability Distribution, Data Modeling and Distribution fitting.

UNIT IV

Predictive Analytics: Karl Pearson Correlation Techniques - Multiple Correlation-Spearman’s Rank correlation-Simple and Multiple regression-Regression by the method of least squares – Building good regression models – Regression with categorical independent variables - Linear Discriminant Analysis- One way and Two Way ANOVA

UNIT V

Data Mining: Scope of Data Mining, Data Exploration and Reduction, Unsupervised learning – cluster analysis, Association rules, Supervised learning- Partition Data, Classification Accuracy, prediction Accuracy, k-nearest neighbors, Classification and regression trees, Logistics Regression.

UNIT VI

Simulation: Random Number Generation, Monte Carlo Simulation-Analysis, Verification and Validation, Advantages and Disadvantages of Simulation, Risk Analysis, Decision Tree Analysis.

TEXT BOOKS

1. James Evans, Business Analytics, 2e, Pearson, 2017.
2. Camm, Cochran, Fry, Ohlmann, Anderson, Sweeney, Williams Essential of Business Analytics, Cengage Learning.

REFERENCES

1. Akil Maheswari: Big Data, Upskill ahead by Tata McGraw Hill, New Delhi, 2016
2. Seema Acharya & Subhashini Chellappan: Big Data and Analytics, Wiley Publications, New Delhi, 2015.

OPERATIONS RESEARCH

(Open Elective - II)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. List out various operation research models and apply LPP model for finding the Optimum solution
2. Calculate transportation cost for a various transportation models.
3. Assess the inventory requirements
4. Estimate the best replacement period for machines under different conditions
5. Decide the number of servers to minimize waiting time of customers and idle time of a server.

UNIT I

Development - History, Definition, OR Models, OR Techniques and phases of implementing OR in practice.

Allocation - Introduction to linear programming formulation, graphical solution, Simplex method, artificial variable technique, Un restricted Variables, Duality principle, Dual Simplex method.

UNIT II

Transportation Problem – Formulation, Optimal solution, unbalanced transportation problem, Degeneracy.

Assignment problem – Formulation, Optimal solution, Variants of Assignment Problem, Traveling Salesman problem.

UNIT III

Sequencing – Introduction, Flow, Shop sequencing, n jobs through two machines, n jobs through three machines, Job shop sequencing, two jobs through ‘m’ machines

Replacement: Introduction, Replacement of items that deteriorate with time, when money value is not counted and counted, Replacement of items that fail completely, Group Replacement.

UNIT IV

Theory of Games – Introduction, Terminology, Solution of games with saddle points and without saddle points- 2 x 2 games, dominance principle, m x 2 & 2 x n games, graphical method.

Inventory: Introduction, Single item, Deterministic models, Purchase inventory models with finite & infinite with one price break and multiple price breaks, Models with shortages, Stochastic models, demand may be discrete variable or continuous variable, Single Period model and no setup cost.

UNIT V

Queuing Theory – Introduction, Terminology, Single Channel, Poisson arrivals and Exponential Service times, with infinite population and finite population models, Multi channel, Poisson arrivals and exponential service times with infinite population. Machine Repair Model, Networks of Queues.

UNIT VI

Dynamic Programming – Introduction, Terminology, Bellman's Principle of Optimality, Applications of Dynamic programming, shortest path problem, Linear programming problem.

TEXT BOOKS

1. J.K.Sharma, "Operation Research", MacMilan, 4th Ed., 2009, ISBN Number: 978-9350593363.
2. R.Pannerselvam, "Operations Research", PHI Publications, 2nd Ed. Jan. 2006, ISBN Number: 978-8120329287.

REFERENCE BOOKS

1. Panneerselvam.R, "Operations Research".
2. Belgundu, Ashok.D & Chandrupatla, Trupathi.R, "Optimization Concepts And Applications".

INTELLECTUAL PROPERTY RIGHTS

(Open Elective - II)

UNIT I

Introduction to Intellectual Property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

UNIT III

Law of Copy Rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of Patents: Foundation of patent law, patent searching process, ownership rights and transfer.

UNIT IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair Competition: Misappropriation right of publicity, false advertising.

UNIT V

New Development of Intellectual Property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

UNIT VI

International overview on intellectual property, international - trade mark law, copy right law, international patent law, international development in trade secrets law.

TEXT BOOKS

1. Deborah, E. Bouchoux, “Intellectual Property Right”, Cengage Learning.
2. M Murray and M.J. Mehlman, “Encyclopedia of Ethical, Legal and Policy Issues in Biotechnology”, John Wiley and Sons, 2000.

REFERENCE BOOKS

1. Prabuddha ganguli, “Intellectual Property Right - Unleashing the Knowledge Economy”, Tata McGraw Hill Publishing Company Ltd.
2. P.Narayanan; “Law of Copyright and Industrial Designs”, Eastern Law House, Delhi, 2010.
3. P.N. Cheremisinoff, R.P. Ouellette and R.M.Bartholomew, “Biotechnology Applications and Research”, Technomic Publishing Co. Inc., USA, 1985.
4. D. Balasubramaniam, C.F.A.Bryce, K. Dharmalingam, J. Green and K. Jayaraman, “Concepts in Biotechnology”, University Press (Orient Longman Ltd.), 2002.

PSYCHOLOGY

(Open Elective - III)

COURSE OUTCOMES:

At the end of the course, the students will be develop ability to

1. Understand the importance of psychology and the biological basis for human behavior
2. Realize the various factors that influence personality and its development
3. Explore the influence of socio and cultural differences on human behavior
4. Understand organizational behavior and the effect of motivation on goals
5. Explore the levels of employee participation as well as deal with workplace stress

UNIT I

Introduction to Psychology – origin, nature, scope and significance, early pioneers, contemporary perspectives and domains of psychology.

UNIT II

Personality – Overview of personality, trait theories, psychoanalytic theory, humanistic theories and behavioral and social learning perspective. Constituents of effective personality.

UNIT III

Social Psychology – a working definition, Social cognition – perceiving and understanding others, Attribution–explaining the causes of behavior, Attitudes and links with behavior.

UNIT IV

Organisational behavior – fundamental concepts, models of organisational behavior, motivation and behavior modification.

UNIT V

Interpersonal and Group dynamics, nature of employee participation, work change and resistance to change.

UNIT VI

Psychology in action – dealing with workplace stress, stress and job performance, stress management, modifying ineffective behavior.

TEXTBOOKS

1. Introduction to Psychology - Coon and Mitterer.
2. Introduction to Psychology – Morgan and King.

REFERENCE BOOKS

1. Psychology – Robert A Baron
2. Social Psychology – Robert S Feldman
3. Social Psychology – David Myers
4. Introduction to Social Psychology - L L Bernard

5. Human behavior at work - Davis and Newstrom
6. Organisational Behavior - Arnold and Feldman
7. Personality: A Psychological Interpretation - G W Allport

DESIGN FOR SOCIAL IMPACT III

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Conduct market research
2. Understand the start-up models
3. Write Proposals for social entrepreneurship
4. Initiate the start-up company
5. Mentor the new student teams

UNIT I

Market Analysis - Market research, understanding target market, potential customers, analysis of the present competitors, challenges and opportunities

UNIT II

Entrepreneurship - Business models in commercial entrepreneurship and social entrepreneurship **-** Case studies, financial resources, and Start-up models

UNIT III

Social Entrepreneurship - Social entrepreneurship tool kit – idea assessment, impact assessment, risk assessment, market assessment and financial assessment, using project in the delivery stage as the case to explore entrepreneurship opportunities

UNIT IV

Launch pad - Legal structures, financial plan, risk mitigation plan, start-up enterprise, mass level production and marketing

UNIT V

Leadership and Mentoring Role - Taking on leadership of teams and mentoring the next batch. Paired with students in the next batch to put leadership tools into practice to on-board the new batch.

UNIT VI

Leadership and Mentoring Role (continued) - Helping the new teams during EPICS-I modules, Identifying new projects with existing partners – or new ones. Coaching new class on interactions with community. Facilitating brainstorming, reviewing projects of new teams, Introduce new batch to project being completed, the community partner and opportunities for the new project(s), Handing off projects to next batch, completed and field support or for new design or redesign.

TEXT BOOKS

1. Product Design & Development, Karl T. Ulrich, Steven D. Eppinger – Mc Graw Hill Irwin

REFERENCE BOOKS

1. Design for the other 90%, Smith, Cynthia (2007). New York, Cooper Hewitt Smithsonian Design Museum
2. How to Change the World: Social Entrepreneurs and the Power of New Ideas, David Bornstein

STARTUP LAUNCH

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Categorize technology adoption life cycle and identify strategies to cross the chasm
2. Appraise scaling of the venture
3. Apply Bullseye framework to improve the operational efficiency
4. Select appropriate pricing & investment strategy
5. Create the business plan

UNIT I

Crossing the Chasm - Technology Adoption Life Cycle - Crossing the Chasm - Innovators, Early Adopters & Early Majority

UNIT II

Scaling the Business - Strategies and Critical Obstacles for Scaling - Anticipating, Planning and Managing Growth

UNIT III

Bullseye Framework for Getting Traction - Bull's-eye Framework - Customer Lifetime Value - Improving Efficiency of Operation

UNIT IV

Entrepreneurial Finance - Value, Price & Cost - Determining Appropriate Pricing Strategy - Financing the Venture - Angel Investment, Venture Capitalism, Crowd Funding - Valuation

UNIT V

Marketing - 4Ps of Marketing - Product Positioning - Building the Brand - Distribution Channels

UNIT VI

Business Plan - Elements of a Business Plan - Evaluating a Business Plan

TEXTBOOKS

1. Moore, Geoffrey A. "Crossing the chasm." (2002).
2. Furr, N., & Ahlstrom, P. (2011). Nail it then scale it: the entrepreneur's guide to creating and managing breakthrough innovation (No. 658.421 FUR. CIMMYT.).

REFERENCE BOOKS

1. Mares, J., & Weinberg, G. (2014). Traction: A Startup Guide to Getting Customers. S Curve Publishing.

COGNITIVE MANAGEMENT

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Identify and structure new opportunities based on cognitive insights
2. Apply the effectuation theory for the development of entrepreneurial ideas
3. Motivate team members to contribute to overall success of the team or organization
4. Understand and apply emotional intelligence strategies for everyday situations
5. Explore the cognitive principles behind leadership and organizational management

UNIT I

Introduction. Interaction to Entrepreneurial Businesses, Culture, and Methods. Lean Startups. Cognitive Management Skills.

UNIT II

Opportunity Recognition. Opportunity Recognition Cognitive Theories. Prototype Theory. Pattern Recognition. Connections for Identifying and Making Opportunities.

UNIT III

Effectuation Theory. Effectual Problem Space.Principles of Effectuation.The Bird in Hand, The Affordable Loss, The Crazy Quilt, The Lemonade, and the Pilot-in-the-Plane Principles.

UNIT IV

Team Cognition. Perspectives on Team Cognition.Cognitive Systems Engineering Perspective on Shared Cognition.Interactive Team Cognition.Collaborative Contributions Activity Awareness.

UNIT V

Emotional Intelligence. Personality and EQ. Models of EI – Trait Model, Mixed Model, Bar-on Model. EI and Personal Relationship. Strategies for Improving EI. EI and Strategic Thinking.

UNIT VI

Leadership. Cognitive Resource Theory of Leadership. Different Types of Leadership. Trait Theory. Behavioral Theory. Transactional and Transformational Leadership. Values. Leadership Lessons. Innovative & Culture.

TEXT BOOKS

1. Daniel Goleman, Richard Boyatzis, and Annie McKee, Primal Leadership: Unleashingthe Power of Emotional Intelligence. Designing Interactions, by Bill Moggridge.
2. Theories of Team Cognition: Cross-Disciplinary Perspectives (Applied Psychology Series) by Eduardo Salas (Editor), Stephen M. Fiore (Chapter 7, 8 & 9)

ADVANCED VISUAL ORGANIZATION AND AFTER EFFECTS

(Open Elective - III)

UNIT I

Size - Scale and proportion of shapes, layers and transform controls in After Effects

UNIT II

Placement - Static and dynamic placement, proximity and distance of lines, layers and transform controls in After Effects

UNIT III

Unity - Proximity and repetition, transform controls, effects and presets

UNIT IV

Variety - Shape, color, texture, size, and placement, transform controls, effects and presets

UNIT V

Balance - Symmetrical and asymmetrical balance, text tool in After Effects

UNIT VI

Focus - Main elements identified through contrast in shape, color, texture, size and/or placement, shape creation in After Effects

MATHS OPERATIONS RESEARCH STATISTICS ECONOMICS – MORSE

(Open Elective - III)

UNIT I

Calculus: Functions, Limit of a Function, Continuity and Derivative of a function, Differentiation: Definition, rules of differentiation, Partial Differentiation of first and second order, Extreme values of functions, Concavity and curve sketching, Indeterminate Forms and L-Hospital's Rule.

UNIT II

Matrix Algebra - Definition, types of matrices, Matrix operations: Addition, Subtraction and Multiplication; Transpose of Matrix, Determinant of matrix, Inverse of Matrix, Rank of Matrix, Solutions of Linear System of equations, Characteristic equations, Eigen values, Eigen vectors and properties, Cayley-Hamilton theorem and its use in finding inverse and powers of a matrix

UNIT III

Statistics, Correlation & Regression: Statistics: Measures of Central tendency - Averages for ungrouped and grouped data, Mean, Median, Mode. Measures of Dispersion - Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance, Coefficient of Dispersion, Coefficient of Variation, Combined Arithmetic Mean and Combined Standard Deviation.

Correlation: Types of correlation, Karl Pearson's correlation coefficient, Spearman's Rank correlation coefficient.

Regression: Simple linear regression, scatter graphs, least squares method, forecasting and use of linear regression equations in forecasting.

UNIT IV

Operations Research: Nature and scope of Operations research, Origin of OR, Applications of OR in different Managerial areas, Problem solving and decision making, Linear Programming Problem: Introduction, Mathematical formulation of LPP, Graphical Solution of LPP, solving LPP by Simplex method, Dual simplex method, Duality and Sensitivity analysis.

UNIT V

Microeconomics: Consumer theory, Supply and demand, Market equilibrium, Producer theory, Monopoly, Oligopoly, Capital markets, Welfare economics, Public goods, Externalities

UNIT VI

Macroeconomics: Basics of macroeconomics, Aggregate demand and aggregate supply, Business cycles, Unemployment and inflation, Economic stabilization policies, Economic growth and development theories of International trade.

REFERENCE BOOKS

3. Thomas' Calculus: Early Transcendentals, 14/E, Joel R. Hass, Davis, Christopher E. Heil, Maurice D. Weir, Pearson publications, 2018.
4. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, S. Chand and Sons, 2012.

5. S. D. Sharma, Operations Research, Kedarnath Ramnath and Company, 2008.
6. Shayle R. Searle, Matrix Algebra useful for statistics: , 2/e, Wiley Publications.

BLOCK CHAIN TECHNOLOGY

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Understand Distributed Ledger Technologies and how they work
2. Illustrate Bitcoin concepts, knowledge of Ethereum.
3. Apply knowledge of Hyperledger fabric.
4. Differentiate Bitcoin, Ethereum and Hyperledger fabrics mechanisms.
5. Design and implement new ways of using blockchain for applications other than crypto currency.

UNIT I

Introduction to Block Chain: What is Blcokchain, Public Ledgers, Blockchain as public ledgers, Bitcoin, Blockchain 2.0, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, The chain and the longest chain cryptocurrency to blockchain 2.0, permissioned model of blockchain, cryptographic hash function, properties of a has function, hash pointer and merkle tree.

Crypto primitives and bitcoin: Digital signature, public key, cryptography, a basic cryptocurrency, creation of coins, payments and double spending, forth – the precursor for bitcoin scripting, bitcoin scripts, bitcoin P2P Network, transaction in bitcoin network, block mining, block propagation and block relay. Why consensus, distributed consensus in open environments, consensus in a bitcoin network.

Consensus: Bitcoin consensus, proof of work (PoW) – basic introduction, hashcash PoW, Bitcoin PoW, attacks on PoW and the monopoly problem, proof of stake proof of burn and proof of elapsed time, the life of a bitcoin miner, mining difficulty, mining pool, permissioned model and use cases, design issues for permissioned blockchains, execute contracts, state machine replication, consensus models for permissioned blockchain, distributed consensus in closed environment, paxos.

UNIT II

Permissioned Blockchain: RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems, practical byzantine fault tolerance, three phase commit, view change, Concepts and benefits of blockchain for enterprise, the hyperledger project, actors in a blockchain, components in blcokchain design, ledger in blockchain,

Hyperledger Fabric: fabric architecture, transaction flow in fabric, ordering services, channels in fabric, fabric peer and certificate authority, Organization and Consortium Network, Membership Service Provide, Transaction Signing, Steps for network setup, Endorsement policies, Setup Blockchain networks, Experience blockchain network as different organizations, Deploy a simple application on IBM cloud.

UNIT III

Fabric Demo: Deploy a simple application on IBM Cloud, Marbles (asset transfer), Example smart contract code, client SDK code, Perform blockchain transactions using a cool UII, Install and instantiate marbles chaincode, Run application on the network you created, Goals of Hyperledger Composer, Key concepts for the business service provide, Key development concepts – model files, Access control lists, transaction processors, business network definition, Key concepts for administrators, how composer maps to fabric chaincode, deploy a simple composer application on IBM Cloud

Blockchain Use Cases-Finance: Sample use cases by industry, Business Problems and Participants, Communities in Blockchian network, Cross border payments, Steller and Ripple protocols, Project Ubin, Know Your Customer (KYC), Privacy Consents, Mortgage over Blockchain, Blockchain enabled Trade, We. Trade-Trade Finance Network, Supply Chain Financing, Blockchain for Trade Logistics, Global Trade Digitization, Blockchain for Container Management.

UNIT IV

Blockchain Use Cases – Industry: Food Safety and Food Traceability, Supply Chain Orchestration, Everledger, The Diamond Lifecycle, Addressing Supply Chain Fraud through Blockchain, Blockchain in Healthcare, Blockchain in Energy Markets Blockchian in Media, Blockchain and Government, Preventing Cyber Crime through blockchain, Government Use-cases, Auditing and compliance, Blockchian for Defense, e-Estonia:A Case Study.

Blockchain in Government and Blockchain Security: Digital Identity and Single Sign On (SSO) Principles of Digital Identity Management, Why Blockchain, Indy for Digital Identity Management, How Indy Works, Blockchain for Tax Payments, Blockchain for Managing Land Registry Records, Security Properties, Security Considerations for Blockchain, Intel SGX, Identities and Policies, Membership and Access Control, Blockchain Crypto Service Providers

UNIT V

Security and Research Aspects: Privacy in a Blockchain System, Privacy through Fabric Channels, Smart Contract Confidentially, Side DB, Motivation, Side DB overview, PoW vs BFT Consensus, Consensus Finally Consensus Scalability, Fairness and Scalability in Nakamoto Consensus, Bitcoin-NG: Working Principles Key Blocks and Microblocks, Authority and Digital Signature, Collective Signing (CoSi) Shnoor Multisignature and BLS Signature

Research Aspects in Blockchain: Strong non-probabilistic consistency, BFT over Bitcoin – increasing scalability, Byzcoin Design and Performance, Strong Synchrony vs Weak Synchrony, Avoiding Forks, Transaction Neutrality and Frictionless Evolution, Asynchronous networks as network fault, Cross fault Tolerant (XFT) architecture, XPaxos, Multi-Party Computation (MPC), Fairness in MPC, MPC over Blockchain ensuring fairness, Big Data and Big Network, Why Blockchain for Big data application aspects, BigChain DB-The Blockchain Database

UNIT VI

AI, Blockckahin and Big Data: Data analysis over Blockchain, Logic over Blockchain network, Inferring Decisions through AI, Architecture and concepts, Smart contracts, Ecosystem, Motivation and concepts, Architecture Transaction processing and consensus, Key Features, Transactions and flows, Consensus and architecture details, Final Remarks.

SUGGESTED READING

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric – https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain – An IBM Redbooks course, by Bob Dill, David Smits – http://www.redbooks.ibm.com/Redbooks.nsf/RedbooksAbstracts/crse0401.html

SMART CITIES

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Judge the needs and cause behind the vision to transform into smart cities.
2. Identify the issues and challenges for urban development, at par with the international scenario.
3. Select and demonstrate new technologies for urban development.
4. Interpret the importance of technology and implementation to have smart transportation.
5. Examine the importance of natural resource (water) and use intelligent concepts for preserving it & Appraise and educate the public for user friendly environment and governance to make the county smarter.

UNIT I

Introduction: Vision and goals of smart city, concept of smart city and its features, issues and challenges of urbanization in India, international scenario, issues and probable solutions, need for smarter approaches process of selection of smart cities, developing and demonstrating new technologies, smart city strategies, digital and information technologies, urban planning best practices.

UNIT II

Smart Transportation: Importance and significance of mobility, data collections, smart sensors, role of geographic information system, integration of GIS and ITS, related air quality; accidents and safety analysis; advanced traffic management systems, commercial vehicle operations, advanced transportation systems, advanced vehicle control systems, case studies, public transportation management; electronic payment, connected vehicle technology and application, mobile applications.

UNIT III

Smart Water Management: Reminded of water's importance, challenges for water use and intelligent water system concept, trends and issues for water use management, specific technologies for smart water use, strategic prioritization and allocation, water quality, flooding, drought and aging infrastructure, leakage and pressure management,

UNIT IV

Smart Waste Management: Introduction - Municipal services, smart solutions and emerging in the solid waste management, technologies to process waste, garbage collection.

UNIT V

Power Grids: Smart grid concepts, development of innovative next-generation technologies and tools in the areas of transmission, distribution, energy storage, power electronics, measures of certain parameters of the electric grid, innovative digital technologies for electricity delivery, intensive application of demand-side technologies, Electric Reliability Technology Solutions (CERTS).

UNIT VI

Smart Payments and E-Governance: People participation, accountability and transparency, user-friendly process, removal of hierarchal process barriers and red tape, service delivery Payments and finance concepts, city governments and citizen benefits, economic growth, global GDP, population growth, inadequate infrastructure, operational costs and concepts of e-administration, e-services, e-governance and e-democracy.

TEXT BOOKS

1. Bob Williams, "Intelligent Transport Systems Standards", Artech House Publishers, 2008
2. Ronald A. Beaulieu, "National Smart Water Grid, Integrated Solutions for Sustainable Fresh Water Supply Flexi Bound", 2010.

REFERENCE BOOKS

1. Austroads, "The Implication of Intelligent Transport Systems for Road Safety", Austroads Incorporated, 1999.
2. Chowdhury, M. A. and Sadek, A, "Fundamentals of Intelligent Transportation Systems Planning", Artech House, 2003.
3. Pernille Ingildsen and Gustaf Olsson, "Smart Water Utilities: Complexity Made Simple", 1st Edition, IWA Publishing.
4. Keyhani, Ali, Marwali and Muhammad, "Smart Power Grids", Springer, 2011

CYBER LAWS

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Discuss and evaluate the current trends and technologies such as e-commerce and governance with reference to free market economy.
2. Sketch the importance of digital signature in electronic records.
3. Formulate the importance and role of cyberspace laws and cyber crimes.
4. Design and motivate laws relating to electronic records and intellectual property rights in India.

5. Summarize about the IT act in India and generate the new IT acts for current cyber space.

UNIT I

Internet, E-Commerce and E-Governance with reference to Free Market Economy: Understanding Computers, Internet and Cyber laws, Conceptual Framework of E-commerce: E-Governance, the role of Electronic Signatures in E-commerce with Reference to Free Market Economy in India.

UNIT II

Law Relating to Electronic Records and Intellectual Property Rights in India: Legal aspects of Electronic records / Digital signatures, The roles and regulations of Certifying Authorities in India, Protection of Intellectual Property Rights in Cyberspace in India.

UNIT III

International Efforts Relating to Cyberspace Laws and Cyber Crimes: International efforts related to Cyber laws, Council of Europe (COE) convention on Cyber Crimes.

UNIT IV

Penalties, Compensation and Offences Under the Cyberspace and Internet in India: Penalties, Compensation and Adjunction of violations of provisions of IT Act and Judicial review, some important offences under the Cyberspace law and the Internet in India, Other offences under the Information Technology Act in India.

UNIT V

Miscellaneous Provisions of IT Act and Conclusions: The role of Electronic Evidence and miscellaneous provisions of the IT Act.

UNIT VI

Cyber Crimes & Legal Framework, Cyber Crimes against, Individuals, Institution and State, Hacking, Digital Forgery Cyber Stalking/Harassment Cyber Pornography Identity Theft & Fraud Cyber terrorism Cyber Defamation Different offences under IT Act, 2000

TEXT BOOK

1. Harish Chander, “Cyber Laws and IT Protection”, PHI, 2012.

REFERENCE BOOKS

1. George Kostopoulos, “Cyberspace and Cyber Security”, Auerbach Publications, 2012
2. Albert Marcella, Jr., Doug Menendez, “Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes”, Auerbach Publications, 2nd Edition, 2007.

B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

(INTERNATIONAL ENGINEERING PROGRAM)

L: Theory, T: Tutorial, P/D: Practical/Drawing, C: Credits

CIE: Continuous Internal Evaluation, SEE: Semester End Examination

I Year I Semester

S. No.	Course Code	Course	Hours/Week			
			L	T	P/D	C
1	HS	English - I	2	-	-	2
2	HS	Finance for Engineers	3	-	-	3
3	BS	Mathematics - I	3	1	-	4
4	BS	Engineering Physics - I	3	1	-	4
5	BS	Engineering Chemistry	3	1	-	4
6	HS	English Language Communication Skills Lab	-	-	2	1
7	BS	Engineering Physics - I Lab	-	-	2	1
8	BS	Engineering Chemistry Lab	-	-	2	1
9	ES	Introduction to Programming Lab	-	-	2	1
Total						**21**

I Year II Semester

S. No.	Course Code	Course	Hours/Week			
			L	T	P/D	C
1	HS	English - II	3	-	-	3
2	BS	Mathematics - II	3	1	-	4
3	BS	Engineering Physics - II	3	1	-	4
4	OE	Open Elective - I	3	-	-	3
5	ES	Problem Solving with Programming	3	-	-	3
6	BS	Engineering Physics - II Lab	-	-	2	1
7	ES	Problem Solving with Programming Lab	-	-	2	1
Total						**19**

II Year I Semester

S. No.	Course Code	Course	Hours/Week			
			L	T	P/D	C
1	BS	Mathematics - III	3	1	-	4
2	ES	Smart System Design	3	-	-	3
3	EC	Analog Electronics	3	1	-	4
4	EC	Signals and Systems	3	1	-	4
5	EC	Circuit Theory - I	3	1	-	4
6	EC	Circuit Theory - I Lab	-	-	4	2
7	EC	Analog Electronics Lab	-	-	2	2
Total						**23**

II Year II Semester

S. No.	Course Code	Course	Hours/Week			
			L	T	P/D	C
1	EC	Circuit Theory - II	3	1	-	4
2	OE	**Open Elective - II**	3	-	-	3
3	EC	Probability Theory and Stochastic Processes	3	1	-	4
4	EC	Digital Electronics	3	1	-	4
5	EC	Engineering Differential Equations	3	1	-	4
6	PE	**Professional Elective - I** Electronic Measurement and Instrumentation Digital Design through VHDL Foundations of IoT Neural Networks	3	-	-	3
7	EC	Circuit Theory - II Lab	-	-	4	2
Total						**24**

III Year I Semester

S. No.	Course Code	Course	Hours/Week			
			L	T	P/D	C
1	EC	Integrated Electronics	3	1	-	4
2	ES	Data Structures	3	1	-	4
3	EC	Electromagnetic Waves and Transmission Lines	3	-	-	3
4	EC	Microcontrollers and Applications	3	-	-	3
5	PE	**Professional Elective II** Biomedical Instrumentation Embedded Systems Distributed IoT Systems Coding Theory Computer Organization & Architecture	3	-	-	3
6	ES	Data Structures Lab	3	-	-	1
7	EC	Integrated Circuit Applications Lab	-	-	4	2
8	EC	Microcontrollers and Applications Lab	-	-	2	1
Total						**21**

III Year II Semester

S. No.	Course Code	Course	Hours/Week			
			L	T	P/D	C
1	ES	Object Oriented Programming Concepts	3	-	-	3
2	OE	Open Elective - III	3	-	-	3
3	PE	**Professional Elective - III** Virtual Instrumentation ARM Architecture Security in IoT Optical Communication Antenna and Wave Propagation	3	-	-	3
4	ES	Discrete Mathematical Structures	3	1	-	4
5	EC	Control Systems	3	1	-	4
6	EC	Analog and Digital Communications	3	-	-	3
7	ES	Object Oriented Programming Concepts Through Java Lab	-	-	2	1
8	EC	Analog and Digital Communications Lab	-	-	2	1
Total						**22**

IV Year I Semester

S. No.	Course Code	Course	Hours /Week			
			L	T	P/D	C
1	PE	**Professional Elective - IV** Computer Networks Scripting Languages in VLSI Design Microwave Engineering	3	-	-	3
2	EC	Digital Signal Processing	3	-	-	3
3	EC	CMOS Fundamental and VLSI Fabrication Design	3	-	-	3
4	EC	Digital Signal Processing Lab	-	-	2	1
5	EC	CMOS Fundamental and VLSI Fabrication Design Lab	-	-	2	1
6	EC	Capstone Phase – I	-	-	8	4
Total						**15**

IV Year II Semester

S. No.	Course Code	Course	Hours /Week			
			L	T	P/D	C
1	OE	**Open Elective - IV**	3	-	-	3
2	PE	**Professional Elective - V** Wireless Communication and Networks PLC and Robotics Digital Image Processing Software Defined Radio	3	-	-	3
3	EC	Capstone Phase – II/ Practice School	-	-	18	9
Total						**15**

OPEN ELECTIVES

OPEN ELECTIVE – I

1. *Philosophy*
2. *Design for Social Impact I*
3. *Essentials of Entrepreneurship*
4. *Foundations to Cognitive Science*
5. *Visual Communication and Computer Art*
6. *Environmental Studies*
7. *Marketing for Engineers*
8. *Project Management*
9. *Principles of Electrical and Electronics Engineering*

OPEN ELECTIVE – II

1. *Sociology*
2. *Design for Social Impact II*
3. *Business Modelling and Validation*
4. *Design Cognition*
5. *Image Manipulation in Adobe Photoshop*
6. *Engineering Ethics*
7. *Business Analytics*
8. *Operations Research*
9. *Intellectual Property Rights*

OPEN ELECTIVE – III

1. *Psychology*
2. *Design for Social Impact III*
3. *Startup Launch*
4. *Cognitive Management*
5. *Advanced Visual Organization and After Effects*
6. *MORSE*
7. *Block Chain Technology*
8. *Smart Cities*
9. *Cyber Laws*

ENGLISH I

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6) Compile effective paragraphs and essays.
7) Compile technical and non -technical terminology.
8) Sketch flawless grammar usage.
9) Identify purpose and audience of a given text.
10) Restate scanning and skimming and build critical thinking.

UNIT I
History
Museum brochures, Should we teach History? Working out meaning from content, Academic vocabulary, Grammar for writing: stating opinions, linking contrasting sentences, critical thinking: analyze different opinions, write an introduction and write a balanced opinion essay, parts of speech, verb and verb forms

UNIT II
Environment
Our changing planet, what are the causes of deforestation and what are its effects on the natural environment? (Natural science journal-reading for main ideas), Scanning to find information, topic vocabulary, cause-effect paragraphs, linking word or phrase, topic sentences, tenses, phrasal verbs.

UNIT III
Health and Fitness

Skim a leaflet-keep fit! It's easier than you might think, read the essay –tackling obesity, understand key vocabulary, verbs and nouns, collocations, giving reasons, organization of an essay, write supporting sentences to a problem-solution essay, articles, punctuation, simple, compound, complex sentences, and concord.

UNIT IV
Discovery and Invention
Read the magazine article-the magic of mimicry, making inferences from the text, scanning to predict content-the world of tomorrow, understanding prefixes, making predictions, understand an issue by finding reasons and evidence to support ideas, common errors, advantage-disadvantage essay, speech and voice.

UNIT V

Economics

Skimming and scanning, synonyms, describing graphs-noun phrases and verb phrases, understand and interpret visual information, writing an explanatory paragraph describing a graph and explaining the data, information transfer techniques.

UNIT VI

The Brain

Tricks played by the brain, mind control, previewing, medical language, understanding technical vocabulary, critical thinking, write a process paragraph, one word substitution, writing e-mail, note making

TEXT BOOK

2. Carolyn Westbrook, "Unlock Reading and Writing Skills 3 - B1 English Profile", Cambridge University Press.

REFERENCE BOOKS

5. Raymond Murphy, "Murphy's Essential English Grammar" with CD, Cambridge University Press.
6. V R Narayanaswami, "Strengthen your English", Orient Longman.
7. "A Hand Book of English for Engineers", BSP.
8. M. Ashraf Rizvi, "Effective Technical Communication", Tata McGraw Hill.

FINANCE FOR ENGINEERS

COURSE OUTCOMES

At the end of the course, the student will develop ability to

6. Estimate the cash flows in a business process.
7. Create value maps using price-benefit to customers.
8. Construct Break even chart and calculate the BEP.
9. Apply various techniques in estimating the time value of money.
10. Analyze the income and profit & loss statement of various organizations.

UNIT I

Cash Flow

The Life Line of Business - Estimate Revenue - Cost of Goods - Operating Expenses - Gross Profit and Net Profit - Revenue and Profit - Cost and Profit.

Increasing Profit

Black-Box Model - Strategies for Increasing Revenue -Strategies for Manufacturing Cost - Strategies for Decreasing Operating Expenses.

UNIT II

Value-Price-Cost

Terminology, Key Drivers, Economic Value to Customer, Value Maps-Construction of Value Maps - Price and Benefit to Customer - Price and Cost of Goods Sold - Value Maps and Profit Maximization.

UNIT III

Break-Even Analysis

Break-Even Point, Cost Volume Profit Analysis-Construction of Break Even Point-Assumptions of Break Event Point, Calculation of Break Even Point.

UNIT IV

Life Cycle Costing

Different Life Cycle Cost Contributors. Time Value of Money-Need of Time Value of Money-Techniques of TVM: Discounting Technique and Compounding Technique, Selecting an Appropriate Product.

UNIT V

Balance Sheet and Income Statement

Basic Principles, The Balance Sheet, The Income Statement, Construction of the Balance Sheet and Income Statement, Key Ratios.

UNIT VI

Cash Flow Statement and Connections

Cash Flow Statement, Balance Sheet Connections. Sales Cycle, Expense Cycle, Investment Cycle, Asset Purchase & Depreciation Cycle.

TEXT BOOKS

3. Robert N. Anthony, David F. Hawkins and Kenneth A.Mechant: Accounting-Text and Cases, 12/e TMH, 2008.
4. Narayanaswamy, R., Financial Accounting: A Managerial Perspective, PHI 2008.

REFERENCE BOOKS

6. Gokul Sinha: Financial Statement Analysis, PHI, 2009.
7. Ambrish Gupta: Financial Accounting Management an Analytical Perspective, Pearson Education.
8. Jawaharlal: Accounting for Management, HPH, 2008.
9. Stice & Stice: Financial Accounting Reporting & Analysis. Cengage, 7/e, 2008.
10. Horngren: Financial Accounting, Pearson, 2009.

MATHEMATICS - I

COURSE OUTCOMES

At the end of the course the student should be able to:

6. Understand the concepts of limit and continuity of a function.
7. Recognize the importance of differentiability of a function and also understand the applications of differentiation.
8. Interpret the definite integral geometrically as the area under a curve
9. Apply the techniques of integration to solve improper integrals and also evaluate the integration numerically.
10. Solve the differential equations of first order and first degree with suitable methods and apply these methods to various real world problems.

UNIT I

Functions, Limits and Continuity

Functions and Their Graphs - Combining Functions; Shifting and Scaling Graphs - Trigonometric Functions - Exponential Functions - Inverse Functions and Logarithms. Limit of a function and limit laws – one sided limits – Continuity - Limits Involving Infinity; Asymptotes of Graphs

UNIT II

Derivatives and Applications

The Derivative as a Function - Differentiation Rules - Derivatives of Trigonometric Functions - The Chain Rule - Implicit Differentiation - Derivatives of Inverse Functions and Logarithms - Inverse Trigonometric Functions - Related Rates - Linearization and Differentials - Extreme Values of Functions - Monotonic Functions and the First Derivative Test - L'Hôpital's Rule - Applied Optimization - The Mean Value Theorems – Graphical representation – Newton Raphson Method – Antiderivatives.

UNIT III

Integrals

Integration - Estimating with Finite Sums - Sigma Notation and Limits of Finite Sums - The Definite Integral – Integrals of Transcendental Functions - The Fundamental Theorem of Calculus - Indefinite Integrals and the Substitution Method - Definite Integral Substitutions and the Area between Curves.

UNIT IV

Techniques of Integration and Applications

Integration by Parts - Trigonometric Integrals - Trigonometric Substitutions - Integration of Rational Functions by Partial Fractions - Numerical Integration - Improper Integrals.

UNIT V

First Order Differential Equations

First Order Differential Equations - Integrals as General and Particular Solutions - Slope Fields and Solution Curves - Separable Equations and Applications: Newton's law of cooling – Laws of Natural Growth and Decay - Linear Equations – Bernoulli Equation - Exact Equations.

UNIT VI

Mathematical Models and Numerical Methods

Population Models - Acceleration-Velocity Models - Numerical Approximation: Euler's Method - Modified Euler Method - Runge-Kutta Method

TEXT BOOKS

7. Thomas' Calculus: Early Transcendentals, Joel R. Hass, Davis, Christopher E. Heil, Maurice D. Weir, Pearson publications.
8. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers, Delhi.

REFERENCES

4. Elementary Differential Equations, C. Henry Edwards, David E. Penney, Prentice Hall.
5. Peter V. O'Neil, "Advanced Engineering Mathematics", Cl-Engineering.
6. Erwin kreyszig, "Advanced Engineering Mathematics", John wiley & sons, 605 Third Evenue, New York.

ENGINEERING PHYSICS - I

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Acquire conceptual understanding of fundamentals related to mechanics.
7. Interpret the important concepts and phenomena linked to waves and oscillations.
8. Analyze the intensity variation of light due to interference and diffraction and its significance.
9. Formulate and solve the engineering problems in mechanics and optics.
10. Examine the physical significance of Maxwell's equations as well as explore them.

UNIT I

Motion of Particle

Elements of vectors, Equations of motion-freely falling body and body projected upwards, Projectile motion-horizontal and oblique projection, Force, Newton's laws of motion, Work done-constant and varying force, Kinetic and potential energy, Work-energy principle, Conservative and non-conservative forces, Conservation of mechanical energy

UNIT II

System of Particles and Rotational Motion

Equilibrium of rigid body, Center of mass, Moment of inertia, Parallel and Perpendicular axes theorems, Angular quantities, Types of motion–translational, rotational and rolling motion, Rotational kinetic energy, Conservation of linear and angular momentum, Universal law of gravitation

UNIT III

Waves and Oscillations

Introduction, Free oscillations, Simple harmonic oscillator-equation of motion and its solution, Characteristics and energy of simple oscillator, Torsional pendulum-rigidity modulus of wire, Damped and Forced oscillations-equations of motion and their solutions, Sharpness of resonance, Quality factor, Electrical analogy of forced oscillator

UNIT IV

Interference and Diffraction

Interference: Conditions for sustained interference of light, Young's double slit experiment, Interference in thin films, Newton's rings by reflected light.

Diffraction: Distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction at a single slit and double slit (qualitative), N-slits-diffraction grating, Resolving power and Dispersive power of grating

UNIT V

Laser

Characteristics of laser, Absorption and emission of radiation, Einstein's coefficients and relation between them, Lasing action, Types of lasers - He-Ne laser and semiconductor laser, Applications of lasers

UNIT VI

Electrodynamics

Introduction to electrostatics, Coulomb's law, Gauss law of electrostatics, Introduction to magnetostatics, Gauss law of magnetostatics, Biot-Savart law, Time varying electric and magnetic fields-Faraday's laws of electromagnetic induction, Lenz's law, Ampere's law, Displacement current, Differential form of Maxwell's equations, Physical significance of Maxwell's equations, Electromagnetic waves - wave equation, Electromagnetic energy density, Poynting theorem

TEXT BOOKS

3. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley & Sons (P) Ltd., Tenth Edition – 2013.
4. R.K. Gaur & S.L. Gupta, "Engineering Physics", Dhanpat Rai Publications (P) Ltd., Eighth Edition – 2001 (Reprint – 2008).

REFERENCE BOOKS

4. Douglas C. Giancoli, "Physics – Principles with Applications", Prentice Hall, Sixth Edition – 2005.
5. Matthew N.O. Sadiku, "Principles of Electromagnetics", Oxford University Press, Fifth Edition – 2010.
6. M.N. Avadhanulu and P.G. Kshirsagar, "A Text book of Engineering Physics", S. Chand & Company Ltd., Tenth Revised Edition – 2013.

ENGINEERING CHEMISTRY

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Predict atomic structure, chemical bonding or molecular geometry based on accepted models
7. Illustrate the concept of chirality, stereochemical and compare various types of chromatography-spectroscopic methods
8. Explain the basics of electrochemistry and different types of electro chemical cells
9. Utilize the softening techniques of hard water
10. Identify the importance of various engineering materials

UNIT I

Periodic properties and Chemical bonding

Properties of elements, electronic configurations, atomic and ionic sizes, ionization energies, electronegativity, oxidation states, polarisability.

Chemical bonding-VBT-Definition, principle, overlapping of orbitals, molecular shapes.

Crystal field theory-Energy level splitting of d-orbitals for tetrahedral and octahedral complexes.

Molecular orbital theory- Molecular diagrams of homo and hetero diatomic molecules, bond order and magnetic properties.

UNIT II

Organic Reactions and Stereochemistry

Introduction to organic chemical reactions, types of reactions-addition, substitution, and elimination reactions.

Stereochemistry

Introduction to stereoisomers, configurations and chirality, enantiomers and diastereomers.

UNIT III

Free Energy in chemical equilibria: Concept of Gibbs free energy, electrode potentials, electrochemical series, EMF of cell, Nernst equation, numerical problems, types of electrodes, metal–metal ion electrode, gas electrode and ion selective electrode-glass electrode and fluoride ion electrode. Applications of electrode potential - Energy storage cells-Lithium ion and Ni-Cd Cells, fuel cells-H_2-O_2 and CH_3OH-O_2 fuel cell.

Corrosion - Definition, control methods-electroplating and anodizing

UNIT IV

Spectroscopic techniques and applications

Introduction, Principles of spectroscopy and selection rules, Beer-Lambert's law, and vibrational electronic spectroscopy (Fluorescence) and their applications in medicine.

Chromatography-Introduction, principles and applications of thin layer chromatography and gas chromatography.

UNIT V

Water Chemistry

Drinking water quality parameters-WHO guidelines, BIS guidelines, alkalinity, dissolved oxygen and hardness of water- representation, types and units of hardness, determination of hardness by EDTA method, problems. boiler troubles- caustic embrittlement, boiler corrosion, scale and sludge formation, methods of softening of water - Zeolite process and problems, Ion-exchange process, brackish water - Electro dialysis and Reverse osmosis.

UNIT VI

Material Chemistry: Bio Polymers-Synthesis and applications of PHA, PLA

Lubricants-Definition, criteria for good lubricants, Properties-viscosity, surface tension, flash point and fire point.

Refractories-Characteristics of Refractories, Concept of Refractoriness (RUL & Segar cone test).

Fuels - Types and Characteristics of fuels (Liquid and gaseous fuels**),** Knocking-Octane number, anti-knocking agents and Cetane number. Gaseous fuels- CNG, LPG, Calorific values (Units), Dulong's formulae for NCV and GCV, numerical problems

TEXT BOOKS

5. Gurudeep Raj, "Advance Physical Chemistry", Krishna Prakasham Media, GOEL Publishing House.
6. K.Mukkanti and SS Dara,"A Text book of Engineering Chemistry",S Chand Publications.
7. C. Parameswara Murthy, CV Agarwal and Andra Naidu, "Text book of Engineering Chemistry", BS Publications, Hyderabad (2008).
8. Shashi Chawla, "A Text Book of Engineering Chemistry", Tata McGraw Hill Education Private Limited, New Delhi-2012.

REFERENCE BOOKS

3. Oleg Roussak and H.D. Gesser, "Applied Chemistry: A Textbook for Engineers and Technologists", Springer, 2nd Edition 2013.
4. P.C. Jain and Jain, "Engineering Chemistry"-Sixteenth Edition, Dhanpat Rai Publishing Company, New Delhi-2014.

ENGLISH LANGUAGE COMMUICATION SKILLS LAB

COURSE OUTCOMES

At the end of the course the student will develop ability to

6. Reproduce the sounds of language as per the rule of pronunciation
7. Build speaking abilities with proper body language.
8. Paraphrase the description of people, objects and place.
9. Evaluate the effectiveness in improving in speaking levels.
10. Build Telephone Etiquette by using language for assent and dissent and recall essentials of communication methods.

The **Language Lab** focuses on the production and practice of sounds of language and familiarises the students with the use of English in everyday situations and contexts.

Exercise I

History

Watch and understand a video about archaeology, watch the video and list the main ideas, using visuals to predict content.

Ice-Breaking activity and JAM session, word formation, speech sounds – speech mechanism diagram.

Exercise II

Environment

Watch and understand a video about global warming- Alaskan glaciers, watch the video and complete the diagram, using knowledge to predict content.

Situational English – Role-Play- Social etiquette: Expressions in Various Situations – Self-introduction and Introducing others – Greetings – Apologies – Requests –– Consonantal sounds.

Exercise III

Health and Fitness

Watch and understand a video about professional cyclists, watch the video and complete the notes, understand key vocabulary.

Descriptions- Narrations- Giving Directions and guidelines – Vowel sounds.

Exercise IV

Discovery and Invention

Watch and understand a video about the ASIMO robot, watch the video and number the main ideas, watch again and complete the sentences with a word or a number.

Oral Presentation – Non verbal communication – gestures – proxemics – facial expressions – Making power point presentation – advantages of PPT – dos and don'ts – using bullets – font size – colour contrast.

Exercise V

Economics

Watch and understand a video about an emerging economy, watch the video and use knowledge to predict content, watch again and complete the lecture notes.

Group Discussion – concept – types of group discussion – dos and don'ts – advantages.

Exercise VI

The Brain

Watch and understand a video about the brain, watch the video and complete the notes using one word for each gap, watch again and choose the correct word in the sentences below.

Reading Comprehension -Resume writing - cover letter.

TEXT BOOKS

a. Carolyn Westbrook, "Unlock Reading and Writing Skills 3 - B1 English Profile", Cambridge University Press.

REFERENCE BOOKS

4. Laxminarayana K, "English for Technical Communication", SciTech.
5. Sudha Rani D, "A Manual for English Language Laboratory", Pearson.
6. Sudha Rani D, "Advanced Communication Skills Laboratory", Pearson.

SUGGESTED SOFTWARE:

7. Cambridge Advanced Learners' English Dictionary with CD.
8. Grammar Made Easy by Darling Kindersley.
9. Punctuation Made Easy by Darling Kindersley.
10. Oxford Advanced Learner's Compass, 8th Edition.
11. DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
12. English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.

ENGINEERING PHYSICS - I LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Estimate the frequency of tuning fork and AC supply with the help of stretched strings
7. Analyze as well as compare the intensity distribution of interference and diffraction patterns
8. Draw the characteristics of electrical circuits and evaluate the dependent parameters
9. Explore and understand the applications of semiconducting devices
10. Develop skills in observation, interpretation, reasoning, predicting and questioning in order to realize new knowledge

List of Experiments: (Any Eight Experiments Compulsory)

13. Frequency of an AC supply using sonometer
14. Frequency of electrically driven tuning fork using Melde's apparatus
15. Rigidity modulus of a wire using torsional pendulum
16. Planck's constant using photocell
17. Radius of curvature of a plano-convex lens using Newton's rings setup
18. Wavelength of a source (sodium vapour lamp) using diffraction grating
19. Wavelength of a laser source using diffraction grating
20. Magnetic field along the axis of current carrying coil using Stewart and Gee's apparatus
21. Time constant of an R-C circuit (Charging and Discharging)
22. Resonant frequency and Quality factor - LCR circuit
23. Characteristics of a solar cell
24. Energy gap of the material of a p-n junction diode

TEXT BOOKS

1. Y.Aparna and K.Venkateswara Rao, "Laboratory Manual of Engineering Physics", VGS Publishers.

ENGINEERING CHEMISTRY LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Explain about the determination of alkalinity and hardness of water.
7. Examine the P^H, conductance and absorbance of copper in brass by using instrumental methods.
8. Make use of bleaching power to determine the amount of chlorine.
9. Utilize the viscometer, stalagnometer to find out the viscocity and surface tension of liquids.
10. Apply the TLC technique for the separation of mixture of compounds.

LIST OF EXPERIMENTS

13. Determination of alkalinity of water sample.
14. Estimation of hardness of water by EDTA method.
15. Determination of available chlorine in bleaching powder.
16. Determination of surface tension
17. Determination of viscosity
18. Determination of cell constant by Conductometry.
19. Determination of strength of acid by Conductometry
20. Potentiometry - Redox titration
21. Determination of strength of acid by pH metry
22. Determination of amount of Cu^{+2} in Brass sample by Colorimetry
23. Determination of Rf factor by Thin layer chromatography
24. Synthesis of Polymer (Urea – Formaldehyde resin) / Drug (Asprin)

INTRODUCTION TO PROGRAMMING LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Design algorithms to solve simple problems
7. Sketch flow charts to the algorithms.
8. Acquire syntactic familiarity with C programming language.
9. Write programs with decision-making and iterative control structures.
10. Develop programs using arrays, strings and string manipulations.

Week: 1

Problem solving Techniques: Algorithm, Properties of Algorithm, Algorithm development approaches, Flow chat development.

b) Creating a new flow charts for solving scientific problems

Assignment:

Creating a new flow charts for solving scientific problems.

Week: 2

Programming environment of C in Linux

d) Basic Commands of Linux
e) vi Editor Usage
f) Compiling and Executing a C Program

Assignment:

4. Create a new subdirectory called CSE2018.
5. Change your current working directory to CSE201811.
6. Display a listing of all the files in the working directory.

Week: 3.

b) Introduction to C Programming: Identifiers, Basic datatypes, I/O functions.

Programs

e) Write a C program to convert a string to an unsigned long integer
   Test Data and Expected Output :
   Input an unsigned number: 25
   Output: 25
f) Write a C program to convert a string to a double.
   Expected Output :
   Output= 4.00

g) Write a program in C that reads a forename, surname and year of birth and display the names and the year one after another sequentially

Expected Output :
Input your firstname: Tom
Input your lastname: Davis
Input your year of birth: 1982
Tom Davis 1982

h) Demonstration on I/O functions and variations.

Assignment:

3. Write a C program to print a block F using hash (#), where the F has a height of seven characters and width of six and five characters.
   Expected Output:

```
######

#

#

#####

#

#

#
```

4. Write a C program to print a big 'C'.
   Expected Output:

```
  ######
 ##    ##
#
#
#
#
#
 ##    ##
  ######
```

Week: 4

b) Operators:

Programs

f) Write a C program to integral quotient and remainder of a division.
g) Write a C program that accepts two item's weight (floating points' values) and number of purchase (floating points' values) and calculate the average value of the items.
 Test Data :
 Weight - Item1: 15
 No. of item1: 5
 Weight - Item2: 25
 No. of item2: 4
 Expected Output:
 Average Value = 19.444444
h) Write a C program to check Least Significant Bit (LSB) of a number is set or not.
i) Write a C program to convert decimal to binary number system using bitwise operator.
j) Demonstration on special operator.

Assignment

4. Write a C program to convert specified days into years, weeks and days.
 Note: Ignore leap year.

 Test Data :
 Number of days : 1329
 Expected Output :
 Years: 3
 Weeks: 33
 Days: 3

5. Write a C program to read an amount (integer value) and break the amount into smallest possible number of bank notes.
 Test Data :
 Input the amount: 375
 Expected Output:
 There are:
 3 Note(s) of 100.00
 1 Note(s) of 30.00

1 Note(s) of 20.00
0 Note(s) of 10.00
1 Note(s) of 5.00
0 Note(s) of 2.00
0 Note(s) of 1.00

6. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

   Test Data :

   Input the first integer: 25

   Input the second integer: 35

   Input the third integer: 15

   Input the fourth integer: 46

   Wrong values

Week: 5

Expressions, Type conversion, precedence & associatively

Programs

d) Demonstration on expression evaluation.
e) Demonstration on type conversion.
f) Demonstration on precedence & associatively rules.

Assignment

Week: 6.

Decision making and branching statements simple if, if else.

Programs

e) Write a C program to check a given integer is positive even, negative even, positive odd or negative odd. Print even if the number is 0.
   Test Data :
   Input an integer: 13
   Expected Output:
   Positive Odd

f) Write a C program to check whether the given year is leap or not.
g) Write a C program to check whether the given number is even or odd.
h) Write a C program to read the age of a candidate and determine whether he/she is eligible for casting his/her own vote.
 Test Data : 21
 Expected Output :
 Congratulation! You are eligible for casting your vote.

Assignment

3. If cost price and selling price of an item is input through the keyboard, write a program to determine whether the seller has made profit or incurred loss. Also determine how much profit he made or loss he incurred.
4. Write a program to calculate overtime pay of 10 employees. Overtime is paid at the rate of Rs. 12.00 per hour for every hour worked above 40 hours. Assume that employees do not work for fractional part of an hour.

Week: 7

If else ladder, nested if, switch-case statement

Programs

a) Write a C program that reads an integer between 1 and 12 and print the month of the year in English.

Test Data :
Input a number between 1 to 12 to get the month name: 8
Expected Output:
August

e) Write a C program to find the largest of three numbers.
 Test Data : 12 25 52
 Expected Output :
 1st Number = 12, 2nd Number = 25, 3rd Number = 52
 The 3rd Number is the greatest among three

f) Write a C program to check whether a character is an alphabet, digit or special character.
 Test Data :
 @
 Expected Output :
 This is a special character

g) Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
   Test Data :
   1
   5
   Expected Output :
   The area is : 78.300000

h) Write a C program to create Simple Calculator using switch case.

Assignment

4. Write a C program to read the value of an integer m and display the value of n is 1 when m is larger than 0, 0 when m is 0 and -1 when m is less than 0.
   Test Data : -5
   Expected Output :
   The value of n = -1
5. Write a C program to find the eligibility of admission for a professional course based on the following criteria:

Marks in Maths >=65
Marks in Phy >=55
Marks in Chem>=30
Total in all three subject >=180
or
Total in Math and Subjects >=140
Test Data :
Input the marks obtained in Physics :65
Input the marks obtained in Chemistry :51
Input the marks obtained in Mathematics :72
Expected Output :
The candidate is eligible for admission.

6. An Insurance company follows following rules to calculate premium.
   (5) If a person's health is excellent and the person is between 25 and 35 years of age and lives in a city and is a male then the premium is Rs. 4 per thousand and his policy amount cannot exceed Rs. 2 lakhs.
   (6) If a person satisfies all the above conditions except that the sex is female then the premium is Rs. 3 per thousand and her policy amount cannot exceed Rs. 1 lakh.
   (7) If a person's health is poor and the person is between 25 and 35 years of age and lives in a village and is a male then the premium is Rs. 6 per thousand and his policy cannot exceed Rs. 10,000.
   (8) In all other cases the person is not insured.

Write a program to output whether the person should be insured or not, his/her premium rate and maximum amount for which he/she can be insured.

Week: 8

b) Decision making and looping statements while, do... while

Programs

f) Write a C program to print 3 numbers in a line, starting from 1 and print n lines. Accept number of lines (n, integer) from the user.

Test Data :

Input number of lines: 5

Expected Output:

1 2 3

4 5 6

7 8 9

10 11 12

13 14 15

g) Write a C program to print a number, it's square and cube in a line, starting from 1 and print n lines. Accept number of lines (n, integer) from the user.

Test Data :

Input number of lines: 5

Expected Output:

1 1 1

2 4 8

3 9 27

4 16 64

5 25 125

h) Write a program in C to display the first n terms of Fibonacci series.

Fibonacci series 0 1 1 2 3 5 8 13 .....

Test Data :

Input number of terms to display : 10

Expected Output :

Here is the Fibonacci series upto to 10 terms :

0 1 1 2 3 5 8 13 21 34

i) Write a program in C to check whether a number is a palindrome or not.

Test Data :

Input a number: 121

Expected Output :

121 is a palindrome number.

j) Programs on special operator

Assignment

4. Write a c program to find the perfect numbers within a given number of range.
   Test Data :
   Input the starting range or number : 1
   Input the ending range of number : 30
   Expected Output :
   The Perfect numbers within the given range : 6 28

5. Write a program to print out all Armstrong numbers between 1 and 300. If sum of cubes of each digit of the number is equal to the number itself, then the number is called an Armstrong number. For example, 153 = (1 * 1 * 1) + (5 * 5 * 5) + (3 * 3 * 3).
6. Write a program in C to make such a pattern like a pyramid with an asterisk.

```
   *
  * *
 * * *
* * * *
```

Week: 9

For loops, unconditional statements – go to break and continue.

Programs

e) Write a program in C to find the number and sum of all integer between 100 and 200 which are divisible by 9.

Expected Output :

Numbers between 100 and 200, divisible by 9 :

108 117 126 135 144 153 162 171 180 189 198

The sum : 1683

f) Write a C program to check whether a number is a Strong Number or not.

Test Data :

Input a number to check whether it is Strong number: 15

Expected Output :

15 is not a Strong number.

g) Write a program in C to convert decimal number to binary number.
h) Demonstration on unconditional statements.

Assignment:

3. Write a C program to print all numbers between 1 to 100 which divided by a specified number and the remainder will be 3.

    TestData :

    Inputan integer: 25

    Expected Output:

    3

    28

    53

    78

4. Write a C program to check whether a number is a Strong Number or not.
   Test Data :
   Input a number to check whether it is Strong number: 15
   Expected Output :
   15 is not a Strong number.

Week: 10

Arrays: single dimensional array

Programs

f) Write a program which performs the following tasks:
   − initialize an integer array of 10 elements in **main( )**
   − multiply each element of array by 3
g) Write a C program to put even and odd elements of array in two separate array.
h) Write a C program to search an element in an array.
i) Write a C program to delete an element from an array at specified position.
j) Write a C program to count total number of duplicate elements in an array

Assignment

3. Write a C program to read and print the elements of an array of length 5, before print, put the triple of the previous position starting from the second position of the array.

For example, if the first number is 2, the array numbers must be 2, 6, 18, 54 and 162

Test Data:

Input the first number of the array: 5

Expected Output:

n[0] = 5

n[1] = 15

n[2] = 45

n[3] = 135

n[4] = 405

4. Maze Problem- Write a C program to check wheather there is a path form starting point to ending point.

Week: 11

b) Two-dimensional Arrey

Programs

c) Write a program to pick up the largest number from any 5 row by 5 column matrix.
d) Write a C program that uses functions to perform the following:
   ii) Addition & Multiplication of 2 matrices

Assignment

1. The partially initialized array "table" can be viewed as a primitive spreadsheet, in which the last column and bottom row have been left blank. Write the code to fill in this row and column with the totals of each column, each row, and the grand total.

1	2	3	4	5	
2	4	6	8	10	
20	10	5	3	1	
3	6	9	12	15	

Week: 12

String Handling

Programs:

g) Write a C program to find length of a string.
h) Write a C program to copy one string to another string.
i) Write a C program to concatenate two strings.
j) Write a C program to compare two strings.
k) Write a C program to determine if the given string is a palindrome or not.
l) Write a C program to demonstrate all string handling functions.

Assignment:

4. Write a program in C to find maximum occurring character in a string.

Test Data :

Input the string : Welcome to Bheemaram

Expected Output :

The Highest frequency of character 'e'

appears number of times : 4

5. Write a program in C to read a sentence and replace lowercase characters by uppercase and vice-versa.

Test Data :

Input the string : This Is A Test String.

Expected Output :

The given sentence is : This Is A Test String.

After Case changed the string is: tHIS iS a tEST sTRING.

6. Write a program that replaces two or more consecutive blanks in a string by a single blank. For example, if the input is Grim   return   to   the   planet   of   apes!!
the output should be
Grim return to the planet of apes!!

Week: 13

c) Storage classes

Programs

d) Write a C program to demonstrate the visibility level of auto variables.
e) Write a C program to demonstrate the visibility level of static variables.

f) Write a C program to demonstrate the visibility level of register variables.

Assignment

2. Output of following programs?

```
#include <stdio.h>

int main()

{

   static int i=5;

   if(--i){

       main();

       printf("%d ",i);

   }

}

#include <stdio.h>

int main()

{

  int x = 10;

  static int y = x;

   if(x == y)

    printf("Equal");

  else if(x > y)

    printf("Greater");

  else

    printf("Less");

  return 0;

}
```

```
#include <stdio.h>
int main()
{
  static int i=5;
  if (--i){
    printf("%d ",i);
    main();
  }
}
```

ENGLISH - II

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Understand and effectively apply the steps in the writing process.
7. Build unified, coherent and adequately developed paragraphs.
8. Adapt writing goals and styles to various audiences to achieve appropriate writing style and content.
9. Identify syntax.
10. Collect and process the information in a specific discipline and use editing and revising techniques to improve writing quality.

UNIT I

Introduction to Academic Writing

Introduction, types, features, responsive reading, reading with a purpose, critical reading and analysis, developing academic writing, academic honesty, plagiarism.

UNIT II

Elements of the Essay

Structure **-** crafting sentences, clauses and phrases, grammatical sentence types, rhetorical sentence types, writing longer sentences, punctuation, expletive constructions, Style-principles of plain style, Vocabulary-task analysis: direction words, choosing specific and concrete words, Evidence, Analysis, Sources-writing introductions and conclusions, pre-draft response, writing the draft, editing and proof reading.

UNIT III

Tertiary Essay Writing

Time management, choosing and narrowing topics, coherent and grammatically correct sentences, production of original and organized compositions, brainstorming, researching the topic, revising the plan.

UNIT IV

Compare and Contrast Essay

Setting, early thoughts develop clarity and focus, planning, significant differences; pose analytical questions, topic sentences and paragraph structures, sample essay.

UNIT V

Exploratory Essay

Value of exploratory writing, knots and questions, practicing exploratory writing, making meanings, organizing an exploratory essay, sample essay in exploratory form.

UNIT VI

Argumentative Essay

Organizing an argumentative essay, drafting a thesis statement, constructing a sentence outline, clarification strategies, metadiscourse and programmatic statements, transitional expressions, definitions, composing titles, comparing the argument essay and the exploratory essay, sample essay in argument form.

TEXT BOOKS

3. Matthew Parfitt.2016. “Writing in Response”, Bedford/ St.martin’s, Macmillan Education, Boston, Newyork.
4. Bailey.S. 2015.”Academic Writing: A Hand book for International students”, London and Newyork: Routledge.

REFERENCE BOOKS

5. Murray, N.2012.”Writing Essays in English Language and Linguistics”, Cambridge University Press.
6. Oshima ,A. & Hogue,A. 2005.”Writing Academic English”, Addison-Wesley, Newyork.
7. Craswell, G.2004.”Writing for Academic Success,” Sage Publications.
8. Jordan, R.R.1999.” Academic Writing Course”, London: Nelson/ Longman.

MATHEMATICS - II

COURSE OUTCOMES

At the end of the course the student should be able to:

6. Apply the methods of solving higher order linear differential equations to solve some real world problems.
7. Apply the Knowledge of Matrices, Eigenvalues and Eigen Vectors in problems involving Science and Engineering
8. Develop Fourier series for different types of functions.
9. Understand the notion of functions of several variables and discuss their maxima & minima.
10. Evaluate the double & triple integrals in a given region of integration by various techniques.

UNIT I

Linear Differential Equations of Higher Order

Introduction: Second-Order Linear Equations - General Solutions of Linear Equations - Homogeneous and Non homogeneous Equations with Constant Coefficients - Applications: Mass Spring Systems - Electrical Circuits.

UNIT II

Functions of Several Variables

Parametrizations of Plane Curves - Calculus with Parametric Curves - Polar Coordinates - Graphing Polar Coordinate Equations - Areas and Lengths in Polar Coordinates. - Functions of Several Variables - Limits and continuity - Partial derivatives - The Chain Rule - Tangent planes and Differentials – Taylor's Formula for Two Variables - Extreme values and saddle points – Lagrange Multipliers.

UNIT III

Fourier Series

Definition of Fourier series - Dirichlet conditions - Fourier series of functions defined in $[0,2\pi]$ - Fourier series of Even and Odd functions - Half range Fourier sine and cosine series - Fourier series in arbitrary intervals.

UNIT IV

Multiple Integrals

Double and Iterated Integrals over Rectangles - Double Integrals over General Regions - Area by Double Integration - Double Integrals in Polar Form - Triple Integrals in Rectangular Coordinates – Triple Integrals in Cylindrical and Spherical Coordinates.

UNIT V

Linear Algebra I

Types of Matrices – Real and Complex Matrices - Rank of a Matrix - Linear Systems of Equations - Solutions of Linear Systems – Inverse of a Matrix: Gauss-Jordan method.

UNIT VI

Linear Algebra II

Symmetric, Skew-Symmetric, and Orthogonal Matrices – Eigen values, Eigen vectors – properties of Eigen values and Eigen vectors – Cayley-Hamilton theorem (without proof) – Inverse and Powers of a Matrix.

TEXT BOOKS

3. Thomas' Calculus: Early Transcendentals, Joel R. Hass, Davis, Christopher E. Heil, Maurice D. Weir, Pearson publications.
4. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers, Delhi.

REFERENCES

4. Elementary Differential Equations, C. Henry Edwards, David E. Penney, Prentice Hall.
5. Erwin kreyszig, "Advanced Engineering Mathematics", John wiley & sons, 605 Third Evenue, New York.
6. Peter V. O'Neil, "Advanced Engineering Mathematics", Cl-Engineering.

ENGINEERING PHYSICS - II

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Understand and apply the fundamentals of quantum mechanics to microscopic particles
7. Recognize the role of defects in physical properties of crystals and analyze crystal structure using X-ray diffraction
8. Elucidate the basis for classification of dielectric and magnetic materials and their related concepts
9. Apply the knowledge acquired from basics of materials science to realize devices with better performance and smaller in size
10. Explore connections between theory and applications

UNIT I

Quantum Mechanics

Classical mechanics and its limitations, de Broglie hypothesis, Matter waves, Davisson-Germer experiment, Heisenberg's uncertainty principle, Schrodinger time independent wave equation, Physical significance and properties of wave function, Particle in one dimensional box, Tunnelling effect (qualitative) – Applications

UNIT II

Band Theory of Solids

Introduction, Motion of electron in a periodic potential-Bloch theorem, Kronig-Penny model (qualitative)-origin of energy bands in solids, Velocity and effective mass of an electron, Classification of solids-conductors, semiconductors and insulators, Direct and indirect band gap of semiconductors

UNIT III

Crystallography

Introduction, Unit cell, Crystal systems and Bravais lattices, Crystal planes and Miller indices, Interplanar spacing of orthogonal crystal systems, Crystal defects-classification, Effect of crystal defects on physical properties, X-ray diffraction-Bragg's law, Debye-Scherrer method, Applications of X-ray diffraction

UNIT IV

Dielectric Properties

Introduction, Polarization mechanisms-electronic, ionic, orientation and space charge polarizations (qualitative), Dielectric relaxation, Piezo-electricity-production and detection of ultrasonics by piezo-electric effect, Applications of ultrasonics, Pyro-electricity, Ferro-electricity-hysteresis, Applications of dielectric materials

UNIT V

Magnetic Properties

Introduction, Origin of magnetic moment, Classification and characteristics of magnetic materials, Domain theory of ferromagnetism-hysteresis, Soft and hard magnetic materials, Magnetostrictive effect, Applications of magnetic materials, Superconductivity-Meissner effect, Type I & II superconductors, High T_c superconductors, Applications

UNIT VI

Nanomaterials

Introduction, Surface area to volume ratio, Quantum confinement, Classification of nanomaterials (1D, 2D, 3D), Properties of nanomaterials, Types and properties of carbon nanotubes, Top-down fabrication - Ball milling method, Bottom-up fabrication - Sol-gel method, Characterization of nanomaterials: X-ray diffractometer (XRD)-Determination of particle size, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) and Atomic Force Microscope (AFM), Applications of various nanomaterials

TEXT BOOKS

3. M.N. Avadhanulu & P.G. Kshirsagar, “A Text book of Engineering Physics”, S. Chand & Company Ltd., Tenth Revised Edition – 2013.
4. P.K. Palanisamy, “Engineering Physics”, SciTech Publications, India (P) Ltd., Third Edition - 2013.

REFERENCE BOOKS

5. S.O. Pillai, “Solid State Physics”, New Age International (P) Ltd., Sixth Edition – 2010.
6. R.K. Gaur & S.L. Gupta, “Engineering Physics”, Dhanpat Rai Publications (P) Ltd., Eighth Edition – 2001 (Reprint – 2008).
7. A.J. Dekker, “Solid State Physics”, Mac Millan India Ltd.
8. B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath & J. Murday, “Textbook of Nanoscience and Nanotechnology”, Universities Press, First Edition – 2013.

PROBLEM SOLVING WITH PROGRAMMING

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Analyze and implement software development tools like algorithm, pseudo codes and programming structure.
7. Modularize the problems into small modules and then convert them into modular programs
8. Apply the pointers, memory allocation techniques and use of files for dealing with variety of problems.
9. Apply C programming to solve problems related to scientific computing.
10. Develop efficient programs for real world applications.

UNIT I

Pointers

Basics of pointers, pointer to array, array of pointers, void pointer, pointer to pointer- example programs, pointer to string.

Project: Simple C project by using pointers.

UNIT II

Structures

Basics of structure in C, structure members, accessing structure members, nested structures, array of structures, pointers to structures - example programs, Unions- accessing union members- example programs.

Project: Simple C project by using structures/unions.

UNIT III

Functions

Functions: User-defined functions, categories of functions, parameter passing in functions: call by value, call by reference, recursive functions. Passing arrays to functions, Passing strings to functions, passing a structure to a function.

Project: Simple C project by using functions.

UNIT IV

File Management

Data Files, Opening and Closing a Data File, Creating a Data File, Processing a Data File, Unformatted Data Files.

Memory Management

Memory Management: Dynamic memory allocation and deallocation functions:- malloc , calloc, realloc and free.

Project: Simple C project by using files.

UNIT V

Low-Level Programming, Register Variables, Bitwise Operations, Bit Fields

Pre-processor Directives

Additional Features of C, Enumerations, Command Line Parameters, More About Library Functions, Macros, The C Preprocessor. Pre-processor directives: Typedef, #define, #undef, #if,#endif,#elif, #ifdef, #ifndef, #error.

UNIT VI

Basic of C++ Programming:

Introduction to C++. Differences between C and C++, C++ Program Structure, Disadvantage of Conventional Programming, data types, variables, scope and life time of variables, operators, expressions, and control statements. Arrays, Strings, Functions. Basics concepts of OOPs

TEXT BOOKS

3. Computer Science: A Structured Programming Approach Using C- B. A. Forouzan and R.F. Gilberg, Third Edition, Cengage Learning'
4. B.W.Kernighan Dennis M. Ritchie, The C Programming Language, PHI/Pearson Education,ISBN:0-13-110362-8

REFERENCE BOOKS

5. “The spirit of C: an Introduction to Modern Programming” by Henry Mulish Cooper.
6. C Programming: A Modern Approach by K.N. King .
7. Let us C by Yashwant Kanetkar. 13th edition, BPB Publications
8. Computer science a structured programming approach using C by Pradeep K.Sinha, Priti Sinha, 3rd edition, Thomson publications.

ENGINEERING PHYSICS - II LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Realize the concept of forced oscillations with the help of electrical circuits
7. Analyze as well as compare the intensity distribution in optical phenomena and their related applications
8. Draw the characteristics of electrical circuits and evaluate the dependent parameters
9. Explore and understand the applications of semiconducting devices
10. Develop skills in observation, interpretation, reasoning, predicting and questioning in order to realize new knowledge

List of Experiments: (Any Eight Experiments Compulsory)

12. Frequency of electrically driven tuning fork using Melde's apparatus
13. Resonant frequency and quality factor - LCR circuit
14. Time constant of an R-C circuit (Charging and Discharging)
15. Magnetic field along the axis of current carrying coil using Stewart and Gee's apparatus
16. Resolving power of diffraction grating
17. Radius of curvature of a plano-convex lens using Newton's rings setup
18. Numerical aperture of an optical fiber
19. Bending losses of an optical fiber
20. Quantum states using PhET simulations
21. Planck's constant using photocell
22. Energy gap of the material of a p-n junction diode

TEXT BOOKS

3. D.C. Tayal, "University Practical Physics", Himalaya Publishing House.
4. Y.Aparna and K.Venkateswara Rao, "Laboratory Manual of Engineering Physics", VGS Publishers.

PROBLEM SOLVING WITH PROGRAMMING LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Analyze and implement software development tools like algorithm, pseudo codes and programming structure.
7. Modularize the problems into small modules and then convert them into modular programs
8. Apply the pointers, memory allocation techniques and use of files for dealing with variety of problems.
9. Apply C programming to solve problems related to scientific computing.
10. Develop efficient programs for real world applications.

Week 1

4. Compute sum of the array elements using pointers !
5. Write a C program to find the sum of all elements of an array using pointers as arguments.
6. Write a C program to convert a Floating Point Number base(10) to binary number.

Week 2

5. Access Elements of an Array Using Pointer
6. C Program Swap Numbers in Cyclic Order Using Call by Reference
7. Find Length of the String using Pointer
8. Program to read integers into an array and reversing them using pointers

Week 3

5. Add Two Numbers Using Pointer !
6. Calculate Size of Pointer in C Programming
7. Difference between two float Pointers
8. Difference between two integer Pointers

Week 4 - Structures

4. write a C program for defining a structure of bank customer details.(account number , acc holder name, acctype, balance)
5. Write a C program to Demonstrate Elecricity Bill of One Year.
6. Write the Programs using structures and Unions

Week 5- Structures

7. Store Information(name, roll and marks) of a Student Using Structure
8. Add Two Distances (in inch-feet) System Using Structures
9. Add Two Complex Numbers by Passing Structure to a Function
10. Calculate Difference Between Two Time Period
11. Store Information of 10 Students Using Structure

Week 6 - Functions

6. Write the programs using functions
7. Display all prime numbers between two Intervals
8. Check Prime and Armstrong Number by making function
9. Check whether a number can be expressed as the sum of two prime number
10.

Week 7 - Functions

6. Find sum of natural numbers using recursion
7. Calculate factorial of a number using recursion
8. Find G.C.D using recursion
9. Reverse a sentence using recursion
10.

Week 8 - Functions

5. Calculate the power of a number using recursion
6. Convert binary number to decimal and vice-versa
7. Convert octal Number to decimal and vice-versa
8. Convert binary number to octal and vice-versa

Week 9 - Files

7. Read name and marks of students and store it in file
8. Read name and marks of students and store it in file. If file already exists, add information to it.
9. Write members of arrays to a file using fwrite()
10. Write a C program which copies one file to another.
11. Program to Write a Sentence to a File
12. Program to Read a Line From a File and Display it

Week 10 – Memory Management

5. Find Largest Number Using Dynamic Memory Allocation
6. Store Information Using Structures with Dynamically Memory Allocation.
7. Write C++ Programs using Basic concepts Like data types,operators etc.
8. Write C++ programs using Loops and Conditional Statements.

Week 11 & 12

Project using C

MATHEMATICS – III

COURSE OUTCOMES

At the end of the course the student should be able to:

6. Find the Laplace and Inverse Laplace transforms of a given function and apply them to solve differential equations.
7. Recognize Irrotational and Solenoidal vector fields
8. Apply various integral theorems relating line, surface and volume integrals.
9. Understand the harmonic and analytic functions and also construct the analytic function.
10. Represent a given function in Taylor's & Laurent's series along a given path and evaluate certain real integrals using integral theorems.

UNIT I

Laplace Transforms

Definition - Existence - Laplace transforms of standard functions - First & Second Shifting theorems - Change of scale property - Laplace transform of Derivatives - Integrals- functions multiplied by t - divided by t - Laplace Transform of Periodic functions.

UNIT II

Inverse Laplace Transforms

Inverse Laplace transforms by partial fractions - Inverse Laplace transforms of Derivatives - Integrals - functions multiplied by s - divided by s - Convolution theorem - Applications of Laplace transforms to Ordinary Differential Equations.

UNIT III

Vector Differentiation

Vectors - The Dot Product - The Cross Product - Lines and Planes in Space - Cylinders and Quadric Surfaces - Arc Length in Space - Curvature and Normal Vectors of a Curve - Vector Fields – Directional Derivatives - Gradient – Divergence – Curl - Vector Identities (without proofs).

UNIT IV

Vector Integration

Integral of a vector valued function – Line Integrals of Scalar Functions: Work, Circulation, and Flux - Path Independence, Conservative Fields, and Potential Functions - Green's Theorem - Surface Integrals - Stokes' Theorem - Divergence Theorem. (All theorems without proof)

UNIT V

Complex Analysis I

Analyticity – properties – Cauchy - Riemann conditions - harmonic and conjugate harmonic functions, construction of analytic function. Line integral - Cauchy's integral theorem - Cauchy's integral formula - Generalized integral formula - applications.

UNIT VI

Complex Analysis II

Radius of convergence - Expansion in Taylor's series - Maclaurin's series - Laurent series - applications. Definitions - Singular point - Isolated singular point - pole of order m - essential singularity. Residues - Evaluation of residues - Residue theorem (without proof) – applications.

TEXTBOOKS

3. Erwin Kreyszig, "Advanced Engineering Mathematics", John wiley & sons, 605 Third Evenue, New York.
4. Peter V. O'Neil, "Advanced Engineering Mathematics", Cl-Engineering.

REFERENCE BOOKS

4. R.K.Jain, S.R.K. Iyengar, "Advanced engineering Mathematics", Narosa publishing house, New Delhi
5. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers, Delhi.
6. J. W. Brown and R.V. Churchill, "Complex Variables and Applications", McGraw Hill.

SMART SYSTEM DESIGN

COURSE OUTCOMES

At the end of the course, the student will develop ability to

6. Understand, illustrate and apply the system design process to address a need
7. Create a smart system design using system design principles.
8. Select appropriate sensors and actuators based on the design requirements
9. Estimate the power requirements for circuits
10. Implement a complete smart system using Arduino Microcontroller

UNIT I

Introduction to Systems Thinking

Definition of System, Design, User, Needs, Tasks and Environment.Relation between User, needs, tasks and environment. Need statement.

Case Study: Identification of the problem, detailed report on problem and need statement.

UNIT II

System Design

Introduction to Smart system design, Key elements of Smart system design, Architectural design – System structure and behavior, Logical design-Abstract representation of data flow, inputs and outputs, Physical design-Verification of input, output and process requirements.

Case Study: Identify the system, design a system with above parameters.

UNIT III

Arduino Microcontroller

Introduction to Arduino controller, pin map, Arduino programming. Signal Processing and Conditioning:Rectifiers, Filters, Regulators, Amplifying signals using OP Amps.

Design a power supply unit with specified requirements.

UNIT IV

Sensors

Characteristics of Sensors – Static and Dynamic, Classification – Analog Sensors (Force, displacement, temperature, LDR), Digital Sensors (Photo sensors, proximity sensor),

UNIT V

Mechanical Drives

Gears, Belt and Chain Drives, Bearings

Electrical Actuation systems

Relays, Solenoids, Solid State Switches – Diodes, Transistors, Thyristors and Triacs, fundamentals of DC and AC Motors, Stepper motor. Speed, position and direction control of motors.

UNIT VI

Project Testing and validation –Defining the test protocol. Product validation. Product delivery. Product Documentation.

TEXT BOOKS

3. Clarence de Silva, “Sensors and Actuators. CRC Press. 2016.
4. W. Bolton, “ Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering. Pearson Education Asia.
5. George E Dieter, Linda C Schimdt “Engineering Design” 4th edition

REFERENCE BOOKS

3. D. Patranabi. Sensors and Transducers. PHI Learning. 2003.
4. Alciatore and Histand. Introduction to Mechatronics and Measurements. Tata McGraw Hill. 2012.

ANALOG ELECTRONICS

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Understand the basic semi conductor devices and their behaviour.
2. Understand the operation of BJT and FET
3. Design a Self Bias circuit for the given specifications. Also find the operating point from the designed circuit.
4. Design RC coupled amplifier for the given specifications and analyze its performance.
5. Explain the effect of negative feedback on amplifiers.
6. Illustrate the generation of sinusoidal signals at audio and radio frequencies using oscillators.

UNIT I

Semiconductor Diodes

p-n junction diode operation, V-I characteristics of p-n diode, Diode resistances (Static and Dynamic), Basic Concepts of Diode capacitances (Transition and Diffusion), Breakdown mechanisms in diodes, Zener diode operation, Applications of Diodes: Diode as switch, Zener shunt voltage regulator, Clippers and Clampers.

UNIT II

Bi-polar and Uni-Polar Junction Transistors

Principle of operation of BJT, C.E characteristics, Operating point, DC load line, Need for biasing, Bias stability, Self bias, Principle of operation of JFET, V-I Characteristics of JFET, Principle of operation of MOSFET (enhancement type & depletion type), V-I characteristics of MOSFET

UNIT III

Small Signal Low Frequency Analysis of Single Stage BJT Amplifiers

Classification of Amplifiers, h-parameters, Exact and Simplified hybrid model, Analysis of Single Stage Self Biased CE amplifier: with Un-bypassed & with by-passed Emitter Resistor using simplified hybrid model; Coupling schemes used in amplifiers.

UNIT IV

Small Signal High Frequency Analysis of BJT Amplifiers

Frequency response of RC coupled BJT amplifier, Effect of Coupling and By-pass Capacitors on Low frequency Response, Effect of Junction Capacitance on High frequency Response, Hybrid-pi CE transistor model.

UNIT V

Negative Feedback Amplifiers

Concepts of negative feedback, Classification of negative feedback amplifiers, General characteristics of negative feedback amplifiers, Analysis of Practical Voltage Series and Current Series feedback amplifiers, illustrative problems.

UNIT VI

Oscillators

Concepts of positive feedback, Classification of oscillators, Conditions for oscillations, Wien-Bridge oscillator, Hartely, and Colpitts oscillators, Crystal oscillators.

TEXT BOOKS

1. Jocob Millman, Christos C.Halkias, "Electronic Devices and Circuit", McGraw Hill, 1991 ISBN: 0070634556
2. Jacob Millman and Christos C Halkias, "Integrated electronics", 1991 ed., 2008 TMH *ISBN*-13, 9780070151420.

REFERENCES BOOKS

1. Anil K. Maini, Varsha Agarwal, "Electronic Devices and Circuits", 1 ed., 2009, Wiley India Pvt. Ltd. *ISBN*: 8126518952, EAN: 9788126518951
2. Robert Boylestad & Lowis Nashelsky, "Electronic Devices and Circuit theory", Prentice Hall of India, 5th Ed., 1993 ISBN-10: 0132505487 | ISBN-13: 978-0132505482
3. Donald L Schilling & Charles Belove, "Electronic Circuits; discrete & Integrated", McGraw Hill International Edition, 3rd Edition, 1989 ISBN 10: 0070553483 / ISBN 13: 9780070553484
4. S. Salivahanan, N. Suresh Kumar, A Vallavaraj, "Electronic devices and circuits", 2ed., 2009 TMH *ISBN*, 0071329153, 9780071329156

SIGNALS AND SYSTEMS

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Classify different signals and systems
2. Apply the concept of Fourier series with respect to signal processing.
3. Analyze the frequency response of signals in frequency domain using Fourier transform
4. Illustrate the characterization of LTI system using Laplace Transform
5. Solve the Discrete time signals using Z transform and realize the concept of sampling.

UNIT I

Classification of Signals and Systems

Classification of Signals: Continuous time signals , Discrete time signals , Periodic and A periodic signals ,Even and odd signals, Energy and power signals ,Deterministic and random signals ,Complex exponential and Sinusoidal signals. Unit step, Unit ramp, Unit impulse - Representation of signals in terms of unit impulse, Convolution and its properties.

Classification of Systems: Continuous time systems- Discrete time systems - Linear system - Time Invariant system - causal system - BIBO system - Systems with and without memory - LTI system. System modeling- basic concepts**.**

UNIT II

Fourier Series Representation of Periodic Signals

Vector analogy, orthogonality, existence of Fourier series (Dirichlets conditions)Fourier series: Representation of Continuous time Periodic signals – Trigonometric and exponential-Symmetry conditions Properties of Continuous time Fourier series, concept of Negative frequency.

UNIT III

Continuous – Time Fourier Transform

Representation of A Periodic signals: The continuous- time Fourier transform, the Fourier transform of periodic signals, Properties of Continuous time Fourier transform, Parseval's relation (Qualitative analysis).

UNIT IV

Laplace Transform

The Laplace transform, the Region of Convergence for Laplace transforms, Properties of Laplace Transform, Inverse Laplace Transform, Analysis and characterization o LTI systems using the Laplace transform

UNIT V

Z – Transform

The z-transform, the Region of convergence for the z - transform, Properties of ROC, Properties of the z-transform, Poles and Zeros, Inverse z-transform using Partial fraction expansion and Long division method.

UNIT VI

Applications of Signals and Systems

Sampling Theorem, Types of sampling, Solution of Differential equations. Modelling of first order system [realization only]

TEXT BOOKS

1. Alan V Oppenheim, Alan S Willsky and A Hamid Nawab, “Signals and Systems”, Pearson Education Asia / PHI.
2. Simon Haykin and Barry Van Veen, “Signals and Systems”, John Wiley and Sons.

REFERENCE BOOKS

1. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2005.
2. Tarun Kumar Rawath, “Signals and Systems”, Oxford University Press.
3. Sanjay Sharma and SK Kataria, “Signals and Systems”, 6^{th} Edition, 2008.
4. Roborts Michel J, “Signals and Systems”, TMH, New Delhi, 2005.

CIRCUIT THEORY - I

UNIT I

Introduction to Electrical Circuits: Circuit Concept – Classification of network elements-R-L-C Parameters- Voltage and Current sources – Independent and dependent sources – Source transformation – Ohm's law-Voltage – Current relationship for passive elements (for different input signals – square, ramp, saw tooth, triangular).

UNIT II

Introduction to Circuits Analysis Techniques: Kirchhoff's laws – network reduction techniques – series, parallel, series parallel, star-to-delta and delta-to-star transformation. Nodal analysis, Super-node, Mesh analysis and Super mesh analysis.

UNIT III

DC Transient Analysis: Transient response of R-L, R-C, R-L-C circuits (Series and parallel combinations) for DC excitation - Initial conditions - Solution method using differential equation approach and Laplace transforms.

UNIT IV

AC Transient Analysis: Transient response of R-L, R-C, R-L- C circuits (Series and parallel combinations) for AC excitation - Initial conditions - Solution method using differential equation approach and Laplace transforms.

UNIT V

Network Topology: Definitions – Graph – Tree, Basic cutset and Basic Tieset matrices for planar networks – Loop and Nodal methods of analysis of Networks with independent voltage and current sources - Duality and Dual networks.

UNIT VI

Network Theorems with DC Excitation: Superposition, Reciprocity, Thevenin's, Norton's, and Maximum Power Transfer Theorems.

TEXT BOOKS:

1. W. Hayt and J. E. Kimmerly, "Engineering Circuit Analysis", Tata McGraw Hill, 8th ed.
2. R. A. DeCarlo and Pen-Min-Lin, "Linear Circuit Analysis", (time domain phasor, and Laplace transform approaches), Oxford University Press, 2nd ed.

REFERENCE BOOKS:

1. Vanvalkenburg, "Network Analysis", PHI, 3rd ed., 2006.
2. S. Sudhakar and P.S.M. Satyanarayana, "Electrical Circuits", TMH Publication, 3rd ed., 2011.
3. Joseph Edminister, Mahmood Nahvi, "Electric Circuit Theory", Schaum's Outline Series, 6th ed., 2014.

CIRCUIT THEORY - I LAB

LIST OF EXPERIMENTS:

1. Verification of Kirchhoff’s laws (KCL and KVL) using hardware and simulation.
2. Verification of Mesh analysis using hardware and simulation.
3. Verification of Nodal analysis using hardware and simulation
4. Determination of average value, RMS value, form factor, peak factor of sinusoidal wave, square wave using hardware and simulation
5. Verification of Superposition theorem for DC circuits using hardware and simulation.
6. Verification of Reciprocity theorem for DC circuits using hardware and simulation
7. Verification of Maximum power transfer theorem for DC circuits using hardware and simulation
8. Verification of Thevenin’s theorem for DC circuits using hardware and simulation
9. Verification of Norton’s theorem for DC circuits using hardware and simulation

ANALOG ELECTRONICS LAB

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Construct the p-n and zener diode circuits to calculate its resistances and analyze their characteristics by applying the theoretical concepts.
2. Experimentally calculate the various parameters such as i/p resistance, o/p resistance, current gain and voltage gain of a transistor in CE & CB configurations and compare them with theoretical values.
3. Design a self-biased CE amplifier as per given specifications and analyze the effect of negative feedback on its various parameters such as voltage gain and bandwidth using frequency response.
4. Build an oscillator circuit safe to use and not hazardous to the environment that generates sinusoidal signals at RF frequencies and compare frequency of oscillations theoretically.
5. Compare various parameters such as efficiency, resonant frequency of power amplifier and tuned amplifier with theoretical values.

LIST OF EXPERIMENTS: (**12** experiments to be done)

I) DEMONSTRATION EXPERIMENTS

Testing in the Hardware Laboratory

1. Forward and reverse bias characteristics of p-n junction diode
2. Zener diode characteristics
3. Input and Output characteristics of transistor in CB configuration.
4. FET characteristics
5. Frequency response of Single Stage CE amplifier.

II) STRUCTURED EXPERIMENTS

i) Design & Testing in the Hardware Laboratory (Any 5 Experiments)

1. Design Zener Shunt Voltage Regulator for the given Specifications.
2. Design a Clipper circuit for the given specifications.
3. Measurement of h-parameters of transistor in CE configuration.
4. Design a Self Bias circuit for the given specifications.
5. Single Stage Common Emitter Amplifier
6. Current Series feedback amplifier
7. Hartley & Colpitt's Oscillators

ii) Design and Simulating in Simulation Laboratory using any Simulation Software. (Any 2 Experiments)

1. Single Stage Common Emitter Amplifier
2. Current Series feedback amplifier (with and without feedback).

3. Voltage series feedback amplifier.
4. Hartley & Colpitt's Oscillators

III) OPEN ENDED EXPERIMENTS

1. Build a Regulated Power Supply using Bridge Rectifier, LC Filter and Zenor Regulator for the given Specifications.
2. Build an electronic circuit that controls the operation of a motor using Transistor acts as a switch.

CIRCUIT THEORY - II

UNIT I

Single Phase A.C. Circuits: Single Phase A.C Circuits, R.M.S and Average values and form factor for different periodic wave forms, Exponential forcing functions.

UNIT II

Analysis of Single Phase A.C. Circuits: Steady state analysis of R, L and C (in series, parallel and series parallel combinations) with sinusoidal excitation – Concept of Reactance, Impedance, Susceptance and Admittance – Phase and Phase difference – concept of average power, Real power , Reactive powers and power factor – J-notation, Complex and Polar forms of representation, Complex power.

UNIT – III

Network Functions: The concept of complex frequency, Physical Interpretation of Complex Frequency, Transform Impedance and Transform Circuits, Series and Parallel Combination of elements, Terminal pairs or ports, Network functions for the one-port and Two port, Poles and zeros of network functions, Significance of poles and zeros, Properties of driving point functions, properties of transfer functions, Necessary conditions for driving point functions, Necessary conditions for transfer functions, Time domain response from pole-zero plot. Concept of S-Plane vectors.

UNIT IV

Locus Diagrams and Resonance: Locus diagrams – Series R-L, R-C, R-L-C and Parallel combination with variation of various parameters- Resonance – series, parallel circuits, concept of band width and Q factor.

UNIT V

Magnetic Circuits: Magnetic Circuits – Faraday's laws of electromagnetic induction – concept of self and mutual inductance – ideal transformer - dot convention – coefficient of coupling – composite magnetic circuit - Analysis of series and parallel magnetic circuits.

UNIT VI

Network Theorems with AC Excitation: Superposition, Reciprocity, Thevenin's, Norton's, and Maximum Power Transfer Theorems. Introduction to matrices and their uses in circuit analysis.

TEXT BOOKS:

1. Vanvalkenburg, “Network Analysis”, 3rd ed., PHI Publication, 2006.
2. William Hayt and Jack E. Kimmerly, “Engineering Circuit Analysis”, 6th ed., McGraw Hill Company, 2012.

REFERENCE BOOKS:

1. David A. Bell, “Electric Circuits”, 7th ed., Oxford University Press, 2009.
2. A. Chakrabarthy, “Electrical Circuits”, 1st ed., Dhanpat Rai and Sons, 1999.
3. A. Sudhakar and Shyammohan S. Palli, “Circuits and Networks”, 1st ed., Tata McGraw Hill, 2002.
4. Joseph Edminister, and Mahmood Nahvi, “Electric Circuit Theory”, 6th ed., Schaum’s Outline Series, 2014.

PROBABILITY THEORY AND STOCHASTIC PROCESSES

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Define random variable and understand the probability, events and random experiments.
2. Analyze the operations like expectation, variance and moments of single random variable.
3. Analyze the operations like expectation, variance and moments of multiple random variables.
4. Describe the stochastic process in both deterministic and non deterministic types.
5. Classify the various processes, functions and state its properties and relate power spectrum density and autocorrelation function.
6. Analyze the Various Noises.

UNIT I

Probability

Concept of Probability, Random Variables, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Joint Probability, Conditional Probability, Total Probability, Bayes’ Theorem. Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution.

UNIT II

Operation on One Random Variable – Expectations

Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Characteristic Function, Moment Generating Function.

UNIT III

Multiple Random Variables

Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density – Interval conditioning, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem, (Proof not expected).

UNIT IV

Stochastic Processes - Temporal Characteristics

The Stochastic Process Concept, Classification of Processes, Stationary Random Process, Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance and its properties.

UNIT V

Stochastic Processes – Spectral Characteristics

Power Spectrum Properties, Relationship between Power Spectrum and Autocorrelation Function, Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function.

UNIT VI

Noise

Types of Noise: Resistive(Thermal)Noise Source, Shot noise, Arbitrary Noise Sources, White Noise, Modeling of Noise Sources, Average Noise Bandwidth, Effective Noise Temperature, Average Noise Figures.

TEXT BOOKS

1. Peyton Z. Peebles, “Probability, Random Variables and Random Signal Principles”, TMH, 4^{th} Edition, 2001.
2. Athanasios Papoulis and S. Unnikrishna Pillai, “Probability, Random Variables and Stochastic Processes”, PHI, 4^{th} Edition, 2002.

REFERENCE BOOKS

1. Johnson Richard A, “Probability and Statistics for Engineers”, Pearson Publications, New Delhi, 2007.
2. Mallikarjuna Reddy, “Probability Theory and Stochastic Processes”, Cengage Learning.
3. BP Lathi, “Communication Systems”, BS Publication, 2006.
4. Murugesan K and Guruswami P, “Probability and Statistics”, Anuradha Publications, Chennai.

DIGITAL ELECTRONICS

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Explain the fundamentals of number system, binary arithmetic and codes.
2. Apply the Boolean laws to reduce the Boolean function and realize using basic gates.
3. Apply K-map and Quine Mc Clusky method for simplification of Boolean function and realize using basic gates.
4. Analyze the combinational logic circuits and realize them.
5. Discuss the basic of flip flops and realize one flip-flop to another flip-flop.
6. Analyze the asynchronous sequential circuits and design them.
7. Analyze clocked sequential circuits and realize them.
8. Describe the operation of PLD's and implement combinational logic using PLD's.

UNIT I

Number Systems and Codes: Review of Binary, Octal and Hexadecimal Number Systems – Conversion methods- complements- signed and unsigned Binary numbers. Binary codes: Weighted and non-Weighted codes – ASCII – Error detecting and Error correcting codes- hamming codes.

UNIT II

Boolean Algebra, Switching Functions And Minimization of Switching Functions: Boolean postulates and laws –De-Morgan's Theorem- Boolean function- Minimization of Boolean expressions – Sum of Products (SOP) –Product of Sums (POS)-Canonical forms – Karnaugh map Minimization – Don't care conditions – Quine Mc'Clusky method of minimization, simplification rules.

Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive – OR and Exclusive - NOR, Implementations of Logic Functions using basic gates, NAND –NOR implementations.

UNIT III

Combinational Logic Design: Definition, Design procedure – Adders-Subtractors - Serial adder / Subtractor - Parallel adder / Subtractor - Carry look ahead adder, BCD adder- Magnitude Comparator- Multiplexer/ Demultiplexer - encoder / decoder parity checker - code converters: Binary to Gray, Gray to Binary, BCD to excess 3 code Implementation of combinational logic using MUX, Decoder.

UNIT IV

Sequential Circuits: Definition, Flip-Flops- SR Flip flop, JK Flip flop, T Flip flop, D Flip flop and Master slave Flip flops – Characteristic table and equation – Application table– Edge triggering – Level Triggering –Realization of one flip flop using other flip flops – Asynchronous / Ripple counters – Synchronous counters – Modulo – n counter – Classification of sequential circuits – Analysis of clocked sequential circuits: State equation- State table- State diagram –State reduction and State assignment- Register – shift registers- Universal shift register – Shift counters.

UNIT V

Programmable Logic Devices: Basic PLD's –ROM, PROM, PLA, PAL. Realization of switching function using PLD's – Introduction to FPGA, CPLD.

UNIT VI

Mealy and Moore Machines

Mealy and Moore machines**,** Capabilities and limitations of FSM**,** Minimization of incompletely specified machines, Partition technique, merger table, Merger Graph. Algorithmic state machines, ASM Chart, Components of ASM charts, Features of ASM Chart, ASM block**,** Example of ASM chart, Binary Multiplier**.**

TEXT BOOKS:

1. M. Moris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson Education, New Delhi, 2012.
2. Zvi. Kohavi, "Switching and Finite Automata Theory", Tata McGraw Hill, New Delhi.

REFERENCE BOOKS:

1. John F Wakerly, "Digital Design: Principles and Practices", 4th Edition, Pearson Education, 2008.
2. R.P. Jain, "Modern Digital Electronics", Prentice Hall of India, New Delhi.
3. Gupta BR, "Digital Electronics", SK Kataria Publishers, 2009.

ENGINEERING DIFFERENTIAL EQUATIONS

COURSE OUTCOMES

At the end of the course the student will be able to

1. Develop a qualitative understanding of the nature of differential equations, their solutions, and their applications;
2. Learn qualitative techniques for obtaining information about solutions to differential equations;
3. Learn numerical methods for finding approximate solutions to differential equations that cannot be solved analytically;
4. Apply the knowledge of differential equations to problems in engineering;
5. Extend an understanding of the mathematical modeling process.

UNIT I

Solutions of First Order Differential Equations.

First Order Differential Equations. Slope Fields and Solution Curves. Euler's Method. A Closer Look at the Euler Method, and Improvements. The Runge-Kutta Method.

UNIT II

Numerical solutions of Second Order Linear Equations.

Second-Order Linear Differential Equations. Homogeneous and Non homogeneous Equations with Constant Coefficients.

UNIT III

Introduction to Systems of Differential Equations.

First-Order Systems and Applications. The Method of Elimination. Numerical Methods for Systems.

UNIT IV

Linear Systems of Differential Equations.

Linear Systems and Matrices. The Eigenvalue Method for Homogeneous Systems. Second Order Systems and Mechanical Applications. Multiple Eigenvalue Solutions. Matrix Exponentials and Linear Systems. Nonhomogenous Linear Systems.

UNIT V

Laplace Transform Methods.

Laplace Transforms and Inverse Transforms. Transformation of Initial Value Problems. Translation and Partial Fractions. Derivatives, Integrals, and Products of Transforms. Periodic and Piecewise Continuous Forcing Functions. Impulses and Delta Functions.

UNIT VI

Applications to Differential Equations

Population Models. Equilibrium Solutions and Stability. Acceleration-Velocity Models. Mechanical Vibrations. Forced Oscillations and Resonance. Electrical Circuits. Endpoint Problems and Eigenvalues.

TEXT BOOKS

1. Differential Equations and Boundary Value Problems: Computing and Modeling, C. Henry Edwards, David E. Penney and David T. Calvis, Pearson publications.
2. Erwin kreyszig, "Advanced Engineering Mathematics", John wiley & sons, 605 Third Evenue, New York.

REFERENCES

1. Differential equations with boundary-value problems, Zill D., Cullen M., Cengage Learning.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", Cl-Engineering.
3. B.S.Grewal, "Higher Engineering Mathematics", Khanna publishers, Delhi.

ELECTRONIC MEASUREMENT AND INSTRUMENTATION

(Professional Elective I)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Demonstrate various Electronic Instruments and their utilization.
2. Analyze the performance characteristics of instruments to select for applications.
3. Design basic meters such as voltmeters and ammeters as Data presentation elements.
4. Illustrate the measurement of resistance, capacitance, inductance and frequency using Bridge
5. Explain about different types of Oscilloscopes and signal analyzers.
6. Analyze various types of Active and passive transducers and select for applications

UNIT I

Characteristics of Measuring Instruments

Significance of Measurement and block diagram of Measurement System, Static characteristics- Accuracy, Precision, Sensitivity, Linearity, Repeatability, Reproducibility, Resolution, Threshold, Drift ,Stability, Dead zone, hysteresis, Dynamic Characteristics- speed of response, measuring lag, fidelity, dynamic error, Types of Errors – Gross error, systematic errors, Random errors.

UNIT II

Measuring Instruments

PMMC, DC voltmeter and current meters and its Extension ranges, True RMS Responding Voltmeter, Average responding rectifier type voltmeter, electronic voltmeter, block diagram approach for measurement of voltage, current and Resistance using Digital Multi Meter (DMM), Basic Potentiometer Circuit , Q-meter – Series Method .

UNIT III

Bridges and Analyzers

DC Bridge- Wheatstone bridge, Kelvin's Double Bridge, AC Bridge- Maxwell’s Bridge, Schering bridge and Wien’s Bridge.

Signal Analyzers

Frequency Selective and Heterodyne Wave Analyzers, Harmonic distortion Analyzers, Total Harmonic distortion, Spectrum Analyzers.

UNIT IV

Oscilloscopes

Cathode Ray Tube (CRT), Electrostatic Deflection, Post Deflection and Acceleration of Electron Beam, Screens for CRT’s, Block diagram of CRO- Time-Base Generator, Delay line, Attenuators, probes, Dual beam oscilloscope, Dual trace oscilloscope, Digital Storage Oscilloscope , Applications of CRO: Measurement of Phase and Frequency using Lissajous Patterns.

UNIT V

Transducers

Transducer and its classification, ideal Requirements of Transducer – Resistive Transducer: Potentiometric type, Strain Gauge type (Gauge factor derivation, SG materials, Bonded and unbounded strain gauges) , Capacitive Transducers - Variable gap type, variable area type and variable Dielectric type , Inductive Transducers - LVDT ,

UNIT VI

Transducers Applications and smart Transducers

Applications of Thermocouple, Thermistor, Piezo Electric Transducers, RTD, photo voltaic cell, LDR. IC Sensor for temperature- AD590, LM35, LM335.

Intelligent and smart transducers

Principle-design approach, interface design, configuration support, communication in smart transducer networks .

TEXT BOOKS

1. Helfrick AD and Cooper WD, "Modern Electronic Instrumentation and Measurement Techniques", PHI.
2. AK Sawhney, "A Course in Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai Publications, New Delhi, 2002.

REFERENCE BOOKS

1. Oilver and Cage, "Electronic Measurements and Instrumentation", McGraw Hill International Edition.
2. Golding EW and Wides FC, "Electrical Measurements and Measuring Instruments", Wheeler Publications.
3. BC Nakra and KK Chowdary, "Instrumentation Measurement and Analysis", TMH, New Delhi.

DIGITAL DESIGN THORUGH VHDL

(Professional Elective - I)

COURSE OUTCOMES

At the end of the course, students will develop the ability to

1. Analyse circuits in terms of hardware description language.
2. Develop program codes for gate level modeling of logic circuits.
3. Program codes using behavioral model.
4. Represent logic using dataflow model.
5. Program codes to represent sequential circuits.
6. Write function codes of any digital system and perform component testing and verification using Verilog HDL.

UNIT I

Introduction to Verilog HDL

Verilog as HDL, Level of Design description, Concurrency, Simulation and Synthesis, Function Verification, System tasks, Programming Language interface, Module, Simulation and Synthesis tools.

Language Constructs and Conventions

Keywords, Identifiers, White space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data types, Scalars and vectors, parameters, operators.

UNIT II

Gate Level Modeling

Introduction, AND Gate Primitive, Module structure, other gate primitives, illustrative examples, tristate gates, array of instances of primitives, Design of Flip-Flops with gate primitives, Delays, Strengths and Construction resolution, Net types, Design of basic circuit.

UNIT III

Behavioral Modeling

Introduction, Operations and assignments, functional bifurcation, 'Initial' construct, 'always' construct, Assignments with Delays, 'wait' construct, multiple always block, Design at behavioral level, blocking and non-blocking assignments, the 'case' statement, simulation flow 'if' an 'if-else' constructs, 'assign-de-assign' construct 'repeat' construct, for loop, 'the disable' construct, 'while loop', forever loop, parallel blocks, 'force- release', construct, Event.

UNIT IV

Modeling at Dataflow Level

Introduction, Continuous assignment structure delays and continuous assignments, assignment to vectors, operators. Switch level modeling: Basic transistor switches, CMOS switches, bi directional gates, time delays with switch primitives, instantiation with 'strengths' and 'delays' strength contention with Trireg nets.

UNIT V

Sequential Circuit Description

Sequential models – feedback model, capacitive model, implicit model, basic memory components, functional register, static machine coding, sequential synthesis.

UNIT VI

Component Test and Verification

Test bench – combinational circuit testing, sequential circuit testing, test bench techniques, design verification, assertion verification.

TEXT BOOKS

1. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, 2005.
2. Ming-Bo Lin., "Digital System Designs and Practices Using Verilog HDL and FPGAs", Wiley, 2008.

REFERENCE BOOKS

1. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL", PHI, 2005.
2. J. Bhasker, "Verilog HDL Synthesis - A Practical Primer", 3rd Edition, 2005.
3. Stephen D. Brown and Zvonko G. Vranesic, "Fundamentals of Digital Logic with Verilog Design", McGraw Hill, New Delhi, 2nd Edition, 2008.

FOUNDATIONS OF IoT

(Professional Elective - I)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

6. Illustrate the key components that make up an IoT system.
7. Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack.
8. Explain the role of big data, cloud computing and data analytics in an IoT system.
9. Understand where IoT fits within the broader industry and future trends.
10. Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.

UNIT I

What is IoT? Overview, Importance, Definition, Elements of IoT, Technology and Business Drivers, IoT Trends and Implications.

UNIT II

Solution Patterns for the IoT, Product – Customer Relationship, Elements of Smart, Connected Devices, Overview of Applications

UNIT III

Connectivity and Networks - The Edge of IoT, Connecting, securing and interacting with things from the cloud. Protocols - Application Layer – MQTT, CoAP, XMPP, AMQP and MAC 802.15.4. Wireless technologies.

UNIT IV

The cloud, Key technologies, Design goals, Implementation Issues

UNIT V

IoT Applications, Realizing IoT applications, Business case

UNIT VI

IoT Applications - Creating a new IoT application, Develop a IoT System from idea to market

Sample Project - “IoT weather station”: Students will build a small IoT device that integrates with temperature sensor, light sensor and rain sensor. The device creates a website where a user is able to read temperature, light, and rain data. This project enables students to implement a small IoT system and learn how to write programs on embedded devices.

http://www.instructables.com/id/Esay-IoT-Weather-Station-With-Multiple-Sensors/. 2.

TEXTBOOKS

3. Foundational Elements of an IoT Solutions: The Edge, The Cloud
4. Application Development, Joe Biron and Jonathan Follett

REFERENCES

4. Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, by Francis daCosta, ISBN: 978-1-4302-5740-0, 2013
5. Architecting the Internet of Things, by Dieter Uckelmann, Mark Harrison and Florian Michahelles, ISBN: 978-3-642-19157-2, 2011
6. McKinsey&Company, "The Internet of Things: Mapping the value beyond the hype", McKinsey Global Institute, 2015

NEURAL NETWORKS

(Professional Elective - I)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Demonstrate the basic concepts of Artificial Intelligence(AI) and Neuro Dynamics.
2. Apply AI principles in solutions that require problem solving, inference perception, knowledge representation and learning.
3. Analyze Single layer perceptrons and Multilayer Perceptrons to develop algorithms
4. Illustrate the Back-propagation concepts, Virtues and Limitations and Supervised Machine learning.
5. Develop Computer simulations based on Self Organization Maps(SOM).
6. Demonstrate proficiency applying scientific method to models of machine learning

UNIT I

Introduction

A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks.

Learning Process

Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process.

UNIT II

Single Layer Perceptrons

Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment.

UNIT III

Multilayer Perceptron

Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

UNIT IV

Back Propagation

Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning.

UNIT V

Self-Organization Maps (SOM)

Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification.

UNIT VI

Neuro Dynamics

Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm.

Hopfield Models – Hopfield Models, Computer Experiment

TEXT BOOKS

1. Simon Haykin, "Neural Networks - A Comprehensive Foundations", PHI.
2. B. Vegnanarayana, "Artificial Neural Networks", Prentice Hall of India, Pvt. Ltd., 2005.

REFERENCE BOOKS

1. Li Min Fu, "Neural Networks in Computer Intelligence", TMH, 2003.
2. James A Freeman and David M S Kapura, "Neural Networks", Pearson Education, 2004.
3. Jacek M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House.

CIRCUIT THEORY - II LAB

LIST OF EXPERIMENTS:

1. Verification of Thevenin's theorem for AC circuits using hardware and simulation
2. Verification of Norton's theorem for AC circuits using hardware and simulation
3. Verification of Maximum power transfer theorem for AC circuits using hardware and digital simulation.
4. Verification of Super position for AC circuits theorem using hard ware and digital simulation.
5. Verification of Reciprocity theorem for AC circuits using hardware and digital simulation
6. Locus Diagram of RL and RC Series Circuits.
7. Verification of series resonance using hard ware and digital simulation
8. Verification of parallel resonance using hard ware and digital simulation
9. Verification of self-inductance, mutual inductance and co-efficient by using hardware

INTEGRATED ELECTRONICS

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Understand the basic semi conductor devices and their behaviour.
2. Understand the frequency response of a given amplifier.
3. Explain the effect of negative feedback on amplifiers.
4. Illustrate the generation of sinusoidal signals at audio and radio frequencies using oscillators.
5. Understand the basic concepts of operational amplifier.
6. Apply the basic concepts of op-amp & timer IC in basic circuit design.

UNIT I

Semiconductor Diodes: p-n junction diode operation**,** Zener diode operation, Applications of Diodes: Diode as switch

Bi-polar and Uni-Polar Junction Transistors: Principle of operation of BJT, Principle of operation of JFET, Principle of operation of MOSFET (enhancement type & depletion type), Volt-Ampere characteristics of MOSFET

UNIT II

BJT Amplifiers: RC Coupled Amplifier operation**,** Frequency response of RC coupled amplifier, direct coupled amplifier, Band pass amplifiers, distortion in amplifiers.

UNIT III

Feedback Amplifiers: Concepts of negative and positive feedback, General characteristics of negative feedback amplifiers, principle of operation oscillator, oscillators.

UNIT IV

Small signal Amplifiers: Classification of Amplifiers – Analysis of CE, CC, and CB Configurations with simplified Hybrid Model, Analysis of CE amplifier with Emitter Resistance.

Large Signal Amplifiers: Principle of operation of power amplifier, heat sinks, .Principle of operation of small signal tuned amplifier.

UNIT V

Integrated Circuits and its Applications: Differential Amplifiers, Operational Amplifiers, Ideal characteristics, Inverting and Non Inverting amplifier, Op-Amp Applications, Basic concept of Filter using op-amp, Waveform generators, Schmitt Trigger, Multiplexers.

UNIT VI

Timers, Analog to Digital & Digital to Analog converters: IC 555 - Pin diagram, applications of IC 555. Basic DAC Techniques – Weighted Resistor type, R-2R Ladder type, Different types of ADCs-Parallel Comparator Type, Successive Approximation Register Type and Dual Slope Type. DAC and ADC Specifications.

TEXT BOOKS

1. Jacob Millman and Christos C Halkias, “Integrated electronics”, 1991 ed., 2008 TMH *ISBN*-13, 9780070151420.
2. D. Roy choudhry, Shail B Jain, "Linear Integrated circuits", 2ed., 2004 New Age International Publishers.

REFERENCE BOOKS:

1. Ramakanth A. Gayakwad, “Op-Amp and Linear ICs”, PHI, 1987.
2. Robert Boylestad & Lowis Nashelsky, “Electronic Devices and Circuit theory”, Prentice Hall of India, 5th Ed., 1993 ISBN-10: 0132505487 | ISBN-13: 978-0132505482
3. Jocob Millman, Christos C.Halkias, “Electronic Devices and Circuit”, McGraw Hill, 1991 ISBN: 007063455620.
4. S. Salivahanan, N. Suresh Kumar, A Vallavaraj, “Electronic devices and circuits”, 2ed., 2009 TMH *ISBN*, 0071329153, 9780071329156

DATA STRUCTURES

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Explain how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms.
2. Compare and contrast the benefits of dynamic and static data structures implementations.
3. Develop and Evaluate programs that use arrays, records, linked structures, stacks, queues, trees and graphs.
4. Demonstrate different methods for traversing trees.
5. Design and implement an appropriate hashing function for an application.
6. Discuss the computational efficiency of the principal algorithms for sorting, searching and hashing.

UNIT I

Basic Concepts of Data Structures: Data objects and Structures, Algorithm Specification-Introduction, Recursive algorithms, Data Abstraction, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega and Theta notations, Complexity Analysis Examples, Introduction to Linear and Non-Linear data structures.

Representation of single, two dimensional arrays, sparse matrices-array and linked representations.

UNIT II

Linear list ADT-array representation and linked representation, Singly Linked Lists-Operations-Insertion, Deletion, Circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists-Operations- Insertion, Deletion.

Stack ADT, definition, array and linked implementations, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue ADT, definition, array and linked Implementations, Circular queues-Insertion and deletion operations.

UNIT III

Trees – definition, terminology, Binary trees-definition, Properties of Binary Trees, Binary Tree ADT, representation of Binary Trees-array and linked representations, Binary Tree traversals, Threaded binary trees, Priority Queues –Definition and applications, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap.

UNIT IV

Searching - Linear Search, Binary Search, Hashing-Introduction, hash tables, hash functions, Overflow Handling, Comparison of Searching methods.

Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Merge sort, Comparison of Sorting methods.

UNIT V

Graphs–Definitions, Terminology, Applications and more definitions, Properties, Graph ADT, Graph Representations- Adjacency matrix, Adjacency lists, Graph Search methods - DFS and BFS, Complexity analysis

UNIT VI

Search Trees-Binary Search Tree ADT, Definition, Operations- Searching, Insertion and Deletion, Balanced search trees-AVL Trees-Definition and Examples only, B-Trees- Definition and Examples only, Red-Black Trees-Definitions and Examples only, Comparison of Search Trees.

TEXT BOOKS

3. Data structures, Algorithms and Applications in C++, 2nd Edition, Sartaj Sahni, Universities Press.
4. Data structures and Algorithms in C++, Adam Drozdek, 4th edition, Cengage learning.

REFERENCE BOOKS

8. Data structures with C++, J. Hubbard, Schaum's outlines, TMH.
9. Data structures and Algorithms in C++, M.T. Goodrich, R. Tamassia and D. Mount, Wiley India.
10. Data structures and Algorithm Analysis in C++, 3rd edition, M. A. Weiss, Pearson.
11. Classic Data Structures, D. Samanta, 2nd edition, PHI.

ELECTROMAGNETIC WAVES AND TRANSMISSION LINES

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Describe the physical concepts of static electric fields.
2. Explain the physical concepts of static magnetic fields.
3. Analyze the boundary conditions for different mediums i.e. dielectric to dielectric, dielectric to conductor interfaces
4. Explain the concept of wave propagation through different media
5. Analyze basic transmission line parameters
6. Contrast λ/4, λ/2/, λ/8 Lines and also analyse TE and TM modes of propagation in waveguide

UNIT I

Electrostatics

Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Maxwell's Two Equations for Electrostatic Fields, Equipotential surface, Illustrative Problems.

UNIT II

Magnetostatics

Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Illustrative Problems

UNIT III

Maxwell's Equations (Time Varying Fields)

Faraday's Law, Inconsistency of Ampere's Law, Maxwell's Equations in Different Final Forms and Word Statements, applications of Maxwell equations, Conditions at a Boundary Surface: Dielectric-Dielectric, Dielectric-Conductor Interfaces

UNIT IV

EM Wave Characteristics

Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves, Wave Propagation in Lossless and Conducting Media, Wave Propagation in Good Conductors and Good Dielectrics, Polarization, Poynting Theorem, Illustrative Problems

UNIT V

Transmission Lines I

Transmission Line Equations, Primary and Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Loss less Transmission Line, Distortion – Condition for Distortionlessness and Minimum Attenuation, Illustrative Problems.

UNIT VI

Transmission Lines II

λ/4, λ2/, λ/8 Lines – Impedance Transformations, Smith Chart, Wave guides, TE and TM modes in wave guides, Impedance

TEXT BOOKS

1. Matthew N.O. Sadiku, "Elements of Electromagnetics", 4th Edition, Oxford University Press, 2008.
2. Umesh Sinha, Satya Prakashan, "Transmission Lines and Networks", Tech India Publications, New Delhi, 2001.

REFERENCE BOOKS

1. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, 2000.
2. William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", 7th Edition, TMH, 2006.
3. John D. Ryder, "Networks, Lines and Fields", 2nd Edition, PHI, 1999.
4. M. Kulkarni, "Microwave and Radar Engineering", 4th Edition, Umesh Publ., 2010

MICROCONTROLLERS AND APPLICATIONS

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Understand the architectures of 8051 and MSP430 microcontrollers
2. Program timers of 8051 and MSP430
3. Demonstrate the mixed signal operation of MSP430
4. Program communication interfaces of 8051 and MSP430.
5. Compare on-chip resources of 8051 and MSP430
6. Interface various devices with microcontrollers.

UNIT I

Fundamentals of Microprocessors

Fundamentals of Microprocessors, classification and comparison.

8051 Microcontroller: 8051 Architecture, pin diagram, memory organization, addressing modes, instruction set. Assembly language programming.

UNIT II

8051 Microcontroller

I/O ports, Timers/counters, Serial Communication, Interrupts. Interfacing of LED, switch, LCD and keyboard.

UNIT III

The Texas Instruments MSP430

The Outside View: Pin-Out, The Inside View-Functional Block Diagram, memory, Central Processing Unit, Memory-Mapped Input and Output, Clock Generator, Exceptions: Interrupts and Resets

UNIT IV

Architecture of the MSP430 Processor

Central Processing Unit, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Reflections on the CPU and Instruction Set, Resets System

UNIT V

Timers in MSP430

Watchdog Timer, Basic Timer1,Timer_ATimer_B

Mixed-Signal Systems

Analog-to-Digital Conversion: Successive Approximation, TheADC10 Successive-Approximation ADC, Basic Operation of theADC10, Digital-to-Analog Conversion

UNIT VI

Communication Peripherals in the MSP430: Serial Peripheral Interface, Inter-integrated Circuit Bus, Asynchronous Serial Communication

TEXT BOOKS

1 M .A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007.

2 John H. Davies ," MSP430 Microcontroller basics"1st Ed,Elsvier 2010.

REFERENC BOOKS

1. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning,2004..
2. Adrian fernadez and Dung Dang, "Getting Started with the MSP430 Launch pad", Elsevier.
3. SencerYeralan, Ashutosh Ahluwalia, "Programming and Interfacing the 8051 Microcontroller", Addison-Wesley Publishing Company, 1993

BIOMEDICAL INSTRUMENTATION

(Professional Elective - II)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Discuss the basic concepts of Physiological system of the body, Biomedical Engineering and Sources of Bioelectric Potentials.
2. Analyze the cardiovascular measurements using different methods
3. Explain the patient care and monitoring using different elements and equipments.
4. Describe various measurements in Respiratory system
5. Compare various Diagnostic Techniques
6. Demonstrate the concepts of Bio Telemetry.

UNIT I

Introduction

The age of Biomedical Engineering, Development of Biomedical Instrumentation, Man–Instrumentation system, Components, Physiological system of the body, Problem encountered in measuring a living system.

Transducers

The Transducers and Transduction principles, Active transducers, Passive Transducers, Transducer for Biomedical Applications.

UNIT II

Sources of Bioelectric Potentials

Resting and Action potentials, propagation of active potential, The Bioelectric potentials-ECG, EEG, EMG, and Invoked responses

Electrodes

Electrode theory, Bio potential Electrodes–Microelectrodes Body surface electrodes, Needle Electrodes, Reference electrodes, PH electrodes, and Blood Gas electrodes.

UNIT III

Cardiovascular Measurements

Electrocardiography – ECG amplifiers, Electrodes and leads, ECG recorders – Three channel, Vector Cardiographs, Continuous ECG recording (Holter recording), Blood pressure measurement, Blood flow measurement, Heart sound measurements.

Patient Care and Monitoring

Elements of Intensive Care monitoring, patient monitoring displays, Diagnosis, pacemakers and Defibrillators.

UNIT IV

Measurements in Respiratory System

Measurement of breathing mechanics- Spiro meter, Respiratory Therapy equipments: Inhalators ventilators and Respirators, Humidifiers, Nebulizers and Aspirators.

UNIT V

Diagnostic Techniques

Ultrasonic Diagnosis Echocardiography, Echo Encephalography, Ophthalmic scans, X-Ray and Radio-isotope Instrumentation, Computerized Axial Tomography Scanners.

UNIT VI

Bio Telemetry

The components of Biotelemetry system Implantable units, Telemetry for ECG measurements for Emergency patient monitoring. Physiological Effects of Electric Current Safety of Medical Electronic Equipments, Shock hazards from Electrical equipment and prevention against them.

TEXT BOOKS

1. Harry N Norton, “Biomedical Sensors- Fundamentals and Applications”, William Andrew Publications, 1982.
2. Richard S C Cobbold, “Transducers for Biomedical Measurements”, Krieger Publishing Company, 1974.

REFERENCE BOOKS

1. Khandpur R S, “Biomedical Instrumentation”, Tata McGraw Hill.
2. Tompkins, “Biomedical DSP: C Language Examples and Laboratory Experiments for the IBM PC”, Prentice Hall of India.
3. Geddes L.A and Baker L.E, “Principles of Applied Biomedical Instrumentation”, Wiley-Inter Science, 1989.

EMBEDDED SYSTEMS

(Professional Elective - II)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Retrieve the concepts of computing devices.
2. Describe the MSP432 architecture and programming.
3. Understand the SOC architectures and programming.
4. Distinguished between RTOS and OS.
5. Describe the advanced microprocessor architectures.
6. Evaluate an appropriate architecture for embedded application.

UNIT I

Embedded Computing

Introduction, processor Embedded into a system, hardware units, software units in a system, Embedded SoC and use of VLSI Circuit Design Technology, Embedded System Design Process.

UNIT II

MSP432Architecture and Programming

Introduction, MSP432 Microcontroller Hardware, Timers and Counters, I/O Ports and Circuits, Serial Data Communication, External Memory, Interrupts.

Assembly Language Programming Process, MSP432 Instruction Set: Data Transfer, Arithmetic, Logical and Branch Instructions, Decimal Arithmetic, Interrupt Programming.

UNIT III

SoC Architecture and Programming

SoC as a Single-Chip Solution for Embedded System Design, Analog, Digital and Controller (MSP432) Blocks in SoC, Hardware Programming through SoC Creator, I/O Pin Configurability and applications.

UNIT IV

Embedded / RTOS Concepts

Architecture of the Kernel, Tasks and Task scheduler, Interrupt service routines, Semaphores, Mutex, Mailboxes , Message Queues, Event Registers, Pipes, Signals, Timers, Memory Management, Priority inversion problem, Embedded operating systems, Embedded Linux, Real-time operating systems, RT Linux.

UNIT V

Embedded Software Development Tools

Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System, Debugging Techniques.

UNIT VI

Introduction to Advanced Architectures

ARM and ARM Cortex, Processor and memory organization and Instruction level parallelism, Networked embedded systems: Bus protocols, I2C bus and CAN bus, Internet – Enabled Systems, Design Examples – Elevator Controller.

TEXT BOOKS

1. Jonathan W. Valvano Embedded Systems: Introduction to the Msp432 Microcontroller
2. Lyla B Das, “Embedded Systems and Integrated Approach”, 2nd Edition, Pearson, 2013.

REFERENCE BOOKS

1. Wayne Wolf, “Computers as Components – Principles of Embedded Computing System Design”, 2nd Edition, Elsevier.
2. Shibu KV, “Introduction to Embedded Systems”, McGraw Hill, New Delhi, 2013.
3. Raj Kamal, “Introduction to Embedded Systems”, TMS, 2002.

DISTRIBUTED IoT SYSTEMS

(Professional Elective - II)

COURSE OUTCOMES

6. Create an IoT system architecture
7. Illustrate the concepts of Middleware for IoT
8. Build a sensor network.
9. Create appropriate program for IoT system
10. Identify programming languages and develop the program to interface various devices with an IoT system
11. Implement (Design–Build–Test) an IoT system

UNIT I

System Design - Embedded system, creating system architecture, hands on the hardware; inputs, outputs and timers, maintaining the flow of activity; core embedded principles in the context of developing quick applications

UNIT II

Middleware for IoT - WSN, SCADA, RFID; Middleware solutions - event based, service oriented, VM based, agent based

UNIT III

Connectivity through Sensors - RFID Ecosystem, RFID Web applications for IoT; IoT connectivity through Blue Tooth, WiFi and NFC.

UNIT IV

Building Sensor Network - Zigbee radio, antenna, buying an adapter, Xbee API Protocol, API and a sensor network Ins and Outs.

UNIT V

Software Development - Setting up the programming environment, identifying programming languages for selected hardware, coding to the device

UNIT VI

System Integration and Testing – Steps in creating a complete system with nodes and sensor network, Testing Protocol

Sample Project

"Home IoT system": Students will learn how to implement a voice-based home IoT system to control home appliance. In this project, students will get familiar with the latest Home IoT technology from Google, called Google Home. Google Home is a voice-activated speaker powered by the Google Assistant. Control devices using Google Home.

TEXT BOOKS

3. Beginning Sensor Networks with Arduino and Raspberry Pi, Charles Bell
4. Coulouris George, Dollimore jean, Kindberg Tim, Blair Gordon, "Distributed Systems", Pearson Education; Fifth edition (31 March 2017)

REFERENCES

1. Hwang, "Distributed and Cloud Computing: From Parallel Processing to the Internet of Things" Elsevier; First edition (2012)
2. Maciej Kranz, "Building the Internet of Things" Wiley 2016.

CODING THEORY

(Professional Elective - II)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Illustrate the average information content of symbol
2. Apply different encoding algorithms for source coding.
3. Compute channel capacity for memory and memory-less channels.
4. Describe channel coding theorem.
5. Analyze error detecting and error correcting codes like linear block codes, cyclic codes and convolution codes.
6. Compare different error control codes.

UNIT I

Introduction to Information Theory

Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark-off statistical model for information source, Entropy and information rate of mark-off source.

UNIT II

Source Coding

Encoding of the source output, Shannon's Encoding Algorithm, Shannon Fano Encoding Algorithm, Huffman Coding.

UNIT III

Communication Channels

Discrete channels representation, Channel Capacity for Memory less and Discrete channels with Memory, Special Channels, Channel coding theorem, Continuous channels representation.

UNIT IV

Error Detecting and Correcting Codes

Types of Error Control, Linear Block Codes, Error Detecting and Correcting Capability.

UNIT V

Binary Cyclic Codes

Binary Cyclic Codes Algebraic structures, Encoding using shift registers, Syndrome calculation.

UNIT VI

Convolutional Encoding

Convolutional Encoder Representation, Formulation of the Convolutional Decoding Problem, Properties of Convolutional Codes, BCH codes: definition, minimum distance, decoding procedure for BCH codes.

TEXT BOOKS

1. K. Sam Shanmugam, "Digital and Analog Communication Systems", John Wiley, 1996.
2. John G Proakis, "Digital Communication", 5th Edition, TMH, 2008.

REFERENCE BOOKS

2. Simon Haykin, "Digital Communication", John Wiley, 2003.
3. Dr. Bernard Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition, Pearson Education, 2001.

COMPUTER ORGANIZATION AND ARCHITECTURE

(Professional Elective - II)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Design logic circuit by minimizing logic expression.
2. Define different number systems and perform different binary arithmetic operations.
3. Illustrate register transfer language using arithmetic, logic, shift micro operations.
4. Explain processor organization and compare hardwired and micro programmed control unit.
5. Discus input output devices organization, modes of transfer, pipelining and parallel processing.
6. Comprehend memory organization and hierarchy.

UNIT I

Basic Structure of Computers: Functional units, Basic operational concepts

Digital Logic Circuits: Logic Gates, Boolean algebra, Sequential Circuits, basic Map simplifications, Combinational Circuits - Decoders, Multiplexers.

UNIT II

Data Representation: Data Types, Complements, Fixed Point Representation, Floating Point Representation. Register Transfer and Microoperations: Register Transfer, Bus and Memory Transfers, Arithmetic Microoperations, Logic Microoperations, Shift Microoperations, Arithmetic Logic Shift Unit.

UNIT III

Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle.

Central Processing Unit: Register Organization, Instruction Formats, Addressing Modes.

UNIT IV

Computer Arithmetic: Addition, Subtraction, Multiplication and Division Algorithm.

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access.

UNIT V

Pipelining: Arithmetic pipeline, Instruction pipeline, RISC Pipelining.

UNIT VI

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

TEXT BOOKS

3. Carl Hamacher, ZvonkoVranesic and SafwatZaky, “Computer Organization”, FifthEdition,McGraw Hill, 2002.
4. M. Morris Mano, “Computer System Architecture”, 3rd Edition, PHI / Pearson, 2006.

REFERENCE BOOKS

3. William Stallings, “Computer Organization and Architecture”, 7th Edition, PHI / Pearson, 2006.
4. David A Patterson, “Computer Architecture and Organization”, TMH.

DATA STRUCTURES LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms.
2. Compare and contrast the benefits of dynamic and static data structures implementations.
3. Develop and Evaluate programs that use arrays, records, linked structures, stacks, queues, trees and graphs.
4. Demonstrate different methods for traversing trees.
5. Design and implement an appropriate hashing function for an application.
6. Discuss the computational efficiency of the principal algorithms for sorting, searching and hashing.

Write a C++ programs to implement recursive and non recursive i) Linear search ii) Binary search

Write a C++ programs to implement

v. Bubble sort
vi. Selection sort
vii. Quick sort
viii. insertion sort

Write a C++ programs to implement the following using an array.

1. Stack ADT b) Queue ADT

Write a C++ programs to implement list ADT to perform following operations

a) Insert an element into a list.

b) Delete an element from list

c) Search for a key element in list

d) Count number of nodes in list

Write C++ programs to implement the following using a singly linked list.

Stack ADT b) Queue ADT

Write C++ programs to implement the deque (double ended queue)

ADT using a doubly linked list and an array.

Write a C++ program to perform the following operations:

a) Insert an element into a binary search tree.

b) Delete an element from a binary search tree.

c) Search for a key element in a binary search tree.

Write C++ programs for implementing the following sorting methods:

Merge sort

Heap sort

Write C++ programs that use recursive functions to traverse the given binary tree in

a)Preorder

b) inorder and

c) postorder.

Write a C++ program to perform the following operations

a)Insertion into a B-tree

b) Deletion from a B-tree

Write a C++ program to perform the following operations

a)Insertion into an AVL-tree

b) Deletion from an AVL-tree

Write a C++ program to implement all the functions of a dictionary (ADT)

INTEGRATED CIRCUIT APPLICATIONS LAB

List of Experiments

1. Demo Experiments:

Linear IC Experiments:

1. Inverting Amplifier and non-inverting amplifier using IC 741 Op-Amp.
2. Adder, Subtractor, Comparator using IC 741 Op-Amp.
3. Integrator using IC 741 Op-Amp.
4. Differentiator using IC 741 Op-Amp.
5. Wien Bridge Oscillators using IC 741 Op-Amp.
6. Monostable operation using IC 555 Timer.

Digital IC Experiments:

1. Verification of Truth Table of basic Logic Gates using ICs.
2. Realization of basic gates using universal gates.
3. Flip Flops: JK Flip Flop, D-Flip Flop, T Flip Flop.
4. Decoder – (74LS138) Encoder – (74147).
5. Multiplexer – (74151), Demultiplexer – (74155).
6. Binary counter – (7493), Decade counter – (7490) and Up Down counters-(74190,74191).
7. Universal Shift Register – (74LS194/195).

2. Design Experiments:

1. Implement second order Differential Equation using IC 741 Op-Amp.

2. Design and Implementation of Code Converters.

3. Using 555 Timer design an A stable Multivibrator having an output frequency and with a Duty Cycle

4. Design 4:1 Multiplexer using two 2:1 multiplexer.

5. Design 4-bit Ripple Counter using IC 7476.

3. Structured Experiments:

1. Design a Summing Amplifier circuit to Add 'n' DC input voltages. The output of this circuit must be equal to 'm' times the sum of the Inputs. (Inverting, Non-inverting, m vary from 1 to m & n vary from 2 to n)
2. Design a High Voltage/Low Voltage Regulator. (723, 13V to 28V, short circuit current protection, Vref)
3. Design an Adder/Subtractor circuit. (Half Adder, Full Adder, Binary Adder, Parallel Adder, Subtractor)
4. Design mod-6 counter. (Synchronous, Asynchronous, Any flip-flop, UP/DOWN)

MICROCONTROLLERS AND APPLICATIONS LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Discuss architectures of 8051 and MSP430 microcontrollers.
2. Develop and assembly language programs.
3. Program of timers, ADC, communication ports
4. Interfacing of various I/O devices to 8051 and MSP430
5. Compare 8051 and MSP430 features.
6. Design and implement microcontroller-based embedded system.

LIST OF EXPIREMENTS

Demonstration

1. Write an ALPs to verify data transfer, Arithmetic & logical instructions.
2. Write a program & demonstrate an interfacing of switch and LED
3. Program timers of 8051.

Structured

4. Program communication port of 8051
5. Verify interrupts of 8051.
6. Program to interface liquid crystal display(LCD) to 8051
7. Program to interface matrix Keyboard to 8051.
8. Interface Stepper motor to 8051.
9. Program the timers of MSP430

Open Ended

10. Programming ADC using MSP430
11. Programming SPI using MSP430

OBJECT ORIENTED PROGRAMMING CONCEPTS

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. List all OOP features to design object oriented applications, and execute straight forward programs using a high level language.
2. Discuss the principles and practice of object oriented analysis and design in the construction of robust, maintainable programs which satisfy their requirements.
3. Analyze implementation, compilation, testing and run java programs comprising more than one class, to address a particular software problem.
4. Classify effective user interface applications through AWT controls and swings.
5. Examine use of members of classes in the Java API.
6. Summarize the framework and architecture for MVC's

UNIT I

Object Oriented Thinking

OOP Principles, Java buzzwords, data types, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion, concepts of classes, objects, constructors, methods, access specifiers, garbage collection.

UNIT II

Inheritance

Super class, Sub class, Types of inheritance's using final with inheritance, polymorphism- method overriding, Dynamic Method dispatch, abstract classes, Interfaces, variables in interface and extending interfaces. Overloading methods, parameter passing, recursion. Packages Defining, Creating and Accessing a Package, importing packages.

UNIT III

Exception Handling

Need for Exceptional Handling, try, catch, throw, throws and finally, built in exceptions, creating own exception. Streams- File Input Stream, File Output Stream, Data Input Stream, Data Output Stream, Scanner, File Reader, File Write. Byte Array, Char Array.

UNIT IV

Multi Threading

Differences between multithreading and multitasking, thread life cycle, creating threads, synchronizing threads, daemon threads, thread groups. Event Handling: Events, Event sources, Event classes, Event Listeners, handling mouse events, keyboard events, Adapter classes, inner classes.

UNIT V

AWT Controls

Labels, button, text components, check box, check box groups, choices, lists, menu bar layout manager types – boarder, grid, flow, card and grib bag. limitations of AWT, MVC architecture, components, containers

UNIT VI

Swings

Introduction exploring swing- J Applet, J Frame and J Component, Icons and Labels, text fields, buttons – The J Button class, Check boxes, Radio buttons, Combo boxes, Tabbed Panes, Scroll Panes, Trees, and Tables.

TEXT BOOKS

1. Java 7 Programming - Black Book, By Kogent Learning Solutions Inc., Freamtech Publications
2. Herbert schildt "Java the complete reference", 7th Edition, TMH,ISBN:0072263857

REFERENCE BOOKS

1. Y. Daniel Liang "Introduction to Java programming" 6th Edition, pearson education, ISBN:10:0132221586
2. R.A. Johnson-An introduction to Java programming and object oriented application development, Thomson, ISBN:-10:0619217464
3. Head First Java 2nd Edition by Kathy Sierra, Oreilly Publication
4. T.Budd "Understanding OOP with Java" updated Edition, Pearson education, ISBN:10:0201612739

WEB LINKS

1. www.tatamcgrawhill.com/html/9780070636774.html
2. http://nptel.iitm.ac.in
3. https://www.cl.cam.ac.uk/teaching/0910/OOProg/OOP.pdf
4. www.java2s.com

VIRTUAL INSTRUMENTATION

(Professional Elective - III)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Demonstrate the data flow techniques in VI.
2. Explain the concepts of VIS, Sub-VIS and illustrate graphical programming in data flow using Lab VIEW.
3. Construct PC based data acquisition system for multi channel inputs.
4. Explain the features of Common Instrument Interface and selection of bus for Industrial applications.
5. Demonstrate the modulation tool kit and Digital filter design tool kit
6. Develop process control projects, data acquisition system using VI major equipments and display units.

UNIT I

Introduction to Virtual Instrumentation

Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of virtual instrument - Conventional Instruments versus Virtual Instruments - data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II

Programming Techniques

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT III

Data Acquisition Basics

Introduction to data acquisition, Sampling fundamentals, Input/ Output techniques and Latest ADCs, DACs, Digital I/O, counters and timers.

UNIT IV

Data acquisition interface requirements

Issues involved in selection of Data acquisition cards – Data acquisition cards with serial communication .SCSI, PCI, PXI system controllers, Ethernet control of PXI.

UNIT V

VI Toolsets

Use of Analysis tools - Fourier transforms, power spectrum, correlation methods, windowing and filtering.

UNIT VI

Applications

Simulation of systems using VI, Industrial Communication, Image acquisition and processing, Development of Virtual Instrument using GUI, Real-time systems, Embedded Controllers.

TEXT BOOKS

1. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
2. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey, 1997.

REFERENCE BOOKS

1. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newness, 2000.
2. John Lenk, D., "Handbook of Micro computer based Instrumentation and Control", PHI, 1984.

ARM ARCHITECTURE

(Professional Elective - III)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Retrieve the history of RISC machines.
2. Differentiate the features of basic processors and RISC machines.
3. Compare the thumb model and ARM model.
4. Execute assembly and C language programming for ARM model.
5. Describe the memory model of ARM.
6. Design and implement ARM based embedded system.

UNIT I

ARM Architecture

ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families.

UNIT II

ARM Programming Model – I

Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

UNIT III

ARM Programming Model – II

Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions

UNIT IV

ARM Programming

Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions. Simple C Programs using Function Calls, Pointers, Structures.

UNIT V

ARM Programming

Integer and Floating Point Arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops.

UNIT VI

Memory Management

Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation, Access Permissions, Context Switch.

TEXT BOOKS

1. Andrew N Sloss, Dominic Symes and Chris Wright, "ARM Systems Developer's Guides-Designing, Optimizing System Software", Elsevier, 2008.
2. Steve Furber, "ARM System on Chip Architecture", 2nd Edition, Pearson.

REFERENCE BOOKS

1. Jonathan W. Valvano, "Embedded Microcomputer Systems: Real Time Interfacing", Brookes - Cole / Thomas Learning, 1999.
2. William Hohl and Christopher Hinds, "ARM Assembly Language: Fundamentals and Techniques", 2nd Edition, CRC Press.

SECURITY IN IoT

(Professional Elective - III)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. Demonstrate the concepts of the security and ethical issues of the Internet of Things
7. Identify vulnerabilities and attacks related to the Internet of Things
8. Describe countermeasures for Internet of Things devices
9. Compare and contrast the threat environment based on industry and/or device type
10. Discuss the security issues in agriculture, Healthcare, Cities, homes and transportation.
11. Create secure system using cryptographic algorithms and security features and protocol

UNIT I

Introduction to IoT Security – Vulnerabilities, Attacks and Countermeasures. Information Assurance. Attack types. New security threats and vulnerabilities. Fault Trees and CPS. Countermeasures to thwart attack. Threat Modeling.

UNIT II

Security Management & Cryptology - Security Controls - Authentication, Confidentiality, Integrity; Access Control, Key Management and Protocols, Cipher – Symmetric Key Algorithms, Public Private Key Cryptography; Attacks – Dictionary and Brute Force, Lookup Tables, Reverse Look Tables, Rainbow Tables, Hashing – MDS, SHA256. SHA 512, RipeMD, WI, Data Mining

UNIT III

Attack Surface and Threat Assessment – Embedded Devices – UART, SPI, I2C, JTAG, Attacks – Software and cloud components, Firmware devices, Web and Mobile Applications.

UNIT IV

IoT Protocol Built-in Security Features – Transport Layer, SSL/TLS and DTLS, Kerberos, Cloud security for IoT

UNIT V

Case Studies and Discussion: Smart Agriculture, Cities, Grid, Healthcare, Homes, Supply Chain, and Transportation

UNIT VI

Application of Security Concepts to Create IoT system

TEXTBOOKS

1. Practical Internet of Things Security, Brian Russell & Drew Van Duren – 2016
2. Security and the IoT ecosystem, KPMG International, 2015

REFERENCES

3. Internet of Things: Privacy & Security in a Connected World, Federal Trade Comission, 2015
4. “Internet of Things: IoT Governance, Privacy and Security Issues” by European Research Cluster

OPTICAL COMMUNICATION

(Professional Elective - III)

COURSE OUTCOMES

At the end, of course, the students will develop ability to

1. Identify the basic elements of optical fiber transmission and basic optical laws.
2. Distinguish modes in multimode fibers and mode field parameter in single-mode fibers.
3. Analyze the different kind of losses, signal distortion and degradation factors in optical wave guides
4. Classify fiber optic connectors and splicing techniques.
5. Discuss the properties of Light emitting diodes (LED) and Laser diodes, PIN and Avalanche photodiode.
6. Analyze optical system design parameters, different concepts and components of wave division multiplexing (WDM).

UNIT I

Overview of optical fiber communication - Historical development, The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays. Cylindrical fibers- Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers. Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index.

UNIT II

Fiber materials - Glass, Halide, Active glass, Chalcogenide glass, Plastic optical fibers. Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity determination, Group delay, Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion. Overall fiber dispersion in Multi-mode and Single mode fibers,

UNIT III

Optical fiber Connectors- Connector types, Single mode fiber connectors, Connector return loss. Fiber Splicing- Splicing techniques, Splicing single mode fibers. Fiber alignment and joint loss- Multimode fiber joints, single mode fiber joints,

UNIT IV

Optical sources- LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes- Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, Resonant frequencies. Reliability of LED and ILD. Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling.

UNIT V

Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors. Optical receiver operation- Fundamental receiver operation, Digital signal transmission, Receiver configuration, Digital receiver performance, Probability of error, Quantum limit, Analog receivers.

UNIT VI

Optical system design — Considerations, Component choice, Multiplexing. WDM, Necessity, Principles, Types of WDM, Point-to- point links, System considerations, Link power budget with examples. Rise time budget with examples. Transmission distance, Measurement of Attenuation and Dispersion.

TEXT BOOKS

1. Gerd Keiser, "Optical Fiber Communications", McGraw Hill International Edition, 3rd Edition, 2000.
2. John M. Senior, "Optical Fiber Communications", PHI, 2nd Edition, 2002.

REFERENCE BOOK

1. D.K. Mynbaev and Gupta and Scheiner, "Fiber Optic Communications", Pearson Edition, 2005.
2. Joseph C. Palais, "Fiber Optic Communications", Pearson Education, 4th Edition, 2004.
3. Harold Kolimbris, "Fiber Optic Communications", Pearson, New Delhi, 200

ANTENNA AND WAVE PROPAGATION

(Professional Elective - III)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Explain the parameters and fundamental concepts of antennas.
2. Demonstrate electric, magnetic fields and radiation patterns for different types of antennas.
3. Construct different arrays of antennas in order to improve their gain and directivity.
4. Classify the various types of antennas depending upon frequency and working.
5. Analyze the basic propagation of wave in troposphere, ionosphere regions
6. Illustrate the various procedures for measurement of different parameters of antenna

UNIT I

Antenna Basics

Introduction, basic antenna parameters – Radiation pattern, E-plane and H-plane, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain, Resolution, Antenna Apertures, Effective height, Illustrative problems, Fields from oscillating dipole, field zones, front-to-back ratio, antenna theorems and related problems.

UNIT II

Thin Linear Wire and loop Antennas

Retarded potentials, Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole – Current Distributions, Radiated Power, Radiation Resistance, Illustrative problems, Types of Loop antennas

UNIT III

Antenna Arrays

2-element arrays, N-elements Linear Arrays – Broadside, Endfire arrays, characteristics and comparison, Principal of Multiplication of patterns, Binomial Arrays, Basic concept of Smart Antennas and array

UNIT IV

VHF, UHF and Microwave Antennas

Folded dipoles, Yagi-Uda antenna, Plane sheet and corner reflectors, Paraboloidal Reflectors – Characteristics, types of feeds, spill over, aperture blocking, offset feed, Cassegrain Feeds, Horn

Antennas – Types, characteristics, optimum horns, Microstrip patch antenna

UNIT V

Wave Propagation

Ground Wave Propagation – Characteristics, Ionosphere – formation of layers and mechanism of propagation, Critical Frequency, MUF, skip distance, space wave propagation, M-Curves, Tropospheric Propagation.

UNIT VI

Antenna Measurements

Basic concepts, Measurement of various parameters-Gain, Polarization, Impedance and Efficiency

TEXT BOOKS

1. John D. Kraus and Ronald J. Mathefka, "Antennas", TMH.
2. E.C. Jordan and K.G. Balman, "Electromagnetic Waves and Radiating Systems", Prentice Hall India Learning Private Limited, 2nd Edition, 1964.

REFERENCE BOOKS

1. K.D. Prasad, "Antennas and Wave Propagation", Satya Prakashan Publication.
2. F.E. Terman, "Electronic and Radio Engineering", McGraw Hill Publication.
3. Balanis, Constantine-A, "Antenna Theory", John Wiley, New Delhi, 2nd Edition, 2008.
4. Raju GSN, "Antenna and Wave Propagation", Pearson, New Delhi, 2006.
5. Frank Gross, "Smart Antennas for Wireless Communications", MGH, 2005.

DISCRETE MATHEMATICAL STRUCTURES

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Apply the mathematical logic, predicate rules to design an abstract system for theorem proof.
2. Apply mathematical foundations, algorithmic principles in modelling and design in computer based system.
3. Understand sets, relations, functions, connectives, truth tables, and discrete structures..
4. Apply the concepts of graph theory in solving practical engineering problems.
5. Develop the ability to solve problems involving recurrence relations and generating functions
6. Visualize and simplify situations using graphs and trees as tools.

UNIT I

Mathematical Logic

Statements and notations, Connectives, Well formed formulas, Truth Tables, tautology, equivalence implication, Normal forms.

Predicates

Predicative logic, Free and Bound variables, Rules of inference, Consistency, proof of contradiction.

UNIT II

Set Theory

Introduction, Sets and Elements, Subsets, Venn Diagrams, Set Operations, Power Sets, Partitions

Relations

Introduction, Product Sets, Relations, Pictorial Representatives of Relations, Composition of Relations, Types of Relations, Closure Properties, Equivalence Relations, compatibility and Partial Ordering Relations

UNIT III

Ordered Sets

Ordered Sets, Hasse Diagrams of Partially Ordered Sets, Supremum and Infimum, Isomorphic (Similar) Ordered Sets, Well-Ordered Sets, Lattices and its Properties

Functions: Introduction, Functions, One-to-One, Onto and Bijective Functions, Invertible Functions, Recursive Functions.

UNIT IV

Techniques of Counting

Introduction, Basic Counting Principles, Permutations, Combinations, The Pigeonhole Principle and its applications, The Inclusion–Exclusion Principle, Combinations with Repetitions, Binomial and Multinomial Theorems

UNIT V

Recurrence Relation

Generating Functions, Function of Sequences Calculating Coefficient of generating function, Recurrence relations, Solving recurrence relation by substitution and Generating functions.

UNIT VI

Graph Theory

Representation of Graph, Basic Concepts, Basic types of Graphs and their properties, types of paths, Isomorphism and Sub graphs, Multi graphs, Euler circuits, Hamiltonian graphs, Chromatic Numbers, DFS, BFS, Trees, Spanning Trees, Planar Graph, Prim's and Kruskal's Shortest Path

TEXT BOOKS

1. Seymour Lipschutz, Lipson Marc, "Discrete Mathematics", Tata Mcgraw Hill, ISBN-100070669120
2. Trembly J.P. and Manohar .P, "Discrete Mathematical Structures with Applications to computer Science", TMH,ISBN-10: 0074631136

REFERENCE BOOKS

1. Ralph. P.Grimaldi "Discrete and Combinational Mathematics- An Applied Introduction", 5th Edition Pearson Education,ISBN:9780201726343
2. BernandKolman, Roberty C. Busby, Sharn Cutter Ross, "Discrete Mathematical Structures", Pearson Education / PHI.
3. J.L. Mott, A. Kandel, T.P. "Discrete Mathematics for Computer Scientists and Mathematicians", Baker Prentice Hall.

CONTROL SYSTEMS

COURSE OUTCOMES

At the end of the course, students will develop ability to

1. Develop concepts and compare different types of control systems.
2. Derive the transfer functions of AC and DC servo meters.
3. Draw the root locus plots and analyze the effect of adding zeros and poles
4. Perform the frequency response analysis and derive the specifications of control systems with transfer function.
5. Design PID controllers and Lag-Lead compensators
6. Calculate state variables and obtain controllability and observability of system

UNIT I

Introduction and Transfer Function Representation

Concepts and examples of Control Systems- Open Loop and closed loop control systems and their differences- Feed-Back Characteristics, Effects of feedback. Mathematical models–Differential equations, Impulse Response and transfer functions-Translational and Rotational mechanical systems. Transfer Function of DC Servo motor - AC Servo motor

UNIT II

Block diagram and Signal Flow graph

Block diagram representation of systems considering electrical systems as examples - Block diagram algebra – Representation by Signal flow graph - Reduction using Mason's gain formula.

UNIT III

Time Response Analysis

Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Time response of second order systems - Time domain specifications – Steady state errors and error constants – Effects of proportional derivative, proportional integral systems (P, PI, and PID controllers).

UNIT IV

Stability Analysis in S-Domain and Frequency Domain

The concept of stability – Routh's stability criterion –limitations of Routh's stability. The root locus concept - construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci.

Introduction to frequency domain analysis, Frequency domain specifications- Stability Analysis from Polar Plots, Nyquist Plots.

UNIT V

Bode Diagrams and Classical Control Design Techniques

Stability Analysis from Bode Plots, Determination of frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin.

Compensation techniques – Lag, Lead, Lead-Lag Controllers design with Bode plot.

UNIT VI

State Space Analysis of Continuous Systems

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

TEXT BOOKS

1. Norman S Nise, "Control Systems Engg.", 4th ed., John wiley Publishers, 2007, ISBN: 81-265-1097-8, 978-81-265-1097-9.
2. Katsuhiko Ogata, "Modern Control Engineering", 3rd ed., Prentice Hall of India Pvt. Ltd., 1998.

REFERENCE BOOKS

1. I. J. Nagrath and M. Gopal, "Control Systems Engineering", 5th ed., New Age International (P) Limited, Publishers, 2009.
2. B. C. Kuo, "Automatic Control Systems", 9th edition, John wiley and son's, 2014.
3. Narciso F. Macia George J. Thaler, "Modelling & Control of Dynamic Systems", Thomson Publishers.
4. N.K.Sinha, "Control Systems", 3rd ed., New Age International (P) Limited Publishers, 1998, ISBN: 81-224-1168-1.

ANALOG AND DIGITAL COMMUNICATIONS

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Calculate the bandwidth, modulation index and power requirements for Analog systems.
2. Discriminate the Time and frequency division multiplexing techniques.
3. Analyze signal-to-noise ratio in pulse code modulation.
4. Analyze various digital modulation techniques
5. Describe various error control codes like LBC, cyclic codes, Convolutional codes.
6. Differentiate between CDMA and OFDM modulation

UNIT I

Amplitude Modulation

Need for modulation, single tone representation of AM, Envelope detector, Generation of DSBSC Waves, coherent Detection of DSBSC Waves, Frequency-Domain description of SSB waves, Frequency division multiplexing.

UNIT II

Frequency Modulation

Basic concepts, Direct FM, Foster Seeley Discriminator, Phase locked loop.

Pulse Modulation

Time Division Multiplexing, Introduction of PAM, PWM, PPM.

UNIT III

Pulse Code Modulation

Block diagram of digital communication system, Pulse code modulation, Uniform quantization, Differential PCM, Delta modulation, Signal-to- Noise Ratio calculations in PCM.

UNIT IV

Digital carrier modulation schemes

Passband transmission model coherent and non coherent digital modulation schemes (ASK, FSK, PSK), QPSK, Deferential Phase Shift Key, keying QAM.

UNIT V

Error Control Codes

Introduction discrete memory less channels, linear block codes, cyclic codes, convolution codes, maximum likely hood decoding of convolution codes.

UNIT VI

Multi user Radio Communications

Multiple access techniques TDMA, FDMA, CDMA, TDMA and CDMA wireless communication systems, Concept of OFDM

TEXT BOOKS

1. Herbert Taud, Donald L. Schiling, GoutamSaha, “Principles of Communication Systems”, – 3rd Edition, McGraw – Hill2008.
2. Simon Haykin, “Communication Systems”, John Wiley, 4 th Ed

REFERENCE BOOKS

1. Sam Shanmugam, “Digital and analog communication system”, John Wiley, 2005.
2. Wireless and Cellular Communication – C. Y. Lee – McGraw Hill, 3 rd Edition, 2006
3. Wireless Communication – Andrea Goldsmith – Cambridge Press, 1 st Edition, 2005
4. Wireless Communication Principle & Practice – T.S.Rappaport – 2 nd edition 2012 Pearson Education

OBJECT ORIENTED PROGRAMMING CONCEPTS THROUGH JAVA LAB

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Design, compile, test and execute straight forward programs using a high level language.
2. Discuss the principles and practice of object oriented analysis and design in the construction of robust, maintainable programs which satisfy their requirements.
3. Analyze implementation, compilation, testing and run java programs comprising more than one class, to address a particular software problem.
4. Illustrate synchronization using multithreading.
5. Classify effective user interface applications through AWT controls and swings.

Week 1

1. Write a Java program that prints all real solutions to the quadratic equation ax2 + bx + c = 0. Read in a, b, c and use the quadratic formula. If the descriminent (b2 -4ac) is negative, display a message stating that there are no real solutions.
2. The Fibonacci sequence is defined by the following rule:

The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursive functions to print the nth value in the Fibonacci sequence.

Week 2

1. Write a Java program that prompts the user for an integer and then prints out all prime numbers up to that integer.
2. Write a Java program to multiply two given matrices.

3. Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use StringTokenizer class of java.util)

Week 3

1. Write a Java program that checks whether a given string is a palindrome or not. Ex: MADAM is a palindrome.
2. Write a Java program for sorting a given list of names in ascending order.
3. Write a Java program to make frequency count of words in a given text

Week 4

1. Write a Java program that reads a file name from the user, and then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes.
2. Write a Java program that reads a file and displays the file on the screen, with a line number before each line.
3. Write a Java program that displays the number of characters, lines and words in a text file.

Week 5

1. Write a Java program that:
   i. Implements stack ADT.
   ii. Converts infix expression into Postfix form
   iii. Evaluates the postfix expression

Week 6

1. Develop an applet that displays a simple message.
2. Develop an applet that receives an integer in one text field, and computes its factorial Value and returns it in another text field, when the button named “Compute” is clicked.

Week 7

Write a Java program that works as a simple calculator. Use a grid layout to arrange Buttons for the digits and for the +, -,*, % operations. Add a text field to display the result.

Week 8

1. Write a Java program for handling mouse events.

Week 9

1. Write a Java program that creates three threads. First thread displays "Good Morning" Every one second, the second thread displays "Hello" every two seconds and the third thread displays "Welcome" every three seconds.
2. Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication.

Week 10

Write a program that creates a user interface to perform integer divisions. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num2 is displayed in the Result field when the Divide button is clicked. If Num1 or Num2 were not an integer, the program would throw a Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception Display the exception in a message dialog box.

Week 11

1. Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green. When a radio button is selected, the light is turned on, and only one light can be on at a time No light is on when the program starts.
2. Write a Java program that allows the user to draw lines, rectangles and ovals.

Week12

1. A demonstration of the ProgressMonitor toolbar. A timer is used to induce progress.
2. This example also shows how to use the UIManager properties associated with progress monitors.
3. **3.** Sample Swing application that manages several internal frames. This is the main class for working with the SiteFrame and PageFrame classes.

ANALOG AND DIGITAL COMMUNICATIONS LAB

COURSE OUTCOMES

At the end of the course the students will develop ability to

1. Generate the modulated and demodulated waves of AM,SSB-SC & DSB-SC and simulate using MATLAB.
2. Design FM transmitter for given specifications.
3. Analyze the operation of TDM and simulate using MATLAB.
4. Analyze frequency domain characteristics of modulated signals.
5. Analyze various pulse modulation schemes and simulate using MATLAB
6. Describe Error Detection and Correction of LBC.

LIST OF EXPERIMENTS: (Note: Minimum 12 experiments to be conducted)

All these experiments are to be simulated first either using Commsim, MATLAB, SCILAB, OCTAVE or any other simulation package and then to be realized in hardware.

Demonstration

1. DSB-SC Modulator &Detector
2. Pulse Amplitude Modulation &DeModulation
3. Pulse position Modulation and Demodulation
4. Study of spectrum analyzer and analysis of AM and FM signals
5. PCM generation and detection
6. Differential pulse code modulation
7. Delta modulation
8. Time division multiplexing of four band limited signals
9. Generation and detection of ASK, PSK and FSK
10. QPSK: generation and detection
11. Study of QAM Characteristics.
12. Linear Block Code: Encoder and Decoder

Structured

13. Measurement of modulating index of Amplitude modulation
14. Measurement of USB and LSB frequencies of SSB-SC Modulator

Open ended

15. Design FM transmitter for given specifications (for e.g standard base station of 90 MHz)

COMPUTER NETWORKS

(Professional Elective - IV)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Describe the architecture of computer communication networks.
2. Distinguish various topologies.
3. Design protocols for various layers.
4. Apply error detection and correction methods in data link layer.
5. Illustrate various wireless networks.
6. Apply different algorithms for congestion control and quality of service.

UNIT I

Introduction to networks, internet, protocols and standards, the OSI model, layers in OSI model, TCP/IP suite, Addressing.

UNIT II

Physical Layer

Digital transmission, multiplexing, transmission media, circuit switched networks, datagram networks, virtual circuit networks.

UNIT III

Data Link Layer

Introduction, Block Coding, cyclic codes, checksum, framing, flow and error control, Noiseless channels, noisy channels, HDLC, point to point protocols.

UNIT IV

Medium Access Sub Layer

Random access, controlled access, channelization, IEEE standards, Ethernet, Fast Ethernet. Giga-Bit Ethernet.

UNIT V

Network Layer

Logical addressing, internetworking, uni-cast routing protocols, Multicast routing protocols.

UNIT VI

Transport Layer

Process to process delivery, UDP and TCP protocol, congestion, congestion control techniques, Quality Of Service(QOS), Quality Of Service techniques.

TEXT BOOKS

1. Andrew S Tanenbaum, “Computer Networks”, 4th Edition, Pearson Education.
2. Behrouz A. Forouzan, “Data Communications and Networking”, 4th Edition, TMH, 2006.

REFERENCE BOOKS

1. William Stallings, “Wireless Communications and Networks”, 2nd Edition, Pearson Hall.
2. WA Shay, “Understanding Communications and Networks”, 3rd Edition, Cengage Learning.
3. Nader F. Mir, “Computer and Communication Networks”, Pearson Education.

SCRIPTING LANGUAGES IN VLSI DESIGN

(Professional Elective - IV)

COURSE OUTCOMES

Student will be able to

1. Interpret typical scripting languages for system applications
2. Create software systems using scripting languages, including Perl and Python.
3. Learn about The TCL phenomena, Philosophy, Structure, Syntax, Parser, Variables and data in TCL, Control flow, Data structures, Simple input/output, Procedures, Working with Strings, Patterns, Files and Pipes.
4. Ability to create and run scripts using PERL/TCl/Python in IC design flow.
5. Write server-side scripts using Perl and Pythons CGI facilities.
6. Develop Java scripts, Python web systems

UNIT I

Introduction to Scripts and Scripting

Characteristics and uses of scripting languages, Introduction to PERL, Names and values, Variables and assignment, Scalar expressions, Control structures, Built-in functions, Collections of Data, working with arrays, Lists and hashes, Simple input and output, Strings, Patterns and regular expressions, Subroutines, Scripts with arguments.

UNIT II

Advanced PERL

Finer points of Looping, Subroutines, Using Pack and Unpack, working with files, Navigating the file system, Type globs, Eval, References, Data structures, Packages, Libraries and modules, Objects, Objects and modules in action, Tied variables.

UNIT III

TCL

The TCL phenomena, Philosophy, Structure, Syntax, Parser, Variables and data in TCL, Control flow, Data structures, Simple input/output, Procedures, Working with Strings, Patterns, Files and Pipes, Example code.

UNIT IV

Advanced TCL

The eval, source, exec and up-level commands, Libraries and packages, Namespaces, Trapping errors, Event-driven programs, Making applications 'Internet-aware'.

UNIT V

JavaScript

Object models, Design Philosophy, Versions of JavaScript, The Java Script core language, Basic concepts of Python.

UNIT VI

Python Scripting

Introduction to Python language, python-syntax, statements, functions, Built-in-functions and Methods, Modules in python, Exception Handling.

TEXT BOOKS

1. The World of Scripting Languages- David Barron, Wiley Student Edition, 2010.
2. Python Web Programming, Steve Holden and David Beazley, New Riders Publications

REFERENCES

1. Practical Programming in Tcl and Tk - Brent Welch, Ken Jones and Jeff Hobbs., Fourth edition.
2. TCL/TK 8.5 Programming Cookbook- Bert Wheeler
3. Java the Complete Reference - Herbert Schildt, 7th Edition, TMH.
4. Programming Python, M.Lutz,SPD

MICROWAVE ENGINEERING

(Professional Elective - IV)

COURSE OUTCOMES

At the end of coursework, the student will develop the ability to

1. Identify the microwave frequencies from the electromagnetic spectrum.
2. Describe the basic concepts and properties of waveguides.
3. Explain the operation of microwave passive and active devices.
4. Estimate efficiency and output powers of oscillators and amplifiers by changing various parameters.
5. Analyse generation of microwave energy from microwave tubes and solid-state devices.
6. Describe measurement of various parameters of microwaves using microwave bench setup.

UNIT I

Microwave Transmission Lines

Introduction to Microwaves, Microwave regions and bands, Applications, Rectangular Waveguides-Solution of Wave Equations in rectangular Coordinates, TE/TM mode analysis, Expressions for Fields, Characteristics Equation and cut-off Frequencies, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section.

UNIT II

Waveguide Components

Coupling probes and loops, Posts and Tuning Screws. Microwave Multi port Junctions – E-plane Tee, H-plane Tee and Magic Tee, Directional coupler, Ferrites – Composition, Faraday rotation, Ferrite components- Gyrator, isolator, and Circulator. Scattering Matrix – Significance, formulation and properties, S-matrix of waveguide Tee junctions, Directional Coupler, Circulator and Isolator.

UNIT III

Microwave Tubes

Limitations and Losses of conventional tubes at Microwave frequencies

O-Type Tubes

2 cavity Klystrons – structure, velocity modulation process and Applegate diagram, Bunching process and Small Signal Theory - Expressions for output Power and Efficiency. Reflex Klystrons-structure, velocity modulation and Applegate diagram, Mathematical Theory of Bunching, Power output, Efficiency.

UNIT IV

M-Type Tubes

Cylindrical Traveling Wave Magnetron – Hull cut-off and Hartree conditions, PI-mode and its separation.

UNIT V

Microwave Solid State Devices

TEDs-Introduction, Gunn diode-principle, RWH theory, modes of operation and characteristics, Avalanche Transit Time Devices-Introduction of IMPATT diodes and TRAPATT diodes.

UNIT VI

Microwave Measurements

Description of Microwave Bench - Different blocks and their Features, Precautions; Microwave Power Measurement – Bolometer, Measurement of Attenuation, Frequency and VSWR.

TEXTBOOKS

1. Microwave Devices and Circuits – by Samusel Y. Liao. PHI
2. Microwave Principles – by Herbert J.Reich J.G. Skolnik, P.F. Ordung, and H.L. Krauss, Affiliated East-West Press Pvt., Ltd., New Delhi

REFERENCE BOOKS

1. Foundations for Microwave Engineering – by R.E. Collins, McGraw Hill Publication
2. Electronic and Radio Engineering – by Frederic E. Terman, McGraw Hill Publication
3. Microwave and Radar Engineering – by M. Kulkarni
4. Electronic Communications Systems – by George Kennedy, McGraw Hill Publication

WEB LINKS

1. www.electron.frba.utn.edu.ar/.../Microwave_Engineering_David_M_Poz...
2. www.burnbits.com/.../Pozar%20-%20Microwave%20Engineering.pdf

DIGITAL SIGNAL PROCESSING

COURSE OUTCOMES

At the end of the course student will develop ability to

1. Define discrete time signals and systems.
2. Sketch the frequency response of discrete time signals.
3. Compute DFT using Radix-2 FFT algorithms.
4. Design different types of digital filters in various domains.
5. Distinguish between the IIR and FIR filters.
6. Design multi stage Decimators and interploators.

UNIT I

Discrete Time Fourier Transform (DTFT)

Introduction**,** Discrete-Time Fourier transform, Frequency domain representation of discrete time signals and systems, Properties.

UNIT II

Discrete Fourier Transform (DFT)

Computation of DFT, properties of DFT, linear convolution, circular convolution of sequences using DFT.

Fast Fourier Transform: Fast Fourier transforms (FFT)-Radix2 decimation in time and decimation in frequency FFT algorithms, Inverse FFT.

UNIT III

IIR Digital Filters

Analog filter approximations, Butterworth and Chebyshev, design of IIR digital filters from analog filters, Impulse invariant techniques, Bilinear transformation method

UNIT IV

FIR Digital Filters

Characteristics of FIR digital filters, frequency response, Design of FIR digital filters: Fourier method, window techniques, comparison of IIR and FIR filters.

UNIT V

Realization Techniques of Digital Filters

Realization of IIR Digital Filters – direct, Canonic, Cascade and Parallel forms, Realization of FIR Digital Filters – transversal structure, linear phase realization.

UNIT VI

Multirate Digital Signal Processing

Introduction, down sampling (Decimation), Spectrum of down sampling, up sampling(interpolation),spectrum of up sampling, sampling rate conversion by a factor of I/D, multi rate digital signal processing.

TEXT BOOKS

1. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", Pearson Education / PHI, 4th Edition, 2007.
2. Mithra, "Digital Signal Processing", McGraw Hill Publications.

REFERENCE BOOKS

1. Li Tan, "Digital Signal Processing- Fundamentals and Applications", Elsevier, 2008.
2. Robert J. Schilling and Sandra L. Harris, "Fundamentals of Digital Signal Processing Using Matlab", Thomson, 2007.
3. Nagoorkhani A, "Digital Signal Processing", TMH, 2nd Edition, 2012.
4. Ramesh Babu P, "Digital Signal Processing", SciTech, 4th Edition, 2013.

CMOS FUNDAMENTALS AND VLSI FABRICATION DESIGN

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Explain Basic Electrical properties of MOS.
2. Describe the limitations of device scaling and explain short channel effects.
3. Explain the applications of MOS and CMOS.
4. Discuss VLSI Fabrication Techniques and draw the fabrication steps.
5. Draw stick diagrams and layouts.
6. Compare BJT, CMOS, BiCMOS and explain latch-up in devices.

UNIT I

Basic Electrical properties

Basic electrical properties of NMOS, PMOS, CMOS, Ids – Vds relationship derivation of NMOS and PMOS, MOS transistor threshold voltage, transconductance (g_m)

UNIT II

MOS Scaling

Second-order effects, Long-channel versus Short-Channel Devices, scaling of MOS- constant field and constant voltage scaling.

UNIT III

MOS Applications

MOS Switch, MOS Active Resistors, MOS Capacitances, pass transistor, NMOS inverter, PMOS inverter, various pull ups, CMOS inverter, CMOS Transmission Gates (Pass Gates)

UNIT IV

VLSI Fabrication Techniques

Introduction to IC Technology, Fabrication Process steps- Oxidation, Lithography, Diffusion, Ion implantation, Metallization, NMOS/PMOS fabrication, n-well CMOS Process, p-well CMOS Process, Twin Tub Processes

UNIT V

Stick diagram and Layouts

VLSI Design Flow, MOS layers, stick diagrams, design rules, layout diagrams for NMOS, PMOS and CMOS Inverters

UNIT VI

Latch up

Physical Origin, Latch-up Triggering, Latch up Prevention, BiCMOS technology, Comparision of BJT, CMOS and BiCMOS

TEXT BOOK

1. Essentials of VLSI circuits and systems – Kamarn Eshraghian, Eshraghian Dougles and A. Pucknell, PHI 2005 Edition.
2. CMOS Digital Integrated Circuits Analysis and Design, Kang and Leblebici, McGraw-Hill

REFERENCE BOOK

1. Wayne Wolf, “Modern VLSI Design”, Pearson education, 3rd edition. 1997.
2. CMOS VLSI Design – A circuits and systems perspective, Neil H.E. Weste, David Harris, Ayan Banerjee, Pearson 2009.
3. Principles of CMOS VLSI Design, Neil H.E. Weste, K.Eshraghian, Pearson, 2009.

DIGITAL SIGNAL PROCESSING LAB

COURSE OUTCOMES

At the end of the course, the student will develop the ability to

1. Learn the coding of C.
2. Implement discrete time signals and systems and perform operations on that signals.
3. Realize digital filter structures and analyze FIR and IIR filters in C.
4. Implement filters on DSP kits.
5. Implementation of the decimation and interpolation process.
6. Compute impulse response of first order and second order systems.

LIST OF EXPERIMENTS: (**12** experiments to be done)

I) DEMONSTRATION EXPERIMENTS

1. Generation of the Sinusoidal waveform, signal
2. To find DFT / IDFT of given DT signal
3. The impulse response of 1st order difference equation
4. The impulse response of 2nd order difference equation
5. Implementation of FFT of a given sequence
6. Determination of power spectrum of the given signal(s)

II) STRUCTURED EXPERIMENTS

1. Generate any two standard signals. Examples are Sin, Cos, Tan, Square, and Cot
2. Find the Response of Linear Time Invariant (LTI) System. (Linear convolution between two sequences with three samples each, Linear convolution between two sequences with four samples each, Linear convolution between two sequences with five samples each)
3. Design a digital filter with a cut off frequency 500Hz (IIR with Butterworth transformation, IIR with Chebyshev transformation, FIR with hamming window, FIR with Hanning window, FIR rectangular window, FIR Blackman window, FIR triangular window)

III) OPEN-ENDED EXPERIMENTS

1. Apply N- point DFT to a unit step sequence with only 5 samples
2. Consider any two discrete sequences and perform the MAC operation
   Example X= [1 2 4 5 6], Y= [2 3 4 5 6]

3. Design the sampling rate conversion of the discrete time sequence

   Example: Compact disc audio at 44,100 Hz is downsampled to 22,050 Hz before broadcasting over FM radio, the bit rate is reduced in half, from 1,411,200 bit/s to 705,600 bit/s, assuming that each sample retains its bit depth of 16 bits. The audio was therefore downsampled by a factor of 2.

CMOS FUNDAMENTALS AND VLSI FABRICATION DESIGN LAB

COURSE OUTCOMES

At the end of the course students will be able to

1. Program HDL code for various basic logic gates.
2. Simulate combinational circuits using HDL.
3. Simulate sequential circuits using HDL.
4. Explain layout design rules.
5. Design layout for NMOS, PMOS and CMOS.
6. Design layout for combinational circuits.

List of Experiments

Design and implementation of the following CMOS digital circuits using Xilinx/Cadence/

Mentor Graphics/ Equivalent CAD tools.

Part –A: VLSI Front End Design programs using HDL:

a. Draw the schematic and verify the following

i)DC Analysis

ii)AC Analysis

iii)Transient Analysis

Demonstration

1. Basic logic gates
2. CMOS inverter
3. Basic logic gates
4. CMOS inverter

Structured

5. CMOS NOR/ NAND gates
6. CMOS XOR and MUX gates
7. CMOS 1-bit full adder
8. Static / Dynamic logic circuit (register cell)
9. Latch
10. Pass transistor
11. CMOS NOR/ NAND gates
12. CMOS XOR and MUX gates
13. CMOS 1-bit full adder

14. Static / Dynamic logic circuit (register cell)
15. Latch
16. Pass transistor

Open Ended

Design an ALU which can perform four bit operations.

VLSI Back End Design programs:

b. Draw the Layout and verify the DRC

c. Check for LVS for the following experiments

WIRELESS COMMUNICATION AND NETWORKS

(Professional Elective - V)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Compare different wireless communication systems
2. Explain different generations of wireless communication system.
3. Explain frequency reuse
4. Analyze the various accessing techniques used in wireless communication
5. Distinguish between wireless and fixed telephone networks
6. Analyze complete wireless communication systems and networks

UNIT I

Introduction to Wireless Communication System

Evolution of mobile radio communications, Examples of wireless communication system.

UNIT II

Modern Wireless Communication Systems

Second generation cellular networks, Third generation wireless networks, Wireless in local loop, Wireless local area networks, Blue tooth and Personal area networks.

UNIT III

Cellular System Design Fundamentals

Spectrum Allocation, Basic Cellular System, Frequency reuse, Channel assignment strategies, Handoff Strategies, Interference and system capacity, Trunking and grade off service, Improving coverage and capacity, cell splitting.

UNIT IV

Multiple Access Techniques for Wireless Communication

Introduction to multiple access, FDMA, TDMA, Spread spectrum multiple access, space division multiple access, Packet ratio, Capacity of a cellular systems.

UNIT V

Wireless Networking

Differences between wireless and fixed telephone networks Development of wireless networks, fixed network transmission hierarchy, Traffic routing in wireless networks, Wireless data services, common channel signaling.

UNIT VI

Wireless LAN

Historical overviews of the LAN industry, Evolution of the WLAN industry, Wireless home networking IEEE 802.11. The PHY Layer MAC Layer, wireless ATM, HYPERLAN, HYPERLAN-2.

TEXT BOOKS

1. Theodore S. Rappaport, "Wireless Communications and Applications," Pearson Education, 2003.
2. William Stallings, "Wireless Communications and Networks", 2nd Edition, Pearson Hall.

REFERENCE BOOKS

1. Upen Dalal, "Wireless Communications", Oxford University Press, 2010.
2. P. Nicopolitidis, MS Obaidat, GI Papadimitria and AS Pomportsis, "Wireless Networks", John Wiley and Sons, 2003.
3. Jon W Mark and Weihua Zhqung, "Wireless Communication and Networking," PHI, 2005.

PLC AND ROBOTICS

(Professional Elective - V)

COURSE OUTCOMES

At the end of the course, the student will develop ability to

1. Understand programmable logic controls.
2. Design a PLC and interface with sensors.
3. Discuss types of robots, robot dynamics and their applications.
4. Illustrate the robotic programming.
5. Select a suitable robot for a specific application.
6. Design complex robotics engineering projects.

UNIT I

Programmable Logic Controllers

Basic Structure, Input / Output Processing, Ladder Logic Programming (Examine If Closed, Examine If Open, Output Energize, Output Latch, Output Unlatch), Data Handling, Selection of a PLC, Interfacing sourcing and sinking sensors , Interfacing actuators

UNIT II

Ladder Logic Programming for Real-World Applications

Timers (Timer on Delay, Timer off Delay) and counters (Count Up, Count Down) with applications, Bit Shift with Applications (Bit shift left and right), Analog I/O, PID Servo Motor Control, Stepper Motor Control

UNIT III

Introduction to Robotics

Robotics, Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Robot programming – teaching positions, different types of move command, different types of pick and place tasks, stacking and palletizing using the robot, using I/O operations to interface PLC to Robot Controller

UNIT IV

Machine Vision

Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis.

UNIT V

Application of Machine Vision System

Application of Machine Vision System, Edge detection, shape, feature and color recognition.

UNIT VI

Design of Mechatronics Systems

Steps in designing Mechatronics Systems. Integrating PLCs, Robotics and Vision Systems in factory automation.

TEXT BOOKS

1. Deb S. R. and Deb S, “Robotics Technology and Flexible Automation”, Tata McGraw Hill Education Pvt. Ltd, 2010.
2. John J Craig, “Introduction to Robotics”, Pearson, 2009.

REFERENCE BOOKS

1. Gary Anderson, “PLC Programming using RS Logix 500: Basic Concepts of ladder Logic Programming”, Create Space Independent Publishing, 2015.
2. Maxrabiee, “Programmable Logic Controllers”, 3rd Edition, Oxford University Press, 2013.
3. R.K. Mittal and I.J. Nagrath, “Robotics and Control”, TMH, New Delhi, 2008.

DIGITAL IMAGE PROCESSING

(Professional Elective - V)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

1. Acquire the fundamental concepts of a digital image processing system.
2. Identify and exploit analogies between the mathematical tools used for 1D and 2D signal analysis and processing.
3. Interpret different types of edge enhancement filters.
4. Analyze images using compression techniques.
5. Apply image processing algorithms in practical applications.
6. Evaluate the methodologies for image segmentation, restoration etc.

UNIT I

Fundamentals of Image Processing

Image Acquisition, Image Model, Sampling, Quantization, Relationship between pixels, distance measures, connectivity, Image Geometry, Photographic film. Histogram: Definition, decision of contrast basing on histogram, operations basing on histograms like image stretching, image sliding, Image classification, definition and Algorithm of Histogram equalization.

UNIT II

Image Transforms

2-D FFT, Properties, walsh transform, Hadamard Transform, Discrete cosine Transform, Haar transform, Slant transform, Hotelling transform

UNIT III

Image Enhancement

Arithmetic and logical operations, point operations, Smoothing filters-Mean, Median, Mode filters. Edge enhancement filters – Directorial filters, Sobel, Laplacian, Robert, KIRSCH Homogeneity and DIFF Filters, Prewitt filter, Contrast Based edge enhancement techniques, low Pass filters, High Pass filters, sharpening filters. Colour image processing, Color fundamentals, color models.

UNIT IV

Image Compression

Definition, A brief discussion on – Run length encoding, contour coding, Huffman Course Code, compression due to change in domain, compression due to quantization Compression at the time of image transmission. Brief discussion on image compression standards.

UNIT V

Image Segmentation

Detection of discontinuities. Edge linking and boundary detection, Thresholding, Region oriented segmentation.

UNIT VI

Image Restoration

Degradation model, Algebraic approach to restoration, Inverse filtering, least mean square filters, Constrained Least Squares Restoration, Interactive Restoration

TEXT BOOKS

1. R.C. Gonzalez and R.E. Woods, "Digital Image Processing", Addison Wesley / Pearson Edition, 2nd Edition, 2002.
2. A K Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India.

REFERENCE BOOKS

1. Rafael C. Gonzalez, Richard E Woods and Steven L, "Digital Image Processing Using MAT LAB", PEA, 2004.
2. William K. Pratt, "Digital Image Processing", John Wiley, 3rd Edition, 2004.
3. Anjireddy and M. Harishankar, "Text Book of Digital Image Processing", BSP, Hyderabad, 2013.

SOFTWARE DEFINED RADIO

(Professional Elective - V)

COURSE OUTCOMES

At the end of the course, the students will develop ability to:

1. Illustrate the basic concepts of software radio aspects .
2. Describe different Radio Architectures.
3. Analyze SCA architecture, specifications and requirements.
4. Analyze the design considerations of transmitter and receiver.
5. Evaluate different reconfiguration strategies.
6. Develop GNU Radio, universal software radio peripherals

UNIT I

SDR Introduction

Software Radio aspects, The Need for Software Radios, Characteristics and Benefits of a Software Radio, Design Principles of a Software Radio. SDR concepts & history, Benefits of SDR, SDR Forum, Ideal SDR architecture, SDR Based End to- End Communication, Worldwide frequency band plans- Future of Software Defined Radio- Introduction to Cognitive Radio.

UNIT II

Architecture

Introduction – 2G Radio Architectures Hybrid Radio Architecture- Basic Software Defined Radio Block Diagram- System Level Functioning Partitioning-Digital Frequency Conversion Partitioning., Functional View, Networking Overview-Core Framework- Operating Environment (OE)- SCA architecture, specification structure- General requirements and services, devices and Certification.

UNIT III

Front End Technology

Radio Frequency translation, Transmitter specifications, Architecture, Design considerations-

Receiver specifications, Architecture, considerations- Front end Implementation-Data conversions- Zero IF receivers, Preselect Filters.

UNIT IV

Baseband Processing and Reconfiguration

Base band component technologies, Design tools, Methodologies- Antenna requirements-

Reconfiguration of network elements- user requirement of SDR terminals- Reconfiguration strategies, requirements and management techniques.

UNIT V

GNU Radio Platform

Software Radio platforms: Low Cost SDR Platform- GNU radio- Python introduction, developing GNU Radio, signal processing blocks, scheduler, Basic GR development flow, Universal Software radio peripherals (USRP).

UNIT VI

Protocols and Network Aspects of SDR

Protocol Stacks: SAPs vs Reconfigurability, Approaches to Protocol Stack Reconfiguration, Reconfiguration Management And Control, Network Support for Software Radios

TEXT BOOKS

1. Bard, Kovarik: Software Defined Radio, The Software Communications Architecture, Wiley rd 2007, 3 Edition.
2. Dr. Walter Tuttlebee: Software Defined Radio-Enabling Technologies, Wiley 2002

REFERENCE BOOKS

1. Tafazolli (Ed.): Technologies for the Wireless Future, Wiley 2005
2. Eugene Grayver, Implementing Software Defined Radio, Springer
3. Cory Clark, Software Defined Radio: With GNU Radio and USRP, McGraw-Hill Companies, Incorporated, 29-Nov-2008
4. Dillinger, Madani, Alonistioti (Eds.): Software Defined Radio, Architectures, Systems and Functions, Wiley 2003

PHILOSOPHY

(Open Elective - I)

COURSE OUTCOMES:

At the end of the course, the students will be develop ability to

6. Explain the core philosophical concepts and approaches.
7. Identify and distinguish Indian and Western Philosophy.
8. Describe and Distinguish the main divisions of philosophy.
9. Understand and explain the abstract philosophical concepts.
10. Understand the applications and implications of philosophical principles in real time situations.

UNIT I
Introduction to Philosophy, nature, scope and significance of philosophy, western philosophy, philosophic thought, history of philosophy, the Sophists and Socrates, Plato and Aristotle.

UNIT II
Introduction to Indian Philosophy, the ancient Vedas, the Upanishads, the epics and the treatises of the Heterodox and Orthodox systems, Buddhism, Advaitha, Jainism, and Sikhism

UNIT III
The classification of Philosophy - The main divisions of Philosophy, Logic, the Philosophy of mathematics, Philosophy of nature, philosophy and the special science, philosophy of art: ethics philosophy and theology, philosophy and Common Sense.

UNIT IV
Criticism (Epistemology), Ontology: Essence, Substance and Accident,.

UNIT V
Modern Philosophy: Political Philosophy, Religious Philosophy, Western or European Philosophy, Eastern Philosophy.

UNIT VI
Relevance of philosophy in modern world: Application of philosophical principles in modern India, its impact and usefulness.

TEXT BOOKS
3. Jacques Maritain, “An Introduction to Philosophy”, Rowman and Littlefield Pub Inc., 2005.
4. John Cottingham, “Western Philosophy: An Anthology”, 2ndEdition, Wiley-Blackwell, 2008.

REFERENCE BOOKS
3. SarvepalliRadha Krishnan and Charles A. Moore, “A Source Book in Indian Philosophy”, Princeton University Press.
4. Bertrand Russell, “A History of Western Philosophy”, Taylor and Francis Ltd.

DESIGN FOR SOCIAL IMPACT I

(Open Elective - I)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Understand the design process
7. Practice Team work and code of cooperation
8. Identify the real problems
9. Develop project concepts
10. Design low fidelity prototypes

UNIT I

Introduction: Basic definitions & Overview of the engineering design process - problem identification, analysis of the existing solutions, Idea generation, specifications and concept development, prototyping, failure analysis, detailed design, usability test, product delivery

UNIT II

Project management: Project charter- setting goals for the project, project time line- to manage the project, Teamwork- Team roles and responsibilities, good practices for teams, code of cooperation

UNIT III

Human Centered Design and Design Thinking: IDEO case studies, IDEO design tool kit, ideal wallet / Personal hydration design activity, partnership with the communities and NGOs, Prototyping- as a communication tool, learning to do low fidelity, rapid prototypes to get user feedback and develop specifications

UNIT IV

Problem Identification: Societal survey: Demographic, Ethnographic and Geographic, Data collection through Experiencing, Observation & Interaction, needs assessment, problem statement, persona development, stakeholder analysis, customer requirements

UNIT V

Market Survey: Detailed analysis of the existing products (Patents, Papers and commercial market), limitations of the available products

UNIT VI

Concept Generation: Design target specifications, Project concepts development and Low-fidelity design for mockup, 3D models, testing with users and community partner

TEXT BOOKS

2. Product Design & Development, Karl T. Ulrich, Steven D. Eppinger – Mc Graw Hill Irwin

REFERENCE BOOKS

3. World changing: A User's Guide for the 21st Century, Alex Steffen (2006). World changing: A User's Guide for the 21st Century, New York, Harry N. Abrams
4. This is Service Design thinking, Marc Stickdorn, Jakob Schneider and the co-authors (2011). The Netherlands, BIS Publishers

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ESSENTIALS OF ENTREPRENEURSHIP

(Open Elective - I)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Describe the elements of the entrepreneurial mindset
7. Identify new opportunities at the intersection of technology and business
8. Develop innovative concepts that create win-win for the stakeholders
9. Design unique value proposition for the customers
10. Express business pitch effectively

UNIT I

Overview of Technology Entrepreneurship Overview, Importance, Definition - The Role and Promise of Entrepreneurship - Entrepreneurial Attributes and Characteristics - Entrepreneurial Style- Entrepreneurial Flow - Intrapreneurship vs. Entrepreneurship - Myths of Entrepreneurship

UNIT II

Opportunity Identification: Mindset in Opportunity Recognition - Sources of Opportunities – Societal, Economic & Technological Factors - Opportunity Recognition- Shaping – Framing - Effectuation - Assessment

UNIT III

Concept Generation & Design Thinking: Elements of Design Thinking - Concept Generation Techniques - Customer Centric Products and Services - Application of Lean Canvas

UNIT IV

Value Proposition: Unique Value Proposition - Value Proposition Canvas - Lean Canvas and its Elements - Crafting Value Proposition

UNIT V

Customer: Markets, Segmentation & Targeting – Personas - Estimating Market Size - Making a Business Case

UNIT VI

Intellectual Property& Elevator Pitch: Protecting Intellectual Property -Trade secrets, Patents, Trademarks, Copyrights - Typical Legal Issues in Startups - Elevator Pitch: Elements of Elevator Pitch - Pitching

TEXT BOOKS

4. Dorf, Richard C. and Byers, Thomas H. "Technology Ventures: From Idea to Enterprise." (2014)
5. Christensen, C. (2013). *The innovator's dilemma: when new technologies cause great firms to fail*. Harvard Business Review Press.
6. Furr, N., & Ahlstrom, P. (2011). *Nail it then scale it: the entrepreneur's guide to creating and managing breakthrough innovation* (No. 658.421 FUR. CIMMYT.).

REFERENCES

1. Christensen, Clayton M., The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail, Boston, Mass.: Harvard Business School Press, 1997.

FOUNDATIONS TO COGNITIVE SCIENCE

(Open Elective - I)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Appreciate the multidisciplinary nature of cognitive science
7. Recognize the different cognitive processes and phenomena in this field
8. Explore the impact of the knowledge categorization on the design process
9. Discover the influence of cognitive biases on the thought process
10. Understand the cognitive aspects of problem solving and decision making processes

UNIT I

Introduction to Cognition: Cognition and cognitive processes, Interdisciplinary nature, History of cognitive science and its permeation to engineering and business management, Structural organization of the brain and neural system

UNIT II

Attention and Perception: Sensation, Attention and Perception phenomena, Selective attention, Cross-modal attention, Priming, Visual and Auditory perception, Top down and Bottom-up processing, Neuroscience of perception, Gestalt psychology – principles and applications, Neuroscience of perception

UNIT III

Knowledge Representation: Human knowledge in representation, Categorization, Semantic networks, Schematic representation Working memory, Long-term memory, Encoding and retrieval, Encoding specificity principle, Recall, Recognition, Mind maps and Concept maps

UNIT IV

Decision Making: Strategies of decision-making, Affinity maps, Human decision-making process, Expected utility and benefits models, Satisficing, Heuristics in decision making Influence of cognition on consumer decision making.

UNIT V

Reasoning& Imperfection in Thinking: Different types of reasoning – Deductive, Inductive, Abductive, Reductive, Techniques in reasoning. Applications in Design – RGA and Laddering in consumer research. Cognitive biases, Fallacies, Mental blocks, Design fixation

UNIT VI

Problem Solving: Problem representation, Re-representing problems, Gestalt accounts of problem solving, Relationship between insight problems and other problems, Effects of instructions. Categorizing the problem, Methods of investigating problem solving / Problem solving approaches, Characterizing problem solving - Information processing approach, Analyzing well-defined problems, Interaction of the problem solver and the task environment, Factors influencing problem solving

TEXT BOOKS

3. Cognitive Psychology: Mind and Brain by E. E. Smith & S. M. Kosslyn
4. Cognition by M. W. Matlin& T. A. Farmer

REFERENCE BOOKS

5. Cognitive Psychology-A Student's Handbook by Michael W. Eysenck and Mark Keane.
6. Cognitive Psychology-Connecting Mind, Research, and Everyday Experience by Bruce Goldstein E.
7. Cognitive Psychology and its Implications by John R. Anderson.
8. Emerging Perspectives on Learning, Teaching and Technology by MichealOrey.

SUGGESTED BOOKS

4. How People Learn by J. D. Bransford, A. L. Brown & R. R. Cocking
5. Emotional Design: Why we Love (or Hate) Everyday Things by Norman, Donald A.
6. Conceptual Blockbusting-A Guide to Better Ideas by James L. Adams.

VISUAL COMMUNICATION & COMPUTER ART

(Open Elective - I)

UNIT I

Shape and Space - Geometric and biomorphic shapes, positive and negative space, shape tools, anchor points, anchor point manipulation, fill and stroke, warp tool, layers

UNIT II

Line - Width, weight, texture, opacity and direction of line, dynamic, static, smooth, and angular lines, brush tool, pen tool, pencil tool, width tool

UNIT III

Text - Fonts and the type tools in Illustrator

UNIT IV

Color - Hue, value, saturation, and opacity, gradient panel and tool, mesh tool, opacity options

UNIT V

Texture - Implied vs. actual texture, pattern panel, symbol sprayer tool

UNIT VI

Content - Form, subject, and context, eraser tool and the effects menu

ENVIORNMENTAL STUDIES

(Open Elective - I)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Demonstrate an ability to integrate the many disciplines and fields that intersect with environmental concerns.
7. Paraphrase about components of eco-system and environmental cycles.
8. Prioritize the energy sources, sustainability and conservation of Bio-diversity
9. Recommend solutions to global environmental problems and formulate the waste management handling rules
10. Formulate the environmental impact assessment and create the environmental awareness by promoting environmental education.

UNIT I

Introduction to Environmental Studies and Ecosystem: Introduction to environment, multidisciplinary nature of environmental studies. Concept of Ecosystem – Structure (biotic and abiotic) and Functions of Ecosystem, Food Chain, Food web, Energy flow in an ecosystem, Bio-geochemical Cycles (Carbon, Nitrogen cycles), concept of Ecological Succession.

UNIT II

Biodiversity and Conservation: Level of Biological diversity– Definition, Genetic, Species and ecosystem – diversity, value of biodiversity - Conservation of Biodiversity (In-situ and Ex-situ).

Biodiversity vs Bioproductivity, Biodiversity vs Biotechnology, Bioenergy.

UNIT III

Environmental Pollution and Climate Change: Introduction, sources, causes, consequences, Control measures of Air, Water and Soil Pollution.

Case studies: Air quality in Delhi, Ganga Action plan.

UNIT IV

Waste Management: Introduction-types of waste: solid – biomedical, electronic waste-disposal-landfills, pyrolysis, incineration, 3R’s Principle, waste from wealth.
Mechanism of waste management – Case studies (composting, vermin technology, activated sludge process).

UNIT V

Human Communities and the Environment Global Issues: Population Growth -Consequences -

Crazy Consumerism, Demographic Transition, Population Explosion, land-use change- Industry and uneven development, Exploitation of Resources - Deforestation, Global Warming – Causes – Effects - Carbon Sequestration, Acid Rains, Ozone Depletion, Carbon foot print, Protocols-Kyoto and Montreal.

UNIT VI
Environmental Impact Assessment (EIA)

Concept of EIA - methodology, Resettlement and rehabilitation of project affected persons; case studies.

Sustainable development – Case Studies - Rain water harvesting, Green Building Concept, Organic agriculture.

TEXT BOOKS:

3. Richard T. Wright, Dorothy F. Boorse., “Environmental Science”, Towards a sustainable Future12/E, PHI Learning Pvt. Ltd., M97, Ashok Goshal, Connaught circuit, New Delhi.
4. Erach Barucha, “Environmental Studies”, UGC-India, Pune.

REFERENCE BOOKS:

5. Gilbert M. Masters and Ela Wendell P, Introduction to “Environmental Engineering and Science”- LPE Pearson educations.
6. Henry J.G. and Heinke G.W., “Environmental Science and Engineering”, Prentice Hall of India, New Delhi.
7. M. Anji Reddy, “Text book of Environmental Science and Technology”, BS Publications (2010).
8. Benny Joseph, “Environmental Studies”, Tata McGraw Hill, New Delhi (2009).

MARKETING FOR ENGINEERS

(Open Elective - I)

COURSE OUTCOMES:

At the end of the course, the students will be develop ability to

6. Understand the concept of marketing and its environment.
7. Distinguish between product and service.
8. Exemplify marketing research process.
9. Evaluate different pricing decisions to design pricing strategies.
10. Create and analyze different marketing promotional tools.

UNIT I

Introduction to Marketing: Marketing Concept Vs Product Concept, Service Concept, Experience Concept, and Green Marketing - Creating Customer Value – Satisfaction and loyalty - Evolution of marketing concept - Marketing Environment – Customer value proposition - Distinctive characteristics of services – Customer relationship management

Cases: Mahindra Scooters – Santoor.

UNIT II

Marketing Research: Definition and Need for Marketing Research - Marketing Process Research - Segmentation and Market Entry – Target market selection – Positioning - Consumer buying decision process.

Case: (Segmentation) Zee TV, (Targeting) Kellogg's - (Positioning), Dalda.

UNIT III

Product Management: Types of Products, Product line and Product mix, Product Life Cycle (PLC), New Product Development, Branding, Packaging, Labeling.

UNIT IV

Pricing strategy: Methods of Pricing, Factors influencing Pricing decision, Pricing cues, Price Sensitivity, Initiating Price Change, Price wars, Skimming, Penetration and Product mix pricing.

Cases: Coca Cola - I phone - Akash Tablet (lamb, Hair – page no: 112, 534, and 557).

UNIT V

Distribution and Promotion: Distribution Designing, Marketing Channel, Role of marketing channels, Channel design decisions, Retailing, Wholesaling, Logistics. Role of Marketing Communication, Marketing Communication Mix, Advertising, Public Relations, Sales Promotion Techniques.

Cases: Barista - Nano Car - Indigo - TESCO.

UNIT VI

Managing Personal Communication: Word of mouth, Personal selling, Designing Sales force, Direct Marketing Techniques, Internet Marketing, Tapping Global markets, Managing a Holistic Marketing Organization, Socially responsible Marketing, Rural Marketing, Rural Consumer Behaviour.

Case: Hero Motor Corp, Avon Cosmetics (lamb, Hair Page no: 446 and 497), Eureka, Home Shop (Arun – page no: 711 and 639).

TEXT BOOKS

3. Philip Kotler, Kevin Lane Keller, Abraham Koshy and Mithleshwar Jha, “Marketing Management”, Pearson Education, 13th Edition, 2009.
4. Joel R. Eans and Barry Berman, “Marketing Management”, Cengage, 2008.

REFERENCE BOOKS

6. Peter Chevton, “Key Marketing Skills”, Kogan Page, 2009.
7. V. S. Ramaswamy and S. Nama Kumari, “Marketing Management”, Macmillan, 4th Edition, 2009.
8. David Jobber and John Fathy, “Foundations of Marketing”, TMH, 2009.

PROJECT MANAGEMENT

(Open Elective - I)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

4. Manage the scope, cost, timing, and quality of the project, at all times focused on project success as defined by project stakeholders.
5. Identify project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in consultation with stakeholders.
6. Adapt project management practices to meet the needs of stakeholders from multiple sectors of the economy

9. Describe a project life cycle, and can skillfully map each stage in the cycle
10. Apply project management practices to the launch of new programs, initiatives, products, services, and events relative to the needs of stakeholders.

UNIT I

Project Management Foundations

Introduction to project management, role of the project manager - Program management and portfolio management, Phases of project management.

UNIT II

Project sponsorship and the project office

Project organizational structures, Project Environment, Deliverables and Milestones, Projects and Companies, Project Life Cycles.

UNIT III

Collect Requirements Process

Project Scope Statement, Project Charter, Work Break Down Structure, The Network Diagram, Cost Estimation, Earned Value Management.

UNIT IV

Stakeholders register & management strategy

Risk management, quality management plan, human resources plan, communication management plan, procurement management, ethics.

UNIT V

Project Execution Phase

Monitoring and Controlling the Project, Quality Control, Project Change Control.

UNIT VI

Team Project (TP)

The Team Project is meant to help the students to apply what they learn in the course. This is a group project. Students should choose any professional project to study. **(Ref: Project charter)**

TEXT BOOKS

3. The Art & Science of Project Management – Warburton and Kanabar, RW, Press, 2013.
4. Harold R.Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", Wiley Publications, 11th Edition.

REFERENCE BOOKS

4. Prasanna Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation, and Review", McGraw Hill Education, 8th Edition.
5. Erik Larson (Author) and Clifford Gray, "Project Management: The Managerial Process", McGraw Hill Higher Education, 5th Revised Edition.
6. Garold (Gary) Oberlender**, "**Project Management for Engineering and Construction", McGraw Hill Education, 3rd Edition.

PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Open Elective - I)

COURSE OUTCOMES:

At the end of the course, the students will be develop ability to

6. Solve the electrical circuits using electric circuit laws and network theorems
7. Describe the constructional details and working principle of electrical machines (Transformer & DC Machines)
8. Explain the principle and operation of alternators and its different applications
9. Differentiate between the types of rectifiers and diode characteristics
10. Explain the characteristics of semiconductor devices (Transistors) with CRO applications

UNIT I

Electrical circuits: Basic definitions, Types of Elements and their representation, Ohm's Law, Resistive networks, Kirchhoff's Laws, Inductive networks, capacitive networks, Series, Parallel circuits, Star to delta and delta to star transformations.

UNIT II

DC Machines and Transformers: Principle of operation of D.C. Generators, EMF equation, Types of D.C. Machines, Torque equation, applications, 3-point starter, Principle of Operation of Single phase transformers, EMF equation, Transformer losses, Efficiency and regulation.

UNIT III

AC machines: Principle of operation of Alternators, applications of synchronous motors; Principle of operation of Induction motors, Slip and torque characteristics and applications,

UNIT IV

Instruments and diode: Basic Principle of Indicating Instruments, P.M.M.C Instruments, M.I Instruments; P.N Junction diode, symbol, V-I Characteristics, Diode Applications, Half Wave Rectifier, Full wave and bridge Rectifiers, Problems on Rectifiers.

UNIT V

Transistors: Operation of PNP and NPN Transistor, Transistor configurations and Characteristics, Transistor as an amplifier, Applications; S.C.R Characteristics, Applications.

UNIT VI

Cathode Ray oscilloscope: Principle of C.R.T, Deflection, sensitivity, Electrostatic and magnetic deflection, Applications of CRO, Voltage, current and frequency measurement.

TEXT BOOKS

3. B. David V. Kerns, JR. J.David, Essentials of Electrical and Computer Engineering, Prentice Hall 2004, ISBN-10:0139239707.
4. V.K. Mehta, Principles of Electrical and Electronics Engineering, S.Chand & Co., 2010, ISBN-10:8121927293.

REFERENCE BOOKS

5. M.S.Naidu and S.Kamakshaiah, Introduction to Electrical Engineering, TMH publ., 2001, ISBN-10:0074622927.
6. Kothari and Nagrath, Basic Electrical and Electronics Engineering, TMH publications, 2009, ISBN-10:007014611X.
7. Elecrical Machines- Ashfaq Husain-Second Edition-Dhanpat Rai & Co.
8. Electronic devices and circuits By Salivahanan, The McGraw Hill Corporation

SOCIOLOGY

(Open Elective - II)

COURSE OUTCOMES

At the end of the course, the students will be develop ability to

1. Demonstrate the knowledge of core concepts of sociology.
2. Enrich their skill of social interaction through verbal and non-verbal communication.
3. Learn about socially acceptable behaviours in a group and use their sociological knowledge in the course of their lives.
4. Think critically about the causes and effects of various social issues.
5. Design and evaluate empirical sociological research**.**

UNIT I

Introduction to Sociology: Sociology - Meaning, Nature, Scope and significance, Basic Concepts of Society – Society, community, Role and Status, Norms and Value, Institution, Association. Social Groups - Meaning, Type of Groups – Primary, Secondary, In Group, Out Group, Reference Group.

UNIT II

Social Processes: Social Processes – Meaning, Socialization - Meaning, Socialization Theories.

Social Interaction: Social Interaction - Verbal - Non Verbal Communication, Forms of Social Interaction - Cooperation, Competition, Conflict, Accommodation, Exchange – Virtual Networking.

UNIT III

Social Control: Deviance and Conformity – Means and Agencies of Social Control.

Social Change: Theories and Factors of Social Change.

UNIT IV

Social Institutions: Marriage, Family, Kinship, Class, Caste, Religion, their function and features.

UNIT V

Social Research, Method and Techniques: Social Research – Definition, Steps in social research, Research Method, Observation method, Interview method, Questionnaire method, Case Study method, and Social Survey.

UNIT VI

Social Problems, Issues and Development Programmes: Social Problem – Meaning and Definition, Importance of the study of Social Problems; Social Issues – Equality of caste, Class gender, Communalism, Community Development Programmes, Women Empowerment.

TEXT BOOKS

3. Goode, W.J. and P.K.Hatt, "Methods in Social Research", McGraw Hill International, 1952.
4. Ahuja, Ram, "Social Problems in India", Rawat Publications, New Delhi, 2000.

REFERENCE BOOKS

3. Gisbert, "Fundamentals of Sociology", Orient Blackswan, New Delhi, 2010.
4. Thakur, Devender, "Research Methodology in Social Science", Delhi Deep and Deep Publication, 2003.

DESIGN FOR SOCIAL IMPACT II

(Open Elective - II)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Design the working prototype
2. Conduct Failure mode analysis
3. Perform validation and user test
4. Deliver the products to the partners
5. Learn leadership skills

UNIT I

Project management revisited: Critical path analysis, learning to use Gantt charts, risk analysis for project timeline, analyzing semester one lessons learned, planning for delivery.

UNIT II

Prototyping: Implementation of the best concept, Concept detailed sketch, functional decomposition and budget approval. High-fidelity design for proof of concepts, for components and required technology

UNIT III

Failure mode analysis: DFMEA, design for failure mode analysis, identify failure modes or potential modes and create plans to address in the design, detailed design of complete product

UNIT IV

Testing: Test plans, user testing, component tests, and system tests, addressing risk in design and project timeline, interaction with users, iterating using customer feedback, redesign product

UNIT V

Product delivery and support plan: Testing with users, field testing, user manual, user feedback - video record, maintenance agreement and support strategy for future batches

UNIT VI

Teamwork and leadership: Teaming skills, leadership styles and approaches, methods for resolving conflict, communication styles, roles and responsibilities, students assume leadership roles on teams

TEXT BOOKS

2. Product Design & Development, Karl T.Ulrich, Steven D.Eppinger – Mc Graw Hill Irwin

REFERENCE BOOKS

3. Design Thinking Methodology Book, Emrah Yayici, ArtBizTech
4. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Brown, Tim (2009). Change by Design, Harper Collins. ISBN: 9780061766084

BUSINESS MODELING AND VALIDATION

(Open Elective - II)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Apply strategies to create new products for blue oceans
7. Develop and test a hypothesis
8. Restate and pivot based on rapid experimentation
9. Apply strategic tools to identify an appropriate strategy to entrepreneurial success
10. Create business value canvas and structure opportunities based on the insights

UNIT I

Blue Ocean Strategy: Red Oceans vs Blue Oceans - Uncontested Market Space - Blue Ocean Strategy Framework – Raise, Reduce, Eliminate and Create - Blue Ocean Strategy Canvas - Applications

UNIT II

Elements of Lean Startup Methodology: Vision – Start, Define, Learn and Experiment - Steer – Leap, Test, Measure and Pivot - Accelerate – Batch, Grow, Adapt and Innovate.

UNIT III

Innovator's Hypothesis - Overview: Business Hypothesis - Business Experiments - Learning to Experiment to Test Simple, Fast, Cheap, Smart, Lean, Important Products or Services - Case Studies.

Unit IV

Innovator's Hypothesis – Method: The 5 × 5 × 5 approach - Exploring and Exploiting Experimentation - The 5 × 5 Portfolio Examples - Key Steps - Building Minimum Viable Product - Build-Measure-Learn Loop – Interviews - GOTB

UNIT V

Strategy Tools: Five Competitive Forces that Shape Strategy - Disruptive Innovation - Ansoff Matrix - Product Positioning - Adjacency Mapping

UNIT VI

Business Model Canvas: Definition of Business Model. Building Blocks. Business Model Canvas. Business Model Environment. Evaluating Business Models.

TEXT BOOKS

3. Maurya, A. (2012). Running lean: iterate from plan A to a plan that works. " O'Reilly Media, Inc.".
4. Schrage, M. (2014). The innovator's hypothesis: how cheap experiments are worth more than good ideas. MIT Press.

REFERENCE BOOKS

6. Kim, W. C., & Mauborgne, R. (2004). Blue ocean strategy. If you read nothing else on strategy, read thesebest-selling articles., 71.
7. Ries, E. (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Crown Books.
8. Porter, M. E. (2008). The five competitive forces that shape strategy. Harvard business review, 86(1), 25-40.
9. Osterwalder, A., &Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons.
10. Mullins, John W., The New Business Road Test, Second edition, Harlow, England: FT Prentice Hall, 2006

DESIGN COGNITION

(Open Elective - II)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Understand the different fronts at the interface between cognitive science and design/entrepreneurship
7. Identify user's needs, abilities, expectations etc. in design from a cognitive perspective
8. Explore the importance and role of analogical thinking and mental models in daily life
9. Understand the role of different cognitive tools in the design process
10. Realize the significance of cognition in the field of interaction design

UNIT I

Cognitive Design Process - Observing and Understanding Users

Descriptive and prescriptive design processes. Characteristics of a good design process.Double diamond design process, Case study and Exercises.Identifying Design Insights from Observations. Ethnographic Methods. Qualitative versus Quantitative research, Conceptual frameworks for cognition, Ethnographic studies of collaboration and communication, Affective aspects, Users – how to observe, data collection, interpreting and presentation Understanding the Socio-Cultural, Economic and Technological Influence.

UNIT II

User Journey

Modeling Users. User personas. Persona Analysis – Application of Affinity Maps. Lean Personas. Storyboards. User Goals.

UNIT III

Analogical Thinking

Importance of analogizing, Types of analogies, Design by Analogy. . TILMAG Method. Bio-mimicry, Generating own analogies, Expository and Aesthetic analogies

UNIT IV

Mental Models

Characteristics, Mental models in daily life, Constituent elements,Role of mental models in design, Building blocks – Affordances, Constraints, Mapping. Matching designer's and user's mental models.

UNIT V

Interaction Design

Introduction to Human-Computer Interaction (HCI), Brain-Computer Interfaces (BCI), Human Factors in engineering design, Neural Networks and Artificial Intelligence, Distributed and Embodied cognition

UNIT VI

User Centered approaches to Interaction Design

Degrees of user involvement, Participatory design. Co-create Process. Shared Mental Models.

TEXT BOOKS

3. Cognitive Psychology and Its Implications by John R. Anderson.
4. The Design of Everyday Things by Norman, Donald A.

REFERENCE BOOKS

5. An Introduction to the Study of mind by Jay Friedenberg and Gordon Silverman.
6. Applied Imagination-Principles and Procedures of Creative Problem Solving by Alex F. Osborn.
7. Mental Models-Aligning Design Strategy with Human Behavior by Indi Young.
8. Living with Complexity by Norman, Donald A.

SUGGESTED BOOKS

10. Emotional Design: Why we Love (or Hate) Everyday Things by Norman, Donald A.
11. Set Phasers on Stun: And Other True Tales of Design, Technology and Human Error by S. M Casey
12. Designing from Both Sides of the Screen: How Designers and Engineers Can Collaborate to Build Cooperative Technology by I. Ellen & W. Alan
13. *Universal principles of design : 125 ways to enhance usability, influence perception, increase appeal, make better design decisions, and teach through design*, by William Lidwell, Kritina Holden, and Jill Butler.
14. Observing the User Experience: A Practitioner's Guide to User Research by Mike Kuniavsky.
15. Cognition in the Wild by Edwin Hutchins.
16. Change by Design by Tim brown.
17. Don’t Make Me Think! by Steve Krug.
18. Handbook of Usability Testing-How to Plan, Design, and Conduct Effective Tests by Jeffrey Rubin and Dana Chisnell.

IMAGE MANIPULATION IN ADOBE PHOTOSHOP

(Open Elective - II)

UNIT I

Image Correction - Introduction to pixel selection, color balance and temperature correction, value correction, retouching skin, changing human form, using the image adjustment menu, the retouch tools, and the liquefy function in Photoshop

UNIT II

Image Combination and Separation - Advanced Pixel selection, subtraction of imagery, addition of imagery, layers

UNIT III

Image Distortion - Filters

UNIT IV

Creative Color - Layer modes, gradient tool, brush tool, image adjustment menu

UNIT V

Effective Black and White Imagery - Taking photographs, converting color photographs to aesthetically pleasing black and white photographs, image adjustment menu, and the burn and dodge tools

UNIT VI

Text Special Effects - Text tools, layers, masks, selection, and filters

ENGINEERING ETHICS

(Open Elective - II)

COURSE OUTCOMES:

At the end of the course, the students will develop ability to

6. Instill moral values that ought to guide ones profession
7. Identify risks and apply safety measures to reduce risk
8. Interpret their rights and responsibilities in their profession
9. Examine various global issues and resolve the situations as a professional
10. Examine the various code of ethics in various programs of Engineering

UNIT I

Scope and Aims of Engineering Ethics: Engineering Ethics, need of Engineering Ethics, professions and professionalism; Engineering as social experimentation, Engineers as responsible Experimenters; Code of Ethics, A balanced outlook on law.

UNIT II

Engineers Responsibility for Safety: Safety and risk, Assessment of safety and Risk, Risk-Benefit analysis and reducing Risk - study questions and case studies.

UNIT III

Rights to Engineers: Professional rights, whistle blowing, Employee rights – study questions and case studies.

UNIT IV

Global Issues: Multi corporations, Business Ethics, Environmental Ethics, Compute Ethics, weapon development- study questions and case studies.

UNIT V

Responsibilities of Engineers: Engineering as Managers, Promoting an ethical climate, Management of Conflict; Engineers as expert advisors in Planning and Policy making, Engineers as Moral leader – Leadership, Participation in Professional Societies. Leadership in communities, Principles of voluntary service.

UNIT VI

Sample Code of Conduct: Role of codes and its function, Limitation of Codes, Role of Law in Engineering, The problem of law in Engineering, code of Engineering Societies, Code of Ethics for Engineers – ASME, NSPE, IEEE.

TEXT BOOKS

3. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, New York, 2005. (Reprint 2013)
4. Ibo Van de Poel and Lamber Royakkers “Ethics, Technology, and Engineering – An Introduction”, John wiley publication, 2011.

REFERENCE BOOKS

3. Edmund G. Seebauer and Robert L. Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, 2014.
4. Caraline whitbeck, “Ethics in Engineering practice and Research”, Cambridge University Press, 2012

BUSINESS ANALYTICS

(Open Elective - II)

COURSE OUTCOMES:

At the end of the course, the students will be develop ability to

6. State the importance of Business Analytics
7. Explain the relationship between Business Analytics and statistics.
8. Explain the various analytical tools used in Business
9. Interpret the Data collected and Analyze for decision Making.
10. Solve business problems using statistical Methods.

UNIT I

Introduction to Business and data Analytics: Introduction to Data- Importance of Analytics- Data for Business Analytics –Big Data - Business Analytics in Practice. Data Visualization – Data Visualization tools, Data queries, Statistical methods for Summarizing data, Exploring data using pivot tables.

UNIT II

Descriptive Statistical Measures – Population and samples, Measures of location, Measures of Dispersion, Measures of variability, measures of Association.

UNIT III

Probability distribution and Data Modeling – Discrete Probability distribution, Continuous Probability distribution, Random sampling from Probability Distribution, Data Modeling and Distribution fitting.

UNIT IV

Predictive Analytics: Karl Pearson Correlation Techniques - Multiple Correlation-Spearman's Rank correlation-Simple and Multiple regression-Regression by the method of least squares – Building good regression models – Regression with categorical independent variables - Linear Discriminant Analysis- One way and Two Way ANOVA

UNIT V

Data Mining: Scope of Data Mining, Data Exploration and Reduction, Unsupervised learning – cluster analysis, Association rules, Supervised learning- Partition Data, Classification Accuracy, prediction Accuracy, k-nearest neighbors, Classification and regression trees, Logistics Regression.

UNIT VI

Simulation: Random Number Generation, Monte Carlo Simulation-Analysis, Verification and Validation, Advantages and Disadvantages of Simulation, Risk Analysis, Decision Tree Analysis.

TEXT BOOKS

3. James Evans, Business Analytics, 2e, Pearson, 2017.
4. Camm, Cochran, Fry, Ohlmann, Anderson, Sweeney, Williams Essential of Business Analytics, Cengage Learning.

REFERENCES

3. Akil Maheswari: Big Data, Upskill ahead by Tata McGraw Hill, New Delhi, 2016
4. Seema Acharya & Subhashini Chellappan: Big Data and Analytics, Wiley Publications, New Delhi, 2015.

OPERATIONS RESEARCH

(Open Elective - II)

COURSE OUTCOMES

At the end of the course, the students will develop ability to

6. List out various operation research models and apply LPP model for finding the Optimum solution
7. Calculate transportation cost for a various transportation models.
8. Assess the inventory requirements
9. Estimate the best replacement period for machines under different conditions
10. Decide the number of servers to minimize waiting time of customers and idle time of a server.

UNIT I

Development - History, Definition, OR Models, OR Techniques and phases of implementing OR in practice.

Allocation - Introduction to linear programming formulation, graphical solution, Simplex method, artificial variable technique, Un restricted Variables, Duality principle, Dual Simplex method.

UNIT II

Transportation Problem – Formulation, Optimal solution, unbalanced transportation problem, Degeneracy.

Assignment problem – Formulation, Optimal solution, Variants of Assignment Problem, Traveling Salesman problem.

UNIT III

Sequencing – Introduction, Flow, Shop sequencing, n jobs through two machines, n jobs through three machines, Job shop sequencing, two jobs through ‘m’ machines

Replacement: Introduction, Replacement of items that deteriorate with time, when money value is not counted and counted, Replacement of items that fail completely, Group Replacement.

UNIT IV

Theory of Games – Introduction, Terminology, Solution of games with saddle points and without saddle points- 2 x 2 games, dominance principle, m x 2 & 2 x n games, graphical method.

Inventory: Introduction, Single item, Deterministic models, Purchase inventory models with finite & infinite with one price break and multiple price breaks, Models with shortages, Stochastic models, demand may be discrete variable or continuous variable, Single Period model and no setup cost.

UNIT V

Queuing Theory – Introduction, Terminology, Single Channel, Poisson arrivals and Exponential Service times, with infinite population and finite population models, Multi channel, Poisson arrivals and exponential service times with infinite population. Machine Repair Model, Networks of Queues.

UNIT VI

Dynamic Programming – Introduction, Terminology, Bellman's Principle of Optimality, Applications of Dynamic programming, shortest path problem, Linear programming problem.

TEXT BOOKS

1. J.K.Sharma, "Operation Research", MacMilan, 4th Ed., 2009, ISBN Number: 978-9350593363.
2. R.Pannerselvam, "Operations Research", PHI Publications, 2nd Ed. Jan. 2006, ISBN Number: 978-8120329287.

REFERENCE BOOKS

1. Panneerselvam.R, "Operations Research".
2. Belgundu, Ashok.D & Chandrupatla, Trupathi.R, "Optimization Concepts And Applications".

INTELLECTUAL PROPERTY RIGHTS

(Open Elective - II)

UNIT I

Introduction to Intellectual Property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

UNIT III

Law of Copy Rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of Patents: Foundation of patent law, patent searching process, ownership rights and transfer.

UNIT IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair Competition: Misappropriation right of publicity, false advertising.

UNIT V

New Development of Intellectual Property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

UNIT VI

International overview on intellectual property, international - trade mark law, copy right law, international patent law, international development in trade secrets law.

TEXT BOOKS

3. Deborah, E. Bouchoux, “Intellectual Property Right”, Cengage Learning.
4. M Murray and M.J. Mehlman, “Encyclopedia of Ethical, Legal and Policy Issues in Biotechnology”, John Wiley and Sons, 2000.

REFERENCE BOOKS

5. Prabuddha ganguli, “Intellectual Property Right - Unleashing the Knowledge Economy”, Tata McGraw Hill Publishing Company Ltd.
6. P.Narayanan; “Law of Copyright and Industrial Designs”, Eastern Law House, Delhi, 2010.
7. P.N. Cheremisinoff, R.P. Ouellette and R.M.Bartholomew, “Biotechnology Applications and Research”, Technomic Publishing Co. Inc., USA, 1985.
8. D. Balasubramaniam, C.F.A.Bryce, K. Dharmalingam, J. Green and K. Jayaraman, “Concepts in Biotechnology”, University Press (Orient Longman Ltd.), 2002.

PSYCHOLOGY

(Open Elective - III)

COURSE OUTCOMES:

At the end of the course, the students will be develop ability to

6. Understand the importance of psychology and the biological basis for human behavior
7. Realize the various factors that influence personality and its development
8. Explore the influence of socio and cultural differences on human behavior
9. Understand organizational behavior and the effect of motivation on goals
10. Explore the levels of employee participation as well as deal with workplace stress

UNIT I

Introduction to Psychology – origin, nature, scope and significance, early pioneers, contemporary perspectives and domains of psychology.

UNIT II

Personality – Overview of personality, trait theories, psychoanalytic theory, humanistic theories and behavioral and social learning perspective. Constituents of effective personality.

UNIT III

Social Psychology – a working definition, Social cognition – perceiving and understanding others, Attribution–explaining the causes of behavior, Attitudes and links with behavior.

UNIT IV

Organisational behavior – fundamental concepts, models of organisational behavior, motivation and behavior modification.

UNIT V

Interpersonal and Group dynamics, nature of employee participation, work change and resistance to change.

UNIT VI

Psychology in action – dealing with workplace stress, stress and job performance, stress management, modifying ineffective behavior.

TEXTBOOKS

3. Introduction to Psychology - Coon and Mitterer.
4. Introduction to Psychology – Morgan and King.

REFERENCE BOOKS

8. Psychology – Robert A Baron
9. Social Psychology – Robert S Feldman
10. Social Psychology – David Myers
11. Introduction to Social Psychology - L L Bernard
12. Human behavior at work - Davis and Newstrom
13. Organisational Behavior - Arnold and Feldman
14. Personality: A Psychological Interpretation - G W Allport

DESIGN FOR SOCIAL IMPACT III

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

1. Conduct market research
2. Understand the start-up models
3. Write Proposals for social entrepreneurship
4. Initiate the start-up company
5. Mentor the new student teams

UNIT I

Market Analysis - Market research, understanding target market, potential customers, analysis of the present competitors, challenges and opportunities

UNIT II

Entrepreneurship - Business models in commercial entrepreneurship and social entrepreneurship **-** Case studies, financial resources, and Start-up models

UNIT III

Social Entrepreneurship - Social entrepreneurship tool kit – idea assessment, impact assessment, risk assessment, market assessment and financial assessment, using project in the delivery stage as the case to explore entrepreneurship opportunities

UNIT IV

Launch pad - Legal structures, financial plan, risk mitigation plan, start-up enterprise, mass level production and marketing

UNIT V

Leadership and Mentoring Role - Taking on leadership of teams and mentoring the next batch. Paired with students in the next batch to put leadership tools into practice to on-board the new batch.

UNIT VI

Leadership and Mentoring Role (continued) - Helping the new teams during EPICS-I modules, Identifying new projects with existing partners – or new ones. Coaching new class on interactions with community. Facilitating brainstorming, reviewing projects of new teams, Introduce new batch to project being completed, the community partner and opportunities for the new project(s), Handing off projects to next batch, completed and field support or for new design or redesign.

TEXT BOOKS

2. Product Design & Development, Karl T. Ulrich, Steven D. Eppinger – Mc Graw Hill Irwin

REFERENCE BOOKS

3. Design for the other 90%, Smith, Cynthia (2007). New York, Cooper Hewitt Smithsonian Design Museum
4. How to Change the World: Social Entrepreneurs and the Power of New Ideas, David Bornstein

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STARTUP LAUNCH

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Categorize technology adoption life cycle and identify strategies to cross the chasm
7. Appraise scaling of the venture
8. Apply Bullseye framework to improve the operational efficiency
9. Select appropriate pricing & investment strategy
10. Create the business plan

UNIT I

Crossing the Chasm - Technology Adoption Life Cycle - Crossing the Chasm - Innovators, Early Adopters & Early Majority

UNIT II

Scaling the Business - Strategies and Critical Obstacles for Scaling - Anticipating, Planning and Managing Growth

UNIT III

Bullseye Framework for Getting Traction - Bull's-eye Framework - Customer Lifetime Value - Improving Efficiency of Operation

UNIT IV

Entrepreneurial Finance - Value, Price & Cost - Determining Appropriate Pricing Strategy - Financing the Venture - Angel Investment, Venture Capitalism, Crowd Funding - Valuation

UNIT V

Marketing - 4Ps of Marketing - Product Positioning - Building the Brand - Distribution Channels

UNIT VI

Business Plan - Elements of a Business Plan - Evaluating a Business Plan

TEXTBOOKS

3. Moore, Geoffrey A. "Crossing the chasm." (2002).
4. Furr, N., & Ahlstrom, P. (2011). Nail it then scale it: the entrepreneur's guide to creating and managing breakthrough innovation (No. 658.421 FUR. CIMMYT.).

REFERENCE BOOKS

2. Mares, J., & Weinberg, G. (2014). Traction: A Startup Guide to Getting Customers. S Curve Publishing.

COGNITIVE MANAGEMENT

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Identify and structure new opportunities based on cognitive insights
7. Apply the effectuation theory for the development of entrepreneurial ideas
8. Motivate team members to contribute to overall success of the team or organization
9. Understand and apply emotional intelligence strategies for everyday situations
10. Explore the cognitive principles behind leadership and organizational management

UNIT I

Introduction. Interaction to Entrepreneurial Businesses, Culture, and Methods. Lean Startups. Cognitive Management Skills.

UNIT II

Opportunity Recognition. Opportunity Recognition Cognitive Theories. Prototype Theory. Pattern Recognition. Connections for Identifying and Making Opportunities.

UNIT III

Effectuation Theory. Effectual Problem Space. Principles of Effectuation.The Bird in Hand, The Affordable Loss, The Crazy Quilt, The Lemonade, and the Pilot-in-the-Plane Principles.

UNIT IV

Team Cognition. Perspectives on Team Cognition. Cognitive Systems Engineering Perspective on Shared Cognition.Interactive Team Cognition.Collaborative Contributions Activity Awareness.

UNIT V

Emotional Intelligence. Personality and EQ. Models of EI – Trait Model, Mixed Model, Bar-on Model. EI and Personal Relationship. Strategies for Improving EI. EI and Strategic Thinking.

UNIT VI

Leadership. Cognitive Resource Theory of Leadership. Different Types of Leadership. Trait Theory. Behavioral Theory. Transactional and Transformational Leadership. Values. Leadership Lessons. Innovative & Culture.

TEXT BOOKS

3. Daniel Goleman, Richard Boyatzis, and Annie McKee, Primal Leadership: Unleashingthe Power of Emotional Intelligence. Designing Interactions, by Bill Moggridge.
4. Theories of Team Cognition: Cross-Disciplinary Perspectives (Applied Psychology Series) by Eduardo Salas (Editor), Stephen M. Fiore (Chapter 7, 8 & 9)

ADVANCED VISUAL ORGANIZATION AND AFTER EFFECTS

(Open Elective - III)

UNIT I

Size - Scale and proportion of shapes, layers and transform controls in After Effects

UNIT II

Placement - Static and dynamic placement, proximity and distance of lines, layers and transform controls in After Effects

UNIT III

Unity - Proximity and repetition, transform controls, effects and presets

UNIT IV

Variety - Shape, color, texture, size, and placement, transform controls, effects and presets

UNIT V

Balance - Symmetrical and asymmetrical balance, text tool in After Effects

UNIT VI

Focus - Main elements identified through contrast in shape, color, texture, size and/or placement, shape creation in After Effects

MATHS OPERATIONS RESEARCH STATISTICS ECONOMICS – MORSE

(Open Elective - III)

UNIT I

Calculus: Functions, Limit of a Function, Continuity and Derivative of a function, Differentiation: Definition, rules of differentiation, Partial Differentiation of first and second order, Extreme values of functions, Concavity and curve sketching, Indeterminate Forms and L-Hospital’s Rule.

UNIT II

Matrix Algebra - Definition, types of matrices, Matrix operations: Addition, Subtraction and Multiplication; Transpose of Matrix, Determinant of matrix, Inverse of Matrix, Rank of Matrix, Solutions of Linear System of equations, Characteristic equations, Eigen values, Eigen vectors and properties, Cayley-Hamilton theorem and its use in finding inverse and powers of a matrix

UNIT III

Statistics, Correlation & Regression: Statistics: Measures of Central tendency - Averages for ungrouped and grouped data, Mean, Median, Mode. Measures of Dispersion - Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance, Coefficient of Dispersion, Coefficient of Variation, Combined Arithmetic Mean and Combined Standard Deviation.

Correlation: Types of correlation, Karl Pearson’s correlation coefficient, Spearman’s Rank correlation coefficient.

Regression: Simple linear regression, scatter graphs, least squares method, forecasting and use of linear regression equations in forecasting.

UNIT IV

Operations Research: Nature and scope of Operations research, Origin of OR, Applications of OR in different Managerial areas, Problem solving and decision making, Linear Programming Problem: Introduction, Mathematical formulation of LPP, Graphical Solution of LPP, solving LPP by Simplex method, Dual simplex method, Duality and Sensitivity analysis.

UNIT V

Microeconomics: Consumer theory, Supply and demand, Market equilibrium, Producer theory, Monopoly, Oligopoly, Capital markets, Welfare economics, Public goods, Externalities

UNIT VI

Macroeconomics: Basics of macroeconomics, Aggregate demand and aggregate supply, Business cycles, Unemployment and inflation, Economic stabilization policies, Economic growth and development theories of International trade.

REFERENCE BOOKS

1. Thomas' Calculus: Early Transcendentals, 14/E, Joel R. Hass, Davis, Christopher E. Heil, Maurice D. Weir, Pearson publications, 2018.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, S. Chand and Sons, 2012.
3. S. D. Sharma, Operations Research, Kedarnath Ramnath and Company, 2008.
4. Shayle R. Searle, Matrix Algebra useful for statistics: , 2/e, Wiley Publications.

BLOCK CHAIN TECHNOLOGY

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Understand Distributed Ledger Technologies and how they work
7. Illustrate Bitcoin concepts, knowledge of Ethereum.
8. Apply knowledge of Hyperledger fabric.
9. Differentiate Bitcoin, Ethereum and Hyperledger fabrics mechanisms.
10. Design and implement new ways of using blockchain for applications other than crypto currency.

UNIT I

Introduction to Block Chain: What is Blcokchain, Public Ledgers, Blockchain as public ledgers, Bitcoin, Blockchain 2.0, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, The chain and the longest chain cryptocurrency to blockchain 2.0, permissioned model of blockchain, cryptographic hash function, properties of a has function, hash pointer and merkle tree.

Crypto primitives and bitcoin: Digital signature, public key, cryptography, a basic cryptocurrency, creation of coins, payments and double spending, forth – the precursor for bitcoin scripting, bitcoin scripts, bitcoin P2P Network, transaction in bitcoin network, block mining, block propagation and block relay. Why consensus, distributed consensus in open environments, consensus in a bitcoin network.

Consensus: Bitcoin consensus, proof of work (PoW) – basic introduction, hashcash PoW, Bitcoin PoW, attacks on PoW and the monopoly problem, proof of stake proof of burn and proof of elapsed time, the life of a bitcoin miner, mining difficulty, mining pool, permissioned model and use cases, design issues for permissioned blockchains, execute contracts, state machine replication, consensus models for permissioned blockchain, distributed consensus in closed environment, paxos.

UNIT II

Permissioned Blockchain: RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems, practical byzantine fault tolerance, three phase commit, view change, Concepts and benefits of blockchain for enterprise, the hyperledger project, actors in a blockchain, components in blcokchain design, ledger in blockchain,

Hyperledger Fabric: fabric architecture, transaction flow in fabric, ordering services, channels in fabric, fabric peer and certificate authority, Organization and Consortium Network, Membership Service Provide, Transaction Signing, Steps for network setup, Endorsement policies, Setup Blockchain networks, Experience blockchain network as different organizations, Deploy a simple application on IBM cloud.

UNIT III

Fabric Demo: Deploy a simple application on IBM Cloud, Marbles (asset transfer), Example smart contract code, client SDK code, Perform blockchain transactions using a cool UII, Install and instantiate marbles chaincode, Run application on the network you created, Goals of Hyperledger Composer, Key concepts for the business service provide, Key development concepts – model files, Access control lists, transaction processors, business network definition, Key concepts for administrators, how composer maps to fabric chaincode, deploy a simple composer application on IBM Cloud

Blockchain Use Cases-Finance: Sample use cases by industry, Business Problems and Participants, Communities in Blockchian network, Cross border payments, Steller and Ripple protocols, Project Ubin, Know Your Customer (KYC), Privacy Consents, Mortgage over Blockchain, Blockchain enabled Trade, We. Trade-Trade Finance Network, Supply Chain Financing, Blockchain for Trade Logistics, Global Trade Digitization, Blockchain for Container Management.

UNIT IV

Blockchain Use Cases – Industry: Food Safety and Food Traceability, Supply Chain Orchestration, Everledger, The Diamond Lifecycle, Addressing Supply Chain Fraud through Blockchain, Blockchain in Healthcare, Blockchain in Energy Markets Blockchian in Media, Blockchain and Government, Preventing Cyber Crime through blockchain, Government Use-cases, Auditing and compliance, Blockchian for Defense, e-Estonia:A Case Study.

Blockchain in Government and Blockchain Security: Digital Identity and Single Sign On (SSO) Principles of Digital Identity Management, Why Blockchain, Indy for Digital Identity Management, How Indy Works, Blockchain for Tax Payments, Blockchain for Managing Land Registry Records, Security Properties, Security Considerations for Blockchain, Intel SGX, Identities and Policies, Membership and Access Control, Blockchain Crypto Service Providers

UNIT V

Security and Research Aspects: Privacy in a Blockchain System, Privacy through Fabric Channels, Smart Contract Confidentially, Side DB, Motivation, Side DB overview, PoW vs BFT Consensus, Consensus Finally Consensus Scalability, Fairness and Scalability in Nakamoto Consensus, Bitcoin-

NG: Working Principles Key Blocks and Microblocks, Authority and Digital Signature, Collective Signing (CoSi) Shnoor Multisignature and BLS Signature

Research Aspects in Blockchain: Strong non-probabilistic consistency, BFT over Bitcoin – increasing scalability, Byzcoin Design and Performance, Strong Synchrony vs Weak Synchrony, Avoiding Forks, Transaction Neutrality and Frictionless Evolution, Asynchronous networks as network fault, Cross fault Tolerant (XFT) architecture, XPaxos, Multi-Party Computation (MPC), Fairness in MPC, MPC over Blockchain ensuring fairness, Big Data and Big Network, Why Blockchain for Big data application aspects, BigChain DB-The Blockchain Database

UNIT VI

AI, Blockckahin and Big Data: Data analysis over Blockchain, Logic over Blockchain network, Inferring Decisions through AI, Architecture and concepts, Smart contracts, Ecosystem, Motivation and concepts, Architecture Transaction processing and consensus, Key Features, Transactions and flows, Consensus and architecture details, Final Remarks.

SUGGESTED READING

5. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
6. Blockchain by Melanie Swa, O'Reilly
7. Hyperledger Fabric – https://www.hyperledger.org/projects/fabric
8. Zero to Blockchain – An IBM Redbooks course, by Bob Dill, David Smits – http://www.redbooks.ibm.com/Redbooks.nsf/RedbooksAbstracts/crse0401.html

SMART CITIES

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Judge the needs and cause behind the vision to transform into smart cities.
7. Identify the issues and challenges for urban development, at par with the international scenario.
8. Select and demonstrate new technologies for urban development.
9. Interpret the importance of technology and implementation to have smart transportation.
10. Examine the importance of natural resource (water) and use intelligent concepts for preserving it & Appraise and educate the public for user friendly environment and governance to make the county smarter.

UNIT I

Introduction: Vision and goals of smart city, concept of smart city and its features, issues and challenges of urbanization in India, international scenario, issues and probable solutions, need for smarter approaches process of selection of smart cities, developing and demonstrating new technologies, smart city strategies, digital and information technologies, urban planning best practices.

UNIT II

Smart Transportation: Importance and significance of mobility, data collections, smart sensors, role of geographic information system, integration of GIS and ITS, related air quality; accidents and safety analysis; advanced traffic management systems, commercial vehicle operations, advanced transportation systems, advanced vehicle control systems, case studies, public transportation management; electronic payment, connected vehicle technology and application, mobile applications.

UNIT III

Smart Water Management: Reminded of water's importance, challenges for water use and intelligent water system concept, trends and issues for water use management, specific technologies for smart water use, strategic prioritization and allocation, water quality, flooding, drought and aging infrastructure, leakage and pressure management,

UNIT IV

Smart Waste Management: Introduction - Municipal services, smart solutions and emerging in the solid waste management, technologies to process waste, garbage collection.

UNIT V

Power Grids: Smart grid concepts, development of innovative next-generation technologies and tools in the areas of transmission, distribution, energy storage, power electronics, measures of certain parameters of the electric grid, innovative digital technologies for electricity delivery, intensive application of demand-side technologies, Electric Reliability Technology Solutions (CERTS).

UNIT VI

Smart Payments and E-Governance: People participation, accountability and transparency, user-friendly process, removal of hierarchal process barriers and red tape, service delivery Payments and finance concepts, city governments and citizen benefits, economic growth, global GDP, population growth, inadequate infrastructure, operational costs and concepts of e-administration, e-services, e-governance and e-democracy.

TEXT BOOKS

3. Bob Williams, "Intelligent Transport Systems Standards", Artech House Publishers, 2008
4. Ronald A. Beaulieu, "National Smart Water Grid, Integrated Solutions for Sustainable Fresh Water Supply Flexi Bound", 2010.

REFERENCE BOOKS

5. Austroads, "The Implication of Intelligent Transport Systems for Road Safety", Austroads Incorporated, 1999.
6. Chowdhury, M. A. and Sadek, A, "Fundamentals of Intelligent Transportation Systems Planning", Artech House, 2003.
7. Pernille Ingildsen and Gustaf Olsson, "Smart Water Utilities: Complexity Made Simple", 1st Edition, IWA Publishing.
8. Keyhani, Ali, Marwali and Muhammad, "Smart Power Grids", Springer, 2011

CYBER LAWS

(Open Elective - III)

COURSE OUTCOMES

At the end of the course the student will be able to

6. Discuss and evaluate the current trends and technologies such as e-commerce and governance with reference to free market economy.
7. Sketch the importance of digital signature in electronic records.
8. Formulate the importance and role of cyberspace laws and cyber crimes.
9. Design and motivate laws relating to electronic records and intellectual property rights in India.
10. Summarize about the IT act in India and generate the new IT acts for current cyber space.

UNIT I

Internet, E-Commerce and E-Governance with reference to Free Market Economy: Understanding Computers, Internet and Cyber laws, Conceptual Framework of E-commerce: E-Governance, the role of Electronic Signatures in E-commerce with Reference to Free Market Economy in India.

UNIT II

Law Relating to Electronic Records and Intellectual Property Rights in India: Legal aspects of Electronic records / Digital signatures, The roles and regulations of Certifying Authorities in India, Protection of Intellectual Property Rights in Cyberspace in India.

UNIT III

International Efforts Relating to Cyberspace Laws and Cyber Crimes: International efforts related to Cyber laws, Council of Europe (COE) convention on Cyber Crimes.

UNIT IV

Penalties, Compensation and Offences Under the Cyberspace and Internet in India: Penalties, Compensation and Adjunction of violations of provisions of IT Act and Judicial review, some important offences under the Cyberspace law and the Internet in India, Other offences under the Information Technology Act in India.

UNIT V

Miscellaneous Provisions of IT Act and Conclusions: The role of Electronic Evidence and miscellaneous provisions of the IT Act.

UNIT VI

Cyber Crimes & Legal Framework, Cyber Crimes against, Individuals, Institution and State, Hacking, Digital Forgery Cyber Stalking/Harassment Cyber Pornography Identity Theft & Fraud

Cyber terrorism Cyber Defamation Different offences under IT Act, 2000

TEXT BOOK

1. Harish Chander, "Cyber Laws and IT Protection", PHI, 2012.

REFERENCE BOOKS

1. George Kostopoulos, "Cyberspace and Cyber Security", Auerbach Publications, 2012.
2. Albert Marcella, Jr., Doug Menendez, "Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes", Auerbach Publications, 2nd Edition, 2007.