MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE

MADANAPALLE

(UGC-AUTONOMOUS)

www.mits.ac.in

Estd 1998

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Structure

&

Detailed Syllabi

For the students admitted to

B. Tech. Regular Four Year Degree Programme from the Academic Year 2023-24

and

B. Tech. Lateral Entry Scheme from the Academic Year 2024-25

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision and Mission of the Institution

Vision	To become a globally recognized research and academic institution and thereby contribute to technological and socio-economic development of the nation
Mission	To foster a culture of excellence in research, innovation, entrepreneurship, rational thinking and civility by providing necessary resources for generation, dissemination and utilization of knowledge and in the process create an ambience for practice-based learning to the youth for success in their careers.

Vision and Mission of the Department

Vision	To excel in technical education and research in the area of Electronics and Communication Engineering and to produce skilled, trained and competent individuals with high motivation to meet the present-day challenges of the society.
Mission	➢ To impart high quality education to enable students face challenges in the fields of Electronics and Communication Engineering. ➢ To provide facilities, infrastructure, environment to develop the spirit of innovation, creativity, and research among students and faculty. ➢ To inculcate ethical, moral values and lifelong learning skills in students to address the societal needs.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: For successful employment in Electronics and Communication Engineering.

PEO2: To design, test and develop the state-of-the-art hardware and software in Electronics and Communication Engineering.

PEO3: For lifelong learning skills, societal ethics and higher education

PROGRAM OUTCOMES (POs)

At the end of the programme, graduate will be able to

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norm of the engineering practice.

PO9: Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with t h e society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Design and analyse systems in the field of Electronics and Communication Engineering.

PSO 2: Apply the concepts to design and develop solutions in the field of VLSI & Embedded System.

PSO 3: Analyse and develop hardware/software applications in the field of Signal & System Engineering.

MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE, MADANAPALLE

B. Tech Four Year Curriculum Structure

Branch: ELECTRONICS AND COMMUNICATION ENGINEERING

Total Credits	163 Credits for 2023(Regular) & 123 Credits 2024(Lateral Entry) Admitted Batch onwards

I. Induction Program and Holistic Development Activities

Sl.No	Title	Duration
1	Induction Program (Mandatory)	Three weeks' duration at the start of First Year

R23 - Curriculum Structure
I Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BS&H	23MAT101	Linear Algebra and Calculus	3	0	0	3	3
2	BS&H	23PHY101	Engineering Physics	3	0	0	3	3
3	ESC	23EEE101	Basic Electrical and Electronics Engineering	3	0	0	3	3
4	ESC	23CSE101	Introduction to Programming	3	0	0	3	3
5	ESC	23ME101	Engineering Graphics	1	0	4	5	3
6	BS&H	23PHY201	Engineering Physics Laboratory	0	0	2	2	1
7	ESC	23EEE201	Electrical and Electronics Engineering Workshop	0	0	3	3	1.5
8	ESC	23CSE201	Computer Programming Laboratory	0	0	3	3	1.5
9	ESC	23CSE202	IT Workshop	0	0	2	2	1
10	BS&H	23HUM202	NSS / NCC / Scouts and Guides / Community Service	-	-	1	1	0.5
Total				**13**	**0**	**15**	**28**	**20.5**

I Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	BS&H	23ENG101	Communicative English	2	0	0	2	2
2	BS&H	23MAT102	Differential Equations and Vector Calculus	3	0	0	3	3
3	BS&H	23CHE102	Chemistry	3	0	0	3	3
4	ESC	23CME101	Basic Civil and Mechanical Engineering	3	0	0	3	3
5	PCC	23ECE101	Network Analysis	3	0	0	3	3
6	HSC	23ENG201	Communicative English Laboratory	0	0	2	2	1
7	BS&H	23CHE202	Chemistry Laboratory	0	0	2	2	1
8	ESC	23ME201	Engineering Workshop	0	0	3	3	1.5
9	PCC	23ECE201	Network Analysis and Simulation Laboratory	0	0	3	3	1.5
10	BS&H	23HUM201	Health and Wellness, Yoga and Sports	-	-	1	1	0.5
Total				**14**	**0**	**11**	**25**	**19.5**

(L = Lecture, T = Tutorial, P = Practical, C = Credit

R23 - Curriculum Structure
II Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	HSMC	23HUM101	Universal Human Values	2	1	0	3	3
2	BSC	23MAT106	Complex Variables and Probability Theory	3	0	0	3	3
3	ESC	23ECE102	Signals and Systems	2	1	0	3	3
4	PCC	23ECE103	Electronic Devices and Circuits	3	0	0	3	3
5	PCC	23ECE104	Digital Circuits Design	2	1	0	3	3
6	PCC	23ECE202	Electronic Devices and Circuits Laboratory	0	0	3	3	1.5
7	PCC	23ECE203	Digital Circuits and Signal Simulation Laboratory	0	0	3	3	1.5
8	SEC		**Skill Enhancement Course – I** *(Refer ANNEXURE - VI)*	1	0	2	3	2
9	AUC	23CHE901	Environmental Science	2	0	0	2	-
Total				**15**	**3**	**8**	**26**	**20**

II Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	HSMC	23HUM102	Economics and Financial Accounting For Engineers	2	0	0	2	2
2	ESC		**Design Thinking and Innovation Related Courses** *(Refer ANNEXURE - II)*	1	0	2	3	2
3	PCC	23ECE105	Linear Control Systems	2	1	0	3	3
4	PCC	23ECE106	EM Waves and Transmission Lines	3	0	0	3	3
5	PCC	23ECE107	Analog Circuits	3	0	0	3	3
6	PCC	23ECE108	Analog Communication	3	0	0	3	3
7	PCC	23ECE204	Analog Circuits Laboratory	0	0	3	3	1.5
8	PCC	23ECE205	Analog Communication Laboratory	0	0	3	3	1.5
9	SEC		**Skill Enhancement Course – II** *(Refer ANNEXURE - VI)*	1	0	2	3	2
Total				**15**	**1**	**10**	**26**	**21**

(L = Lecture, T = Tutorial, P = Practical, C = Credit

R23 - Curriculum Structure
III Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PCC	23ECE109	Analog and Digital IC Applications	2	1	0	3	3
2	PCC	23ECE110	Digital Communication	3	0	0	3	3
3	PCC	23ECE111	Microprocessors and Microcontrollers	3	0	0	3	3
4	ESC	23PHY102	Introduction to Quantum Technologies and Applications	3	0	0	3	3
5	PE		**Professional Elective - I** *(Refer ANNEXURE - IV)*	3	0	0	3	3
6	OE		**Open Elective - I** *(Refer ANNEXURE - III)*	3	0	0	3	3
7	PCC	23ECE206	Digital Communication Laboratory	0	0	3	3	1.5
8	PCC	23ECE207	Microprocessors and Microcontrollers Laboratory	0	0	3	3	1.5
9	SEC		**Skill Enhancement Course – III** *(Refer ANNEXURE - VI)*	1	0	2	3	2
10	ESC	23ECE501	Tinkering Laboratory	0	0	2	2	1
11	PROJ	23ECE701	Summer Internship I	0	0	4	4	2
Total				**18**	**1**	**14**	**33**	**26**

III Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PCC	23ECE112	Digital Signal Processing	3	0	0	3	3
2	PCC	23ECE113	Microwave and Optical Communications	3	0	0	3	3
3	PCC	23ECE114	VLSI Design	3	0	0	3	3
4	PE		**Professional Elective - II** *(Refer ANNEXURE - IV)*	3	0	0	3	3
5	PE		**Professional Elective-III** *(Refer ANNEXURE - IV)*	3	0	0	3	3
6	OE		**Open Elective – II** *(Refer ANNEXURE - III)*	3	0	0	3	3
7	PCC	23ECE208	Microwave and Optical Communications Laboratory	0	0	3	3	1.5
8	PCC	23ECE209	VLSI Design Laboratory	0	0	3	3	1.5
9	SEC		**Skill Enhancement Course – IV** *(Refer ANNEXURE - VI)*	1	0	2	3	2
10	AUC	23ENG901	Technical Paper Writing and IPR	2	0	0	2	-
11	MC	23ECE901	Workshop*	0	0	0	0	0
Total				**21**	**0**	**8**	**29**	**23**

(L = Lecture, T = Tutorial, P = Practical, C = Credit

* Domain specific workshop should be completed at the end of III Year I Semester

Tentative Structure for Final Year:

R23 - Curriculum Structure
IV Year I Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PCC	23ECE115	Antennas and Wave Propagation	3	0	0	3	3
2	Management Course		**Management Course** *(Refer ANNEXURE – V)*	2	0	0	2	2
3	PE		**Professional Elective – IV** *(Refer ANNEXURE - IV)*	3	0	0	3	3
4	PE		**Professional Elective – V** (Refer *ANNEXURE - IV)*	3	0	0	3	3
5	OE		**Open Elective – III** *(Refer ANNEXURE - III)*	3	0	0	3	3
6	OE		**Open Elective – IV** *(Refer ANNEXURE - III)*	3	0	0	3	3
7	SEC		**Skill Enhancement Course – V** *(Refer ANNEXURE - VI)*	1	0	2	3	2
8	AUC	23HUM901	Gender Sensitization	2	0	0	2	-
9	PROJ	23ECE702	Summer Internship II	0	0	4	4	2
Total				**20**	**0**	**6**	**26**	**21**

IV Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PROJ	23ECE703	Project Work and Internship	0	0	24	24	24
Total				**0**	**0**	**24**	**24**	**12**

(L = Lecture, T = Tutorial, P = Practical, C = Credit

ANNEXURE - I

THREE WEEK MANDATORY INDUCTION PROGRAMME

- Yoga and Meditation
- Sports and Games
- NSS
- NCC
- MITS Social Responsibility Club
- Management module
- Design Thinking
- Spoken and Written Communication

- ***Proficiency modules***

  - Basic Computer Proficiency
  - Interpersonal skills
  - Computer Graphics
  - Web programming
  - Mobile Apps
  - Vocabulary enhancement

HOLISTIC DEVELOPMENT ACTIVITIES

Description of Activities

1. Physical and Health
2. Culture
3. Literature and Media
4. Social Service
5. Self-Development
6. Nature and Environment
7. Innovation

ANNEXURE - II

DESIGN THINKING AND INNOVATION RELATED COURSES
(To be offered under MOOC's Category from SWAYAM – NPTEL)

Sl. No.	Course Code	Course Title
1	23IIC5M01	Design, Technology and Innovation
2	23IIC5M02	Introduction on Intellectual Property to Engineers and Technologists
3	23IIC5M03	Product Engineering and Design Thinking
4	23IIC5M04	Intellectual Property Rights and Competition Law
5	23IIC5M05	Innovation, Business Models and Entrepreneurship
6	23IIC5M06	Understanding Incubation and Entrepreneurship
7	23IIC5M07	Intellectual Property
8	23IIC5M08	Roadmap for Patent Creation

Any new Innovation and Incubation Course offered by SWAYAM NPTEL can be appended in future.

ANNEXURE - III

OPEN ELECTIVE – I

(To be offered under Conventional Mode)

Sl. No.	Course Code	Course Title	Course Offered by Department of
1	23HUM301	Indian Knowledge System	Humanities
2	23MAT301	Advanced Numerical Methods	Mathematics
3	23MAT302	Engineering Optimization	Mathematics
4	23PHY301	LASER Physics and Advanced LASER Technology	Physics
5	23PHY302	Thin Film Technology and its Applications	Physics
6	23PHY303	Waste To Sustainable Energy and Energy Systems	Physics
7	23CHE301	Chemistry of Polymers and its Applications	Chemistry
8	23CHE302	Green Chemistry and Catalysis for Sustainable Environment	Chemistry
9	23CHE303	Chemistry of Energy Systems	Chemistry
10	23CE301	Disaster Management	Civil
11	23CE302	Green Buildings	Civil
12	23ME301	Materials Science for Engineers	Mechanical
13	23ME302	Sustainable Energy Technologies	Mechanical
14	23EEE301	Electrical Safety Practices and Standards	EEE
15	23EEE302	Introduction to MEMS	EEE
16	23CSE301	JAVA Programming	CSE
17	23CST301	Operating Systems	CST
18	23CAI301	Mobile Computing	CSE (AI)
19	23CSD301	Introduction to Data Science	CSE (DS)
20	23CSM301	AI for Everyone	CSE (AI and ML)
Any new Interdisciplinary Course can be appended in future.			

OPEN ELECTIVE – II (To be offered under MOOC's Category from SWAYAM – NPTEL)			
Sl. No.	**Course Code**	**Course Title**	**Course Offered by Department of**
1	23HUM3M01	English Language for Competitive Exams	Humanities and Social Sciences
2	23HUM3M02	Public Speaking	Humanities and Social Sciences
3	23HUM3M03	Indian Business History	Humanities and Social Sciences
4	23HUM3M04	Indian Economy: Some Contemporary Perspectives	Humanities and Social Sciences
5	23MG3M01	E – Business	Management
6	23MG3M02	AI in Human Resource Management	Management
7	23MG3M03	AI in Marketing	Management
8	23MG3M04	Artificial Intelligence for Investments	Management
9	23CE3M01	Plastic Waste Management	Civil
10	23CE3M02	Safety in Construction	Civil
11	23ME3M01	Operations Management	Mechanical
12	23EEE3M01	Transducers For Instrumentation	EEE
13	23CSE3M01	Privacy and Security in Online Social Media	CSE
14	23CSE3M02	Computer Networks and Internet Protocol	CSE
15	23CSE3M03	Introduction to Soft Computing	CSE
16	23CSE3M04	Human Computer Interaction (in Hindi)	CSE
17	23MD3M01	Research Methodology	Multidisciplinary
18	23MD3M02	Fuzzy Logic and Neural Networks	Multidisciplinary
Any new Interdisciplinary Course offered by SWAYAM NPTEL can be appended in future.			

OPEN ELECTIVE – III (To be offered under MOOC's Category from SWAYAM – NPTEL)			
Sl. No.	**Course Code**	**Course Title**	**Course Offered by Department of**
1	23HUM3M05	Indian Society: Sociological Perspectives	Humanities and Social Sciences
2	23MAT3M01	Foundations of R Software	Mathematics
3	23MAT3M02	Foundations of R Software (in Hindi Language)	Mathematics
4	23MGM05	HR Analytics	Management
5	23MG3M06	Management Information System	Management
6	23MG3M07	Business Analytics & Text Mining Modeling using Python	Management
7	23CE3M03	Building Materials and Composites	Civil
8	23ME3M02	Power Plant Engineering	Mechanical
9	23EEE3M02	Design of Photovoltaic Systems	EEE
10	23CSE3M05	Multi-Core Computer Architecture	CSE
11	23CSE3M06	Introduction to Machine Learning - IITKGP	CSE
12	23CSE3M07	Introduction to Internet of Things	CSE
13	23CSE3M08	Ethical Hacking	CSE
14	23CSEM09	Cyber Security and Privacy	CSE
15	23CSEM10	Introduction to Machine Learning (Tamil)	CSE
16	23MD3M04	Learning Analytics Tools	Multidisciplinary
Any new Interdisciplinary Course offered by SWAYAM NPTEL can be appended in future.			

OPEN ELECTIVE – IV (To be offered under Conventional Mode)			
Sl. No.	**Course Code**	**Course Title**	**Course Offered by Department of**
1	23PHY304	Smart Materials and Devices	Physics
2	23CHE304	Introduction to Nano Science and Technology	Chemistry
3	23CHE305	Water Pollution and its Management	Chemistry
4	23CE303	Environmental Impact Assessment	Civil
5	23CE304	Ground Improvement Techniques	Civil
6	23CE305	Sustainability in Engineering Practice	Civil
7	23ME303	Total Quality Management	Mechanical
8	23ME304	3D Printing Technologies	Mechanical
9	23EEE303	Robotics	EEE
10	20CSE302	Software Project Management	CSE
11	23CSD302	Cloud Computing	CSE (DS)
12	23CSM302	Chatbots and Virtual Assistants	CSE (AI and ML)
Any new Interdisciplinary Course can be appended in future.			

ANNEXURE – IV

List of Professional Elective

Professional Elective – I (To be offered under MOOC's Category from SWAYAM – NPTEL)		
Sl. No.	**Course Code**	**Course Title**
1.	23ECE4M01	Computer Architecture and Organization
2.	23ECE4M02	Computer Architecture
3.	23ECE4M03	Microsensors and Nanosensors
4.	23ECE4M04	System Design Through Verilog
5.	23ECE4M05	Fundamentals of Wireless Communication (Hindi)
Any other new Disciplinary Course which doesn't exist in the Curriculum can be appended in future.		

Professional Elective – II		
Sl. No.	**Course Code**	**Course Title**
1.	23ECE401	Electronic Measurements and Instrumentation
2.	23ECE402	Embedded Systems
3.	23ECE403	Wireless Sensor Networks
Any advanced courses can be appended in future.		

Professional Elective – III		
Sl. No.	**Course Code**	**Course Title**
1.	23ECE404	Radar Engineering
2.	23ECE405	Community Radio Technology
3.	23ECE406	Satellite Communications
Any advanced courses can be appended in future.		

Professional Elective – IV		
Sl. No.	**Course Code**	**Course Title**
1.	23ECE407	Digital Image Processing
2.	23ECE408	DSP Processors and Architectures
3.	23ECE409	Testing of VLSI Circuits
Any advanced courses can be appended in future.		

Professional Elective –V		
Sl. No.	**Course Code**	**Course Title**
1.	23ECE410	Low Power VLSI Design
2.	23ECE411	Speech Processing
3.	23ECE412	5G Communications
Any advanced courses can be appended in future.		

ANNEXURE - V

MANAGEMENT COURSE		
Sl. No.	**Course Code**	**Course Title**
1	23HUM103	Business Ethics and Corporate Governance
2	23HUM104	Principles of Management
3	23HUM105	Human Resource Development
4	23HUM106	Management Science
5	23HUM107	National Cadet Corps

ANNEXURE – VI

List of Skill Enhancement Courses

Skill Enhancement Course – I		
Sl. No.	**Course Code**	**Course Title**
1.	23CSE601	Python Programming
Any Courses in Communication Skills can be appended in future.		

Skill Enhancement Course – II		
Sl. No.	**Course Code**	**Course Title**
1.	23ENG601	Soft Skills
Any Courses can be appended in future.		

Skill Enhancement Course – III		
Sl. No.	**Course Code**	**Course Title**
1.	23ECE601	PCB Design and Prototype Development.
2.	23ECE602	Internet of Things
Any Courses can be appended in future.		

Skill Enhancement Course – IV		
Sl. No.	**Course Code**	**Course Title**
1.	23ECE603	MATLAB for Engineers
2.	23ECE604	Digital Signal Processor
Any Courses can be appended in future.		

Skill Enhancement Course – V		
Sl. No.	**Course Code**	**Course Title**
1.	23ECE605	RF System Design tools
2.	23ECE606	QNX based Real Time OS
Any Courses can be appended in future.		

ANNEXURE – VII

Minor in Electronics and Communication Engineering

(Applicable to CE, ME, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

Stream Name: Communication Systems (CS)

SI. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	Professional Core Course	23MDECE101	Signals and Systems	3	0	0	3	3
2	Professional Core Course	23MDECE102	Communication Systems	3	0	0	3	3
3	Professional Core Course	23MDECE201	Communication Systems Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23MDECE103	Digital Signal Processing	3	0	0	3	3
5	Professional Core Course	23MDECE104	Optical Communication	3	0	0	3	3
6	Professional Core Course	23MDECE202	Digital Signal Processing Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23MDECE105	Mobile Telecommunication Networks	3	0	0	3	3
			Total	**15**	**0**	**6**	**21**	**18**

Minor in Electronics and Communication Engineering
(Applicable to CE, EEE, ME, CSE, CST, CSE (AI), CSE (DS), CSE (CS) , CSE (AI and ML) and CSE (Networks)

Stream Name: Embedded Systems

SI. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	Professional Core Course	23MDECE106	Microcontrollers and Programmable Digital Signal Processors	3	0	0	3	3
2	Professional Core Course	23MDECE107	Programming Languages for Embedded Software	3	0	0	3	3
3	Professional Core Course	23MDECE203	Microcontrollers and Programmable Digital Signal Processors Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23MDECE108	Real Time Operating Systems	3	0	0	3	3
5	Professional Core Course	23MDECE109	SoC Architecture	3	0	0	3	3
6	Professional Core Course	23MDECE204	QNX based Real Time OS Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23MDECE110	DSP Architecture	3	0	0	3	3
			Total	**15**	**0**	**6**	**21**	**18**

Minor in Quantum Computing

(Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

Stream Name: Quantum Computing

Sl. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	Professional Core Course	23MDINS101	Introduction to Quantum Computing	3	0	0	3	3
2	Professional Core Course	23MDINS102	Mathematical Foundations for Quantum Computing	3	0	0	3	3
3	Professional Core Course	23MDINS201	Quantum Programming and Simulation Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23MDINS103	Quantum Algorithms	3	0	0	3	3
5	Professional Core Course	23MDINS104	Quantum Information and Communication	3	0	0	3	3
6	Professional Core Course	23MDINS202	Quantum Algorithms Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23MDINS105	Quantum Machine Learning (QML)	3	0	0	3	3
			Total	**15**	**0**	**6**	**21**	**18**

Minor in Quantum Technologies

(Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

Stream Name: Quantum Technologies

Sl. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	Professional Core Course	23MDINS106	Foundations of Quantum Technologies	3	0	0	3	3
2	Professional Core Course	23MDINS107	Solid State Physics for Quantum Technologies	3	0	0	3	3
3	Professional Core Course	23MDINS203	Quantum Devices and Materials Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23MDINS108	Introduction to Quantum Communication	3	0	0	3	3
5	Professional Core Course	23MDINS109	Introduction to Quantum Sensing	3	0	0	3	3
6	Professional Core Course	23MDINS204	Quantum Communication and Sensing Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23MDINS110	Quantum Optics Prerequisites for Quantum Technologies	3	0	0	3	3
			Total	**15**	**0**	**6**	**21**	**18**

ANNEXURE – VIII

Honors in Electronics and Communication Engineering

SI. No	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total Contact Hours	
III Year I Semester								
1	Professional Core Course	23HDECE101	Analog IC Design	3	0	0	3	3
2	Professional Core Course	23HDECE102	Digital IC Design	3	0	0	3	3
3	Professional Core Course	23HDECE201	Analog and Digital IC Design Laboratory	0	0	3	3	1.5
III Year II Semester								
3	Professional Core Course	23HDECE103	Advanced Digital Signal Processing	3	0	0	3	3
4	Professional Core Course	23HDECE104	CAD for VLSI	3	0	0	3	3
5	Professional Core Course	23HDECE202	Physical Design Automation Laboratory	0	0	3	3	1.5
IV Year I Semester								
6	Professional Core Course	23HDECE105	FPGA Architectures	3	0	0	3	3
			Total	**15**	**0**	**6**	**21**	**18**

I Year I Semester

B. Tech I Year I Semester

23MAT101 LINEAR ALGEBRA AND CALCULUS

L	T	P	C
3	0	0	3

Course Objectives:

To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

UNIT I MATRICES **9 hours**

Rank of a matrix by echelon form, normal form. Cauchy–Binet formulae (without proof). Inverse of non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods.

UNIT II EIGENVALUES, EIGENVECTORS AND ORTHOGONAL TRANSFORMATION **9 hours**

Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem,Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonicalforms by Orthogonal Transformation.

UNIT III CALCULUS **9 hours**

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

UNIT IV PARTIAL DIFFERENTIATION AND APPLICATIONS (MULTI VARIABLE CALCULUS) **9 hours**

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, Functional dependence, maxima and minima of functionsof two variables, method of Lagrange multipliers.

UNIT V MULTIPLE INTEGRALS (MULTI VARIABLE CALCULUS) **9 hours**

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Course Outcomes:

At the end of the course, the student will be able to

CO1: Solve the system of linear equations and apply the matrix algebra techniques in practical applications.

CO2: Utilize the Eigenvalues, Eigenvectors and applications of diagonalization in the field of Science and Technology.

CO3: Relate the results of mean value theorems in real life problems.

CO4: Apply the functions of several variables to evaluate the rates of change with respect to time and space variables in engineering.

CO5: Compute the area and volume by interlinking them to appropriate double and triple integrals.

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition

2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14^{th} Edition.
2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, AlphaScience International Ltd., 2021 5^{th} Edition(9th reprint).
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5^{th}Edition.
4. Advanced Engineering Mathematics, Micheael Greenberg, Pearson publishers, 9^{th}edition
5. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, Third Edition (Reprint 2021)

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year I Semester

23PHY101 ENGINEERING PHYSICS

L	T	P	C
3	0	0	3

Course Objectives:

To bridge the gap between the Physics in school at 10+2 level and UG level engineering courses by identifying the importance of the optical phenomenon like interference, diffraction etc, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

UNIT I WAVE OPTICS 9 hours

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton's Rings, Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT II CRYSTALLOGRAPHY AND X-RAY DIFFRACTION 9 hours

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods

UNIT III QUANTUM MECHANICS AND FREE ELECTRON THEORY 9 hours

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy

UNIT IV SEMICONDUCTORS 9 hours

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effect and its applications.

UNIT V DIELECTRIC AND MAGNETIC MATERIALS 9 hours

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

Course Outcomes:

CO1: Apply the knowledge of Interference, Diffraction and Polarization techniques for materials testing and explore their applications in both science and technology.

CO2: Explain the crystal structure in terms of atomic positions, unit cells, and crystal symmetry and also relate the crystal symmetry to the symmetry observed in a diffraction pattern.

CO3: Evaluate the Schrodinger wave equations for simple potentials and explain the concept of conductivity of different types of materials.

CO4: Distinguish the semiconductors using Fermi level and identify the type of semiconductors using Hall effect.

CO5: Explain the origin of fundamental magnetic phenomena and types of magnetic materials. Understand the induced fields in dielectrics, and electrical behaviour of dielectrics.

Text Books:

1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G.Kshirsagar & TVS ArunMurthy, S. Chand Publications, 11th Edition 2019.

2. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

Reference Books:

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.

2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.

3. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.2010

4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

Web Resources: https://www.loc.gov/rr/scitech/selected-internet/physics.html

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year I Semester

23EEE101 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives:

- To expose to the field of electrical & electronics engineering, laws and principles of electrical/ electronic engineering and to acquire fundamental knowledge in the relevant field.

PART A: BASIC ELECTRICAL ENGINEERING

UNIT I DC & AC CIRCUITS 8 hours

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

UNIT II MACHINES AND MEASURING INSTRUMENTS 8 hours

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

UNIT III ENERGY RESOURCES, ELECTRICITY BILL & SAFETY MEASURES 8 hours

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops,Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricitytariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker(MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types,Safety Precautions to avoid shock

Course Outcomes:

After the completion of the course students will be able to

CO1: Infer the basic AC and DC electrical circuits.

CO2: Analyze construction and operation of AC and DC machines, different electrical measuring instruments.

CO3: Illustrate operation of various power generating stations, energy consumption and electrical safety.

Text Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, FirstEdition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti,Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, ThirdEdition

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019,Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford UniversityPress, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition.

Web Resources:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

PART B: BASIC ELECTRONICS ENGINEERING

Course Objectives:

This course provides the student with the fundamental skills to understand the principles of digital electronics, basics of semiconductor devices like diodes & transistors, characteristics and its applications.

UNIT I SEMICONDUCTOR DEVICES 8 hours

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor - CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

UNIT II BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION 8 hours

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT III DIGITAL ELECTRONICS 8 hours

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of BooleanAlgebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adder, Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only).

Course Outcomes:

After the completion of the course students will be able to

CO1: Explain the theory, construction, and operation of electronic devices.

CO2: Apply the concept of science and mathematics to explain the working of diodes, transistors, and their applications.

CO3: Analyze logic gates and its applications in design of combinational circuits.

Text Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, PearsonEducation, 2021.

2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.

2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.

3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version,Pearson Education,2009.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year I Semester

23CSE101 INTRODUCTION TO PROGRAMMING

L	T	P	C
3	0	0	3

Course Objectives:

- Comprehensive knowledge to computer systems, programming languages, and problem-solving techniques.
- Know the concept of control structures and their usage in programming.
- Introduce to the arrays, memory models, and basic string concepts
- Gain a knowledge from the concept of functions, including declaration, definition, and various aspects of function usage.
- Acquire the advanced programming concepts, including user-defined data types, pointers, and file handling.

UNIT I INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING **9 hours**

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting. Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

UNIT II CONTROL STRUCTURES **9 hours**

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do- while) Break and Continue.

UNIT III ARRAYS AND STRINGS **9 hours**

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings, String Operations and String functions.

UNIT IV POINTERS & USER DEFINED DATA TYPES **9 hours**

Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions, Dynamic memory allocation.

UNIT V FUNCTIONS & FILE HANDLING **9 hours**

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, Basics of File Handling

Note: The syllabus is designed with C Language as the fundamental language of implementation**.**

Course Outcomes:

A student after completion of the course will be able to

CO1: Illustrate the basic computer concepts and programming principles of C language.

CO2: Develop programs using various control structures in 'C'.

CO3: Design applications using arrays and basic string manipulation.

CO4: Demonstrate the applications of pointers, user-defined types and dynamic memory allocation.

CO5: Design various applications using functions and file concepts.

Text Books:

1. C Programming, A Problem Solving Approach, Forouzan, Gilberg,Prasad, CENGAGE, 3rd edition.

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-HillEducation, 2008.

2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition

3. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988

4. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education,1996

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year I Semester

23ME101 ENGINEERING GRAPHICS

L	T	P	C
1	0	4	3

Course Objectives:

- To enable the students with various concepts like dimensioning, conventions and standards related to Engineering Drawing.
- To impart knowledge on the projection of points, lines and plane surfaces
- To improve the visualization skills for better understanding of projection of solids
- To develop the imaginative skills of the students required to understand Section of solids and Developments of surfaces.
- To make the students understand the viewing perception of a solid object in Isometric and Perspective projections.

UNIT I **9 hours**

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.
Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.
Scales: Plain scales, diagonal scales and vernier scales.

UNIT II **9 hours**

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.
Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes
Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT III **9 hours**

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

UNIT IV **9 hours**

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.
Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

UNIT V **9 hours**

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.
Computer graphics: Creating 2D&3D drawings ofobjects including PCB and Transformations using Auto CAD (Not for end examination).

Course Outcomes:

Students will use the Auto CAD software and will be able to
CO1: Construct the geometrical constructions, engineering curves and scales.
CO2: Draw the projections of points, straight lines and planes
CO3: Draw the projections of solids in various positions
CO4: Sketch the sections of solids and developments of surfaces
CO5: Draw the conversion of the isometric views to orthographic views and vice versa.

Text Books:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.

2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.

3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, TataMcGraw Hill, 2017.

Mode of Evaluation: Day-to-day Evaluation, Mid Term Tests and End Semester Examination.

B. Tech I Year I Semester

23PHY201 ENGINEERING PHYSICS LABORATORY

L	T	P	C
0	0	2	1

Course Objectives:

To study the concepts of optical phenomenon like interference, diffraction etc., recognize the importance of energy gap in the study of conductivity and Hall effect in semiconductors and study the parameters and applications of dielectric and magnetic materials by conducting experiments.

List of Experiments:

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3. Verification of Brewster's law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck's constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
11. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using a Compound pendulum.
14. Determination of magnetic susceptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.
17. Determination of young's modulus for the given material of wooden scale by non-uniform bending (or double cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

Course Outcomes:

CO1: Know the various phenomena of light practically and gain knowledge about various optical technique methods.
CO2: Verify the theoretical concepts of optics, magnetism and dielectrics by hands on experiment.
CO3: Apply the scientific process in the conduct of semiconductor experiments and report the experimental findings.
CO4: Understand mechanical phenomena by instruments and apply them in real time applications.
CO5: Acquire and interpret experimental data to examine the physical laws.

Web Resources:

www.vlab.co.in
https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

Reference Books:

1. A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017.

2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.

3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; AtulPrakashan, 2021-22.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year I Semester

23EEE201 ELECTRICAL AND ELECTRONICS ENGINEERING WORKSHOP

L	T	P	C
0	0	3	1.5

Course Objectives:

To impart knowledge on the fundamental laws & theorems of electrical circuits, functions of electrical machines and energy calculations.

Activities:

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set,wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
   - Provide some exercises so that hardware tools and instruments are learned to be usedby the students.
2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
   - Provide some exercises so that measuring instruments are learned to be used by thestudents.
3. Components:
   - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
   - Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

PART A: ELECTRICAL ENGINEERING LABORATORY

List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

Note: Minimum Six Experiments to be performed.

Course Outcomes:

At the end of the course, the student will be able to

CO1: Analyze basic DC circuits.

CO2: Understand the usage of common electrical & electronic measuring instruments.

CO3: Understand the basic characteristics of electrical machines and perform energy calculations.

PART B: ELECTRONICS ENGINEERING LABORATORY

Course Objectives:

- To impart knowledge on the principles of digital electronics and fundamentals of electron devices & its applications.

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifier.
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gatesusing ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Tools / Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters,AC Voltmeters, CROs, all the required active devices.

Note: Minimum Six Experiments to be performed. All the experiments shall be implemented using Hardware / Software.

Course Outcomes:

At the end of the course, the student will be able to
CO1: Plot and discuss the characteristics of various electron devices.
CO2: Explain the operation of a digital circuit.

Reference Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, PearsonEducation, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version,Pearson Education,2009.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year I Semester

23CSE201 COMPUTER PROGRAMMING LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

2. Provide hands-on experience in programming fundamentals, algorithm design, and basic problem-solving techniques.
3. Enable students to implement control structures for program flow control in practical scenarios.
4. Reinforce understanding of arrays, memory models, and string manipulation through practical exercises
5. Provide hands-on practice with functions, function calls, and parameter manipulation using pointers.
6. Offer practical exposure to advanced programming concepts, including user-defined data types, file handling, and pointer operations.

UNIT I

WEEK 1

Objective: Getting familiar with the programming environment on the computer and writingthe first program.

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii) Exposure to Turbo C, gcc
iii) Writing simple programs using printf(), scanf()

WEEK 2

Objective: Getting familiar with how to formally describe a solution to a problem in a seriesof finite steps both using textual notation and graphic notation.

Suggested Experiments /Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab 1: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

i) Sum and average of 3 numbers
ii) Conversion of Fahrenheit to Celsius and vice versa

Simple interest calculation

WEEK 3

Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments/Activities:
Tutorial 3: Variable types and type conversions:

Lab 3: Simple computational problems using arithmetic expressions.
Problems to Practice:

i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

UNIT II

WEEK 4
Objective: Explore the full scope of expressions, type-compatibility of variables & constantsand operators used in the expression and how operator precedence works.

Suggested Experiments/Activities:

Tutorial4: Operators and the precedence and as associativity:
Lab4: Write C program to solve Simple computational problems using the operator' precedence and associativity
Problems to Practice:

i) Evaluate the following expressions.
    a. A+B*C+(D*E) + F*G
    b. A/B*C-B+A*D/3
    c. A+++B---A
    d. J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator
iii) Take marks of 5 subjects in integers, and find the total, average in float

WEEK 5
Objective: Explore the full scope of different variants of "if construct" namely if-else, null-else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".

Suggested Experiments/Activities:
Tutorial 5: Branching and logical expressions:
Lab 5: Write C program for Problems involving if-then-else structures.
Problems to Practice:

i) Write a C program to find the max and min of four numbers using if-else.
ii) Write a C program to generate electricity bill.
iii) Find the roots of the quadratic equation.
iv) Write a C program to simulate a calculator using switch case.
v) Write a C program to find the given year is a leap year or not.

WEEK 6

Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and for loop in addition to structured jump constructs like break and continue including when eachof these statements is more appropriate to use.

Suggested Experiments/Activities:
Tutorial 6: Loops, while and for loops
Lab 6: Write a C program for Iterative problems e.g., the sum of series
Problems to Practice:

i) Find the factorial of given number using any loop.
ii) Find the given number is a prime or not.
iii) Compute sine and cos series
iv) Checking a number palindrome
v) Construct a pyramid of numbers.

UNIT III

WEEK 7:
Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:
Tutorial 7: 1 D Arrays: searching.
Lab 7:Write a C program to solve 1D Array manipulation, linear search
Problems to Practice:

i) Find the min and max of a 1-D integer array.
ii) Perform linear search on1D array.
iii) The reverse of a 1D integer array
iv) Find 2's complement of the given binary number.
v) Eliminate duplicate elements in an array.

WEEK 8:
Objective: Explore the difference between other arrays and character arrays that can be usedas Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:
Tutorial 8: 2 D arrays, sorting and Strings.
Lab 8: Write a C program to solve Matrix problems, String operations, Bubble sort
Problems to Practice:

i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort
iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

UNIT IV

WEEK 9:

Objective: Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gainexperience processing command-line arguments received by C

Suggested Experiments/Activities:
Tutorial 9: Pointers, structures and dynamic memory allocation
Lab 9: Write a C program for Pointers and structures, memory dereference.
Problems to Practice:

i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc() and display failed students list
iv) Read student name and marks from the command line and display the student details alongwith the total.
v) Write a C program to implement realloc()

WEEK 10:

Objective: Experiment with C Structures, Unions, bit fields and self-referential structures(Singly linked lists) and nested structures

Suggested Experiments/Activities:
Tutorial 10: Bitfields, Self-Referential Structures, Linked lists
Lab10 : Bitfields, linked lists
Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the samewithout using bit- fields

i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

UNIT V

WEEK 11:

Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

Suggested Experiments/Activities:
Tutorial 11: Functions, call by value, scope and extent,
Lab 11: Write a C program to solve Simple functions using call by value, solving differential equations using Eulers theorem.
Problems to Practice:

i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.
iii) Write a C function to transpose of a matrix.

iv) Write a C function to demonstrate numerical integration of differential equations using Euler'smethod

WEEK 12:

Objective: Explore how recursive solutions can be programmed by writing recursive functionsthat can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:

Tutorial 12: Recursion, the structure of recursive calls

Lab 12: Write C program for Recursive functions.

Problems to Practice:

i) Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.
iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

WEEK 13:

Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers

Suggested Experiments/Activities:

Tutorial 13: Call by reference, dangling pointers

Lab 13: Write a C program to solve Simple functions using Call by reference, Dangling pointers.

Problems to Practice:

i) Write a C program to swap two numbers using call by reference.
ii) Demonstrate Dangling pointer problem using a C program.
iii) Write a C program to copy one string into another using pointer.
iv) Write a C program to find no of lowercase, uppercase, digits and othercharacters using pointers.

WEEK14:

Objective: To understand data files and file handling with various file I/O functions. Explore thedifferences between text and binary files.

Suggested Experiments/Activities:

Tutorial 14: File handling

Lab 14: Write a C program to handle File operations.

Problems to Practice:

i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-linearguments.
v) Find no. of lines, words and characters in a file.

Write a C program to print last n characters of a given file.

Course Outcomes:

CO1: Implement coding and debugging the simple programs, create algorithms, and practice problem solving strategies using programming languages.

CO2: Demonstrate programs that incorporate conditional statements, loops, and break/continue statements to control program execution.

CO3: Apply coding for real time examples with arrays, array indexing, and manipulate strings in programming tasks.

CO4: Create, call, and debug functions, modify function parameters using pointers, and gain practical knowledge of variable scope within functions.

CO5: Apply user-defined data types, manipulate files, pointer operations to solve real-world programming challenges.

Textbooks:

1. Ajay Mittal, Programming in C: A practical approach, Pearson.

2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India

2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw Hill

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year I Semester

23CSE202 IT WORKSHOP

L	T	P	C
0	0	2	1

Course Objectives:

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSSTo teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

Task 2: Every student should disassemble and assemble the PC back to working condition. Labinstructors should verify the work and follow it up with a Viva. Also students need to go throughthe video which shows the process of assembling a PC. A video would be given as part of the course content.

Task 3: Every student should individually install MS windows on the personal computer. Labinstructor should verify the installation and follow it up with a Viva.

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

Task 5: Every student should install BOSS on the computer. The system should be configuredas dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finallystudents should demonstrate, to the instructor, how to access the websites and email. If there isno internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD

Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

Task 2: Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word.

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.

Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

Task 2: Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function,

LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI TOOLS – ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.

- Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

- Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

- Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Course Outcomes:

CO1: Gain expertise in computer hardware, assembly, and dual-boot OS configuration, enhancing their ability to manage and troubleshoot computer systems effectively.
CO2: Learn to connect to the LAN, configure browsers, use search engines effectively, and practice cyber hygiene for secure internet use.
CO3: Create well-formatted documents and presentations using Microsoft Office and Latex
CO4: Gain proficiency in using Excel or its FOSS equivalent for tasks like scheduling, GPA calculation, data manipulation, and formatting.
CO5: Craft effective and tailored inputs to obtain desired responses from AI tools like ChatGPT.

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech,2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and KenQuamme. – CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCOPress, Pearson Education, 3rd edition

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year I Semester

23HUM202 NSS/NCC/SCOUTS AND GUIDES/COMMUNITY SERVICE

L	T	P	C
0	0	1	0.5

Course Objectives:

The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

UNIT I ORIENTATION **5 hours**

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, careerguidance.

Activities:

i) Conducting –ice breaking sessions-expectations from the course-knowing personaltalents and skills
ii) Conducting orientations programs for the students –future plans-activities-releasingroad map etc.
iii) Displaying success stories-motivational biopics- award winning movies on societalissues etc.
iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II NATURE & CARE **5 hours**

Activities:

i) Best out of waste competition.
ii) Poster and signs making competition to spread environmental awareness.
iii) Recycling and environmental pollution article writing competition.
iv) Organising Zero-waste day.
v) Digital Environmental awareness activity via various social media platforms.
vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
vii) Write a summary on any book related to environmental issues.

UNIT III COMMUNITY SERVICE **5 hours**

Activities:

i) Conducting One Day Special Camp in a village contacting village-area leaders-Surveyin the village, identification of problems- helping them to solve via media-authorities-experts-etc.
ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii) Conducting consumer Awareness. Explaining various legal provisions etc.
iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and PopulationEducation.
v) Any other programmes in collaboration with local charities, NGOs etc.

Course Outcomes:

After completion of the course the students will be able to

CO1: Understand the importance of discipline, character and service motto.

CO2: Solve some societal issues by applying acquired knowledge, facts, and techniques.

CO3: Explore human relationships by analyzing social problems.

CO4: Determine to extend their help for the fellow beings and downtrodden people.

CO5: Develop leadership skills and civic responsibilities.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme*
2. Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
3. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, DirectorateGeneral of NCC, Ministry of Defence, New Delhi
4. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering",McGraw Hill, New York 4/e 2008
5. Masters G. M., Joseph K. and Nagendran R. "Introduction to EnvironmentalEngineering and Science", Pearson Education, New Delhi. 2/e 2007

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting vivavoce on the subject.

I Year II Semester

B. Tech I Year II Semester

23ENG101 COMMUNICATIVE ENGLISH

L	T	P	C
2	0	0	2

Pre-requisite: None

Course Objectives:

The main objective of introducing this course, Communicative English, is to facilitate effective listening, Reading, Speaking and Writing skills among the students. It enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students to make them effective in speaking and writing skills and to make them industry ready.

UNIT I Lesson: HUMAN VALUES: Gift of Magi (Short Story) 6 hours

Listening: Identifying the topic, the context and specific pieces of information by listeningto short audio texts and answering a series of questions.
Speaking: Asking and answering general questions on familiar topics such as home,family, work, studies and interests; introducing oneself and others.
Reading: Skimming to get the main idea of a text; scanning to look for specific pieces ofinformation.
Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.
Grammar: Parts of Speech, Basic Sentence Structures-forming questions
Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT II Lesson: NATURE: The Brook by Alfred Tennyson (Poem) 6 hours

Listening: Answering a series of questions about main ideas and supporting ideas afterlistening to audio texts.
Speaking: Discussion in pairs/small groups on specific topics followed by short structuretalks.
Reading: Identifying sequence of ideas; recognizing verbal techniques that help to linkthe ideas in a paragraph together.
Writing: Structure of a paragraph - Paragraph writing (specific topics)
Grammar: Cohesive devices - linkers, use of articles and zero article; prepositions.
Vocabulary: Homonyms, Homophones, Homographs.

UNIT III Lesson: BIOGRAPHY: Elon Musk 6 hours

Listening: Listening for global comprehension and summarizing what is listened to.
Speaking: Discussing specific topics in pairs or small groups and reporting what

isdiscussed
Reading: Readinga text in detail by making basic inferences -recognizing and interpretingspecific context clues; strategies to use text clues for comprehension.
Writing: Summarizing, Note-making, paraphrasing
Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations
Vocabulary: Compound words, Collocations

UNIT IV **Lesson: INSPIRATION: The Toys of Peace by Saki** **6 hours**

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters, Resumes

Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice

Vocabulary: Words often confused, Jargons

UNIT V **Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)** **6 hours**

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic contexts

Reading: Reading comprehension.

Writing: Writing structured essays on specific topics.

Grammar: Editing short texts –identifying and correcting common errors in grammar andusage (articles, prepositions, tenses, subject verb agreement)

Vocabulary: Technical Jargons

Course Outcomes:

CO1: Understand the topic, context, and pieces of specific information from personal , professional and social situations

CO2: Apply discourse markers to speak clearly in formal discussions

CO3: Analyze and apply grammatical structures to formulate contextualized phrases and sentences

CO4: Analyze texts and images to write summaries based on global comprehension

CO5: Draft coherent paragraphs and structured essays

Text Books:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5)

Reference Books:

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

Web Resources

Grammer

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/

VOCABULARY

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year II Semester

23MAT102 DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

L	T	P	C
3	0	0	3

Course Objectives:

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

UNIT I DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE **9 hours**

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

UNIT II LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER (CONSTANT COEFFICIENTS) **9 hours**

Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS **9 hours**

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT IV VECTOR DIFFERENTIATION **9 hours**

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions- Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT V VECTOR INTEGRATION **9 hours**

Line Integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.

Course Outcomes:

At the end of the course, the student will be able to

CO1: Find the solution of engineering problems formulated in the form of linear first order differential equations.

CO2: Solve the linear higher order differential equations related to various engineering fields.

CO3: Determine the solutions for linear partial differential equations that model the physical processes.

CO4: Interpret the physical meaning of different operators such as gradient, curl and divergence.

CO5: Estimate the work done against field, circulation and flux using vector calculus.

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10thEdition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, PearsonPublishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, Dennis G. Zill and Warren S. Wright, Jones andBartlett, 2018.
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018,5th Edition.
4. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha ScienceInternational Ltd., 2021 5th Edition (9th reprint).
5. Higher Engineering Mathematics, B. V. Ramana, , McGraw Hill Education, 2017

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year II Semester

23CHE102 CHEMISTRY

L	T	P	C
3	0	0	3

Course Objectives:

7. To familiarize engineering chemistry and its applications
8. To train the students on the principles and applications of electrochemistry and polymers
9. To introduce instrumental methods, molecular machines and switches.

UNIT I STRUCTURE AND BONDING MODELS 9 hours

Fundamentals of Quantum mechanics, Schrodinger Wave equation, significance of Ψ and Ψ2, particle in one dimensional box, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of N2, O2 and NO, CO π-molecular orbitals of butadiene and benzene, calculation of bond order.

UNIT II MODERN ENGINEERING MATERIALS 9 hours

Semiconductors – Introduction, basic concept, role of doping agents, applications
Super conductors -Introduction, basic concept, applications.
Supercapacitors: Introduction, Basic Concept-Classification – Applications.
Nano materials: Introduction, classification, properties and applications of Fullerenes, carbon nano tubes and Graphene nanoparticles.

UNIT III ELECTROCHEMISTRY AND APPLICATIONS 9 hours

Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations).
Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.
Primary cells – Zinc-air battery, Sodium-air battery, Secondary cells –lithium-ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen fuel cell– working of the cells. Polymer Electrolyte Membrane Fuel cells (PEMFC).

UNIT IV POLYMER CHEMISTRY 9 hours

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, with specific examples and mechanisms of polymer formation, Poly Dispersity Index (PDI) & it's significance
Plastics –Thermo and Thermosetting plastics, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6, carbon fibres.
Elastomers–Buna-S, Buna-N–preparation, properties and applications.
Conducting polymers – polyacetylene, polyaniline, – mechanism of conduction and applications.
Bio-Degradable polymers - Poly Glycolic Acid (PGA), Poly Lactic Acid (PLA).

UNIT V INSTRUMENTAL METHODS AND APPLICATIONS 9 hours

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. UV-Visible Spectroscopy, electronic transition, Instrumentation, IR spectroscopy, fundamental modes and selection rules, Instrumentation. Chromatography-Basic Principle, Classification-HPLC: Principle, Instrumentation and Applications.

Course Outcomes:

At the end of the course, the students will be able to:

CO1: Explain the foundations of Quantum mechanics and concept of bonding in homo and hetero diatomic molecules like O2, CO etc.

CO2: Apply the principle of Band diagrams in the application of conductors and semiconductors. Properties and applications of nanomaterials.

CO3: Compare the materials of construction for battery, its working principles, fuel cells & electrochemical sensors.

CO4: Explain the preparation, properties, and applications of thermoplastics & thermosetting & elastomers conducting polymers.

CO5: Explain the principles of spectrometry, technique of HPLC in separation of solid and liquid mixtures. Summarize the concepts of Instrumental methods.

Text Books:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.

2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e,Oxford University Press, 2010.

3. G V Subba Reddy, K N Jayaveera, C Ramachandraiah, Engineering Chemistry, McGraw-Hill; First Edition, 2019.

Reference Books:

1. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.

2. J.D. Lee, Concise Inorganic Chemistry, 5th Edition, Wiley Publications, Feb.2008

3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year II Semester

23CME101 BASIC CIVIL AND MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives:

10. Get familiarized with the scope and importance of Civil Engineering sub-divisions.
11. Introduce the preliminary concepts of surveying.
12. Acquire preliminary knowledge on Transportation and its importance in nation's economy.
13. Get familiarized with the importance of quality, conveyance and storage of water.
14. Introduction to basic civil engineering materials and construction techniques.

PART A: BASIC CIVIL ENGINEERING

UNIT I BASICS OF CIVIL ENGINEERING 8 hours

Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT II SURVEYING 8 hours

Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

UNIT III TRANSPORTATION ENGINEERING 8 hours

Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

Course Outcomes:

CO1: Identify various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society.

CO2: Measure of distances, angles and levels through surveying.

CO3: Identify various transportation infrastructures, sources of water and various water conveyance, storage structures like dams and reservoirs.

Text Books:

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt.Ltd. Fourth Edition.

2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers.2022. First Edition.

3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. FifthEdition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, KhannaPublishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, KhannaPublishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.

PART B: BASIC MECHANICAL ENGINEERING

Course Objectives:

The students after completing the course are expected to

- Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
- Explain different engineering materials and different manufacturing processes.
- Provide an overview of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

UNIT I **8 hours**

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries andSociety-Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

UNIT II **8 hours**

Manufacturing Processes: Principles of Casting**,** Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Thermal Engineering – working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

UNIT III **8 hours**

Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants. Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

(Note: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject)

Course Outcomes:

On completion of the course, the student should be able to

CO1: Understand the role and importance of mechanical engineering and engineering materials

CO2: Identify the different manufacturing processes for engineering applications and explain the basics of thermal engineering and its applications.

CO3: Explain the working of different mechanical power transmission systems, power plants and robotics.

Text Books:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India)Pvt. Ltd.
2. A Tear book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications,(India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengagelearning India Pvt. Ltd.

Reference Books:

1. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak MPandey, Springer publications
3. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt.Ltd.
4. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, TataMcGraw Hill publications (India) Pvt. Ltd.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year II Semester

23ECE101 NETWORK ANALYSIS

L	T	P	C
3	0	0	3

Course Objectives:

15. Understand the formulation of network equations, Network theorems and Graph theory.
16. Expose the students to the concepts of resonance in electrical circuit
17. Expose the students to the concepts of various types of Transient analysis of different electrical circuits with and without initial conditions using Laplace Transform.
18. Demonstrate relationship of two port network variables and connections.
19. Analyse and design passive network filter circuits, attenuators and equalizers

UNIT I **9 hours**

Types of circuit components, Types of Sources and Source Transformations, Mesh analysis and Nodal analysis, problem solving with resistances only including dependent sources also. Principal of Duality with examples.

Network Theorems: Thevenin's, Norton's, Milliman's, Reciprocity, Compensation, Substitution, Superposition, Max Power Transfer, Tellegens - problem solving using dependent sources also.

UNIT II **9 hours**

Transients: First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem-solving using R-L-C elements with DC excitation and AC excitation, Response as related to s-plane rotation of roots.

Laplace transform: introduction, Laplace transformation, basic theorems, problem solving using Laplace transform, partial fraction expansion, Heaviside's expansions, problem solving using Laplace transform.

UNIT III **9 hours**

Steady State Analysis of A.C Circuits: Impedance concept, phase angle, series R-L, R-C, R-L- C circuits problem solving. Complex impedance and phasor notation for R-L, R-C, R-L-C problem solving using mesh and nodal analysis, Star-Delta conversion, problem solving using Laplace transforms also.

UNIT IV **9 hours**

Resonance: Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, general case-resistance present in both branches, anti-resonance at all frequencies.

Coupled Circuits: Coupled Circuits: Self-inductance, Mutual inductance, Coefficient of coupling, analysis of coupled circuits, Natural current, Dot rule of coupled circuits, conductively coupled equivalent circuits- problem solving.

UNIT V **9 hours**

Two-port Networks: Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h- parameters, Relationships Between parameter Sets, Parallel & series connection of two port networks, cascading of two port networks, problem solving using dependent sources also.

Image and iterative impedances. Image and iterative transfer constants. Insertion loss. Attenuators and pads. Lattice network and its parameters. Impedance matching networks.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand basic electrical circuits with nodal and mesh analysis Analyse the circuit using network theorems.

CO2: Find Transient response and Steady state response of a network.

CO3: Analyze the response of RL, RC and RLC circuits with different inputs.

CO4: Analyse the series and parallel resonance circuits.

CO5: Compute the parameters of a two-port network.

Text Books:

1. Network Analysis – ME Van Valkenburg, Prentice Hall of India, revised 3rd Edition,2019.

2. Engineering Circuit Analysis by William H. Hayt, Jack Kemmerly, Jamie Phillips,Steven M. Durbin, 9th Edition 2020.

3. Network lines and Fields by John. D. Ryder 2nd Edition, PHI

Reference Books:

1. D. Roy Choudhury, Networks and Systems, New Age International Publications, 2013.

2. Joseph Edminister and Mahmood Nahvi, Electric Circuits, Schaum's Outline Series,7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017

3. Fundamentals of Electric Circuits by Charles K. Alexander and Matthew N. O. Sadiku,McGraw-Hill Education.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech I Year II Semester

23ENG201 COMMUNICATIVE ENGLISH LABORATORY

L	T	P	C
0	0	2	1

Course Objectives:

The main objective of introducing this course, Communicative English Laboratory, is to expose the students to a variety of self-instructional, learner friendly modes of language learning. The students will get trained in basic communication skills and also make them ready to face job interviews.

List of Topics:

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover letter, SOP
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

Course Outcomes:

CO1: Understand the English speech sounds, stress, rhythm, intonation and syllabic division for better listening and speaking
CO2: Apply communication strategies and implement them in language learning activities.
CO3: Analyze and enhance job-relevant writing skills
CO4: Evaluate and exhibit professionalism in debates and group discussions.
CO5: Make effective presentations by developing public speaking abilities

Suggested Software:

1. Walden Infotech
2. Young India Films

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. Oxford Press.2018.

2. Taylor Grant: *English Conversation Practice*, Tata McGraw-Hill Education India,2016

3. Hewing's, Martin. Cambridge *Academic English* (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2nd Ed),Kindle, 2013

Web Resources:

Spoken English:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net

4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

Voice & Accent:

1. https://www.youtube.com/user/letstalkaccent/videos
2. https://www.youtube.com/c/EngLanguageClub/featured
3. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year II Semester

23CHE202 CHEMISTRY LABORATORY

L	T	P	C
0	0	2	1

Course Objectives:

20. Verify the fundamental concepts with experiments.

List of Experiments:

1. Measurement of 10Dq by spectrophotometric method
2. Conductometric titration of strong acid vs. strong base
3. Conductometric titration of weak acid vs. strong base
4. Determination of cell constant and conductance of solutions
5. Potentiometry - determination of redox potentials and emfs
6. Determination of Strength of an acid in Pb-Acid battery
7. Preparation of a Bakelite
8. Verify Lambert-Beer's law
9. Wavelength measurement of sample through UV-Visible Spectroscopy
10. Identification of functional groups in simple organic compounds by IR
11. Preparation of nanomaterials by precipitation method
12. Estimation of Ferrous Iron by Dichrometry

Course Outcomes:

At the end of the course, the students will be able to
CO1: Determine the cell constant and conductance of solutions.
CO2: Prepare advanced polymer Bakelite materials.
CO3: Measure the strength of an acid present in secondary batteries.
CO4: Measure the wavelength of absorption of some organic compounds using UV-Vis spectroscopy.
CO5: Determine the EMF & redox potentials using potentiometric titrations.

Reference Books:

1. Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C.Denney, J.D.Barnes and B. Sivasankar

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year II Semester

23ME201 ENGINEERING WORKSHOP

L	T	P	C
0	0	3	1.5

Course Objectives:

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

List of Experiments

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.
   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridlejoint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire punctureand change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make the following connections.
   a) Parallel and series b) Two-way switch c) Godown lighting
   d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

Course Outcomes:

CO1: Identify workshop tools and their operational capabilities.
CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding.
CO3: Apply fitting operations in various applications.
CO4: Apply basic electrical engineering knowledge for House Wiring Practice

Textbooks:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, MediaPromoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; AtulPrakashan, 2021-22.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year II Semester

23ECE201 NETWORK ANALYSIS AND SIMULATION LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

- To gain hands on experience in verifying Kirchoff's laws and network theorems
- To analyze transient behavior of circuits
- To study resonance characteristics
- To determine 2-port network parameters

List of Experiments:

The following experiments need to be performed using both Hardware and simulation Software.

The experiments need to be simulated using software and the same need to be verified using the hardware.

1. Study of components of a circuit and Verification of KCL and KVL.
2. Verification of mesh and nodal analysis for AC circuits
3. Verification of Superposition, Thevenin's & Norton theorems for AC circuits
4. Verification of maximum power transfer theorem for AC circuits
5. Verification of Tellegen's theorem for two networks of the same topology.
6. Study of DC transients in RL, RC and RLC circuits
7. To study frequency response of various 1st order RL & RC networks
8. To study the transient and steady state response of a 2nd order circuit by varying its various parameters and studying their effects on responses
9. Find the Q Factor and Bandwidth of a Series and Parallel Resonance circuit.
10. Determination of open circuit (Z) and short circuit (Y) parameters
11. Determination of hybrid (H) and transmission (ABCD) parameters
12. To measure two port parameters of a twin-T network and study its frequency response.

Hardware Requirements:

Regulated Power supplies, Analog/Digital Function Generators, Digital Multimeters, Decade Resistance Boxes/Rheostats, Decade Capacitance Boxes, Ammeters (Analog or Digital), Voltmeters (Analog or Digital), Active & Passive Electronic Components

Software requirements:

Multisim/ Pspice/Equivalent simulation software tool, Computer Systems with required specifications

Course Outcomes:

CO1: Verify Kirchoff's laws and network theorems.

CO2: Measure time constants of RL & RC circuits.

CO3: Analyze behavior of RLC circuit for different cases.

CO4: Design resonant circuit for given specifications.

CO5: Characterize and model the network in terms of all network parameters.

Reference Books:

1. Network Analysis – ME Van Valkenburg, Prentice Hall of India, revised 3rd Edition,2019.

2. Engineering Circuit Analysis by William H. Hayt, Jack Kemmerly, Jamie Phillips,Steven M. Durbin, 9th Edition 2020.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech I Year II Semester

23HUM201 HEALTH AND WELLNESS, YOGA AND SPORTS

L	T	P	C
0	0	1	0.5

Course Objectives:

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

UNIT I **5 hours**

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index(BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT II **5 hours**

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III **5 hours**

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
ii) Practicing general and specific warm up, aerobics
iii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Course Outcomes:

After completion of the course the student will be able to

CO1: Understand the importance of yoga and sports for Physical fitness and sound health.

CO2: Demonstrate an understanding of health-related fitness components.

CO3: Compare and contrast various activities that help enhance their health.

CO4: Assess current personal fitness levels.

CO5: Develop Positive Personality

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning,2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty,
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. HumanKinetics, Inc.2014

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as manyas Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting vivavoce on the subject.

II Year I Semester

B. Tech II Year I Semester

23HUM101 UNIVERSAL HUMAN VALUES

L	T	P	C
2	1	0	3

Course Prerequisite: None or Universal Human Values I (desirable)

Course Description :

The course has 28 lectures and 14 tutorials in 5 Units. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions. The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

Course Objectives: None. Universal Human Values-I (desirable)

The main objectives of the course is to

1. help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure happiness and prosperity in continuity, which are the core aspirations of all human beings.
2. facilitate the development of a Holistic perspective among students towards life and profession based on right understanding of the Human reality, family, society and the rest of nature. Such holistic perspective forms the basis of Universal Human Values (UHV) and movement towards value-based living in a natural way.
3. highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. aid the students to realize their full human potential and act accordingly.
5. assist the students to live with feeling of relationship, harmony and co-existence.

UNIT I INTRODUCTION TO VALUE EDUCATION 9 hours

Lecture 1: Understanding Value Education
Lecture 2: self-exploration as the Process for Value Education
Tutorial 1: Practice Session PS1 - Sharing about Oneself
Lecture 3: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 - Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 - Exploring Natural Acceptance

UNIT II HARMONY IN THE HUMAN BEING 9 hours

Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 - Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 - Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 - Exploring Harmony of self with the body

UNIT III HARMONY IN THE FAMILY AND SOCIETY **9 hours**

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 - Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 - Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 - Exploring Systems to fulfil Human Goal

UNIT IV HARMONY IN THE NATURE/EXISTENCE **9 hours**

Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 - Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 - Exploring Co-existence in Existence.

UNIT V IMPLICATIONS OF THE HOLISTIC UNDERSTANDING – A LOOK AT PROFESSIONAL ETHICS **9 hours**

Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 - Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 - Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 - Exploring Steps of Transition towards Universal Human Order

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the Natural Acceptance and basic human aspiration.
CO2: Aware of themselves and self-regulation.
CO3: Recognize human-human relationship (Justice) and identify human goals in the society.
CO4: Appreciate the harmony in the nature and existence.
CO5: Develop as socially and ecologically responsible engineers in handling problems with sustainable solutions (user-friendly and eco-friendly).

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

2. R R Gaur, R Asthana, G P Bagaria,Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Online Learning Resources

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview
10. https://uhv.org.in/

11. https://www.youtube.com/@UniversalHumanValues/playlists
12. https://fdp-si.aicte-india.org/index.php

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year I Semester

23MAT106 COMPLEX VARIABLES AND PROBABILITY THEORY

L	T	P	C
3	0	0	3

Course Prerequisite: 23MAT101 & 23MAT102

Course Description:

This course covers the Complex functions and their analyticity, complex integration, Taylor and Laurent series expansions and Calculus of Residues. The course also deals Probability, Bayes theorem, Univariate random variables and its probability distributions, Chebyshev's inequality, Multivariate Random variables and Joint distributions.

Course Objectives:

This course enables students to

1. Analyze the functions of Complex variables and their analyticity.
2. Get Acquainted with complex integration, Laurent series and Calculus of residues.
3. Understand the concepts of Probability, Random Variables and probability distributions.
4. Study operations on the univariate random variable and the transformation of the random variable.
5. Learn multiple random variables, conditional probability, joint distribution, and statistical independence.

UNIT I COMPLEX VARIABLE – DIFFERENTIATION 9 hours

Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method

UNIT II COMPLEX VARIABLE – INTEGRATION 9 hours

Cauchy's theorem, Cauchy Integral formula, Taylor's series, Laurent series, singularities, Cauchy Residue theorem

UNIT III PROBABILITY AND RANDOM VARIABLES 9 hours

Probability through Sets and Probability Definitions and Axioms, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, Independent Events.

The Random variable concept, Distribution and Density functions, Properties, Probability distributions: Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh

UNIT IV OPERATIONS ON UNIVARIATE RANDOM VARIABLE 9 hours

Expectation, Moments-moments about the origin, Central moments, Variance and Skewness, Chebyshev's inequality, moment generating function, characteristic function. Transformations of one dimensional random variable

UNIT V MULTIPLE RANDOM VARIABLES 9 hours

Vector random variables, joint distribution function, joint density function and its properties, conditional distribution and conditional density functions; Statistical independence, Central Limit Theorem, Expected value of a function of random variables, Joint moments, joint characteristic function, Jointly Gaussian random variables, Transformation of multiple random variables

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Examine the concepts of complex functions using CR-equations.

CO2: Evaluate complex contour integrals and Taylor and Laurent series expansions.

CO3: Understand the importance of probability, discrete and continuous probability distributions in engineering

CO4: Apply the operations on one dimensional random variable.

CO5: Get an idea about joint density functions, distribution functions to the random variables and analyze the multivariate problems in engineering

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd Edition, 2012.

2. Peyton Z. Peebles, Probability, Random Variables & Random Signal Principles, TMH, 4th edition, 2001.

Reference Books:

1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," 3rd edition, Pearson Education.

2. A. Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," 4th edition, McGraw-Hill.

3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International

4. R. V Churchill and J. W. Brown, Complex variables and applications by, 8th edition, 2008, McGraw Hill.

5. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year I Semester

23ECE102 SIGNALS AND SYSTEMS

L	T	P	C
2	1	0	3

Course Objectives:

1. Understanding the basics of signals and systems required for ECE courses
2. To teach concepts of signals and systems and its analysis using different transform techniques.
3. To provide basic understanding of random processes which is essential for the random signals and systems encountered in communications and signal Processing areas.

UNIT I **9 hours**

Signals & Systems: Basic definitions and classification of Signals and Systems (Continuous time and discrete time), operations on signals, Concepts of Convolution and Correlation of signals, Analogy between vectors and signals-Orthogonality, mean square error,

Fourier series: Trigonometric & Exponential forms of Fourier series, Properties, Concept of discrete spectrum, Illustrative Problems.

UNIT II **9 hours**

Fourier Transform: Definition, Computation and properties of Fourier transform for different types of signals and systems, Inverse Fourier transform. Sampling: Sampling theorem – Graphical and analytical proof for Band Limited Signals, Reconstruction of signal from its samples, Effect of under sampling – Aliasing. Illustrative Problems.

Laplace Transform: Definition, ROC, Properties, Inverse Laplace transforms, the s-plane and BIBO stability, Transfer functions, System Response to standard signals, Solution of differential equations with initial conditions, Illustrative Problems.

UNIT III **9 hours**

Signal Transmission through Linear Systems: Linear system, impulse response, Response of a linear system for different input signals, linear time-invariant (LTI) system, linear time variant (LTV) system, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, System bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between bandwidth and rise time, Energy and Power spectral densities, Illustrative Problems.

UNIT IV **9 hours**

Random Processes – Temporal Characteristics: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second- Order and Wide-Sense Stationarity, (N-Order) and Strict Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and Its Properties, Cross-Correlation Function and Its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process. Random Signal, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output.

UNIT V **9 hours**

Random Processes – Spectral Characteristics: The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross Correlation Function. Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectrums of Input and Output.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the mathematical description and representation of continuous-time and discrete-time signals and systems, Also, understand the concepts of various transform techniques and Random Processes (L2)

CO2: Apply sampling theorem to convert continuous-time signals to discrete-time signals and reconstruct back, different transform techniques to solve signals and system related problems. (L3)

CO3: Formulate and solve engineering problems involving random processes. (L3)

CO4: Analyze the frequency spectra of various continuous-time signals using different transform methods. (L4)

CO5: Classify the systems based on their properties and determine the response of them. (L4)

Text Books:

1. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", 4th Edition, TMH, 2002.
2. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, "Signals and Systems", 2nd Edition, PHI, 2009.

Reference Books:

1. B.P. Lathi, "Signals, Systems & Communications", 2013, BSP.
2. Athanasios Papoulis and S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, PHI, 2002
3. Simon Haykin and Van Veen, "Signals & Systems", 2nd Edition, Wiley, 2005.
4. Matthew Sadiku and Warsame H. Ali, "Signals and Systems A primer with MATLAB", CRC Press, 2016.
5. Hwei Hsu, "Schaum's Outline of Signals and Systems", 4th Edition, TMH, 2019.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year I Semester

23ECE103 ELECTRONIC DEVICES AND CIRCUITS

L	T	P	C
3	0	0	3

Course Objectives:

1. Students will be able understand the basic principles of all semiconductor devices.
2. Able to analyze diode circuits, various biasing and small signal equivalent circuits of amplifiers, compare the performance of BJTs and MOSFETs
3. Able to design rectifier circuits and various amplifier circuits using BJTs and MOSFETs.

UNIT I **9 hours**

PN junction diode: Band structure of PN Junction, Quantitative Theory of PN Diode, types of PN junction diode, VI Characteristics, PN diode current equation, Diode resistance, Transition and Diffusion Capacitance, effect of temperature on PN junction diode, Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Ripple Factor and Regulation Characteristics, Clipping and Clamping circuits, Voltage doubler, Illustrative problems.

Special Diodes: Zener and Avalanche Breakdowns, VI Characteristics of Zener diode, Zener diode as voltage regulator, Construction, operation and VI characteristics of Tunnel Diode, Varactor Diode, LED, LCD, Photo Diode, SCR and UJT.

UNIT II **9 hours**

Bipolar Junction Transistors: Transistor construction, BJT Operation, Transistor as an Amplifier and as a Switch, Common Emitter, Common Base and Common Collector Configurations, Limits of Operation, BJT Specifications.

Biasing and Stabilization: Operating Point, DC and AC Load Lines, Importance of Biasing, Fixed Bias, Collector to Base Bias, Self-Bias, Bias Stability, Thermal Runaway, Thermal Stability, Illustrative problems.

UNIT III **9 hours**

MOS Field Effect Transistors: Introduction, Device Structure and Physical Operation, CMOS, V - I Characteristics, MOSFET Circuits at DC, MOSFET as an Amplifier and as a Switch. Biasing in MOS Amplifier circuits - biasing by fixing VGS with and without source resistance, biasing using drain to gate feedback resistor, biasing using constant current source, body effect, Problem solving.

UNIT IV **9 hours**

BJT Small Signal Operation and Models- the transconductance, input resistance at the base, input resistance at the emitter, Voltage gain, separating the Signal and the DC Quantities, The Hybrid π Model, the T Model. Single Stage BJT Amplifiers - Common-Emitter (CE) amplifier without and with emitter resistance, Common-Base (CB) amplifier, Common-Collector (CC) amplifier or Emitter Follower, Problem solving.

UNIT V **9 hours**

MOSFET Small Signal Operation Models– the dc bias, separating the DC analysis and the signal analysis, Small signal equivalent circuit models, the transconductance, the T equivalent circuit model, Single stage MOS Amplifiers – common source (CS) amplifier without and with source resistance, common gate (CG) amplifier, source follower, Problem Solving.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand principle of operation, characteristics and applications of Semiconductor diodes, Bipolar Junction Transistor and MOSFETs. (L2)

CO2: Applying the basic principles solving the problems related to Semiconductor diodes, BJTs, and MOSFETs. (L3)

CO3: Analyze diode circuits for different applications such as rectifiers, clippers and clampers also analyze biasing circuits of BJTs, and MOSFETs. (L4)

CO4: Design of diode circuits and amplifiers using BJTs, and MOSFETs. (L4)

CO5: Compare the performance of various semiconductor devices. (L4)

Text Books:

1. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits – Theory and Applications", 6th Edition, Oxford Press, 2013.

2. J. Milliman and C Halkias, "Integrated electronics", 2nd Edition, Tata McGraw Hill, 1991.

Reference Books:

1. Donald A Neamen, "Electronic Circuits – analysis and design", 3rd Edition, McGraw Hill (India), 2019.

2. Behzad Razavi, "Microelectronics", Second edition, Wiley, 2013.

3. R.L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits," 9th Edition, Pearson, 2006.

4. Jimmie J Cathey, "Electronic Devices and Circuits," Schaum's outlines series, 3rd Edition, McGraw-Hill (India), 2010.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year I Semester

23ECE104 DIGITAL CIRCUITS DESIGN

L	T	P	C
2	1	0	3

Course Objectives:

1. Understand the properties of Boolean algebra, logic operations, and minimization of Boolean functions.
2. Analyze combinational and analyze sequential logic circuits.
3. Understand the concepts of FSM and compare various Programmable logic devices.
4. Model combinational and sequential circuits using HDLs.

UNIT I BOOLEAN ALGEBRA, LOGIC OPERATIONS, AND MINIMIZATION OF BOOLEAN FUNCTIONS **9 hours**

Number Systems and Codes, Representation of unsigned and signed integers, Floating Point representation of real numbers, Laws of Boolean Algebra, Theorems of Boolean Algebra, Realization of functions using logic gates, Canonical forms of Boolean Functions, Minimization of Functions using Karnaugh Maps.

UNIT II COMBINATIONAL LOGIC CIRCUITS **9 hours**

Combinational circuits, Design with basic logic gates, design procedure, adders, subtractors, 4-bit binary adder/ subtractor circuit, BCD adder, carry look- a-head adder, binary multiplier, magnitude comparator, data selectors, priority encoders, decoders, multiplexers, demultiplexers.

UNIT III HARDWARE DESCRIPTION LANGUAGE **9 hours**

Introduction to Verilog - structural specification of logic circuits, behavioral specification of logic circuits, hierarchical Verilog Code, Verilog for combinational circuits - conditional operator, if-else statement, case statement, for loop using storage elements with CAD tools-using Verilog constructs for storage elements, flip-flop with clear capability, using Verilog constructs for registers and counters.

UNIT IV SEQUENTIAL LOGIC CIRCUITS **9 hours**

Basic architectural distinction between combinational and sequential circuits, Design procedure, latches, flip-flops, truth tables and excitation tables, timing and triggering consideration, conversion of flip- flops, design of counters, ripple counters, synchronous counters, ring counter, Johnson counter, registers, shift registers, universal shift register.

UNIT V FINITE STATE MACHINES AND PROGRAMMABLE LOGIC DEVICES **9 hours**

Types of FSM, capabilities and limitations of FSM, state assignment, realization of FSM using flip-flops, Mealy to Moore conversion and vice-versa, reduction of state tables using partition technique, Design of sequence detector. Types of PLD's: PROM, PAL, PLA, basic structure of CPLD and FPGA, advantages of FPGAs, Design of sequential circuits using ROMs, PLAs, CPLDs and FPGAs.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand the properties of Boolean algebra, logic operations, concepts of FSM (L2)
CO2: Apply techniques for minimization of Boolean functions (L3)
CO3: Analyze combinational and Sequential logic circuits. (L4)
CO4: Compare various Programmable logic devices. (L4)
CO5: Design and Model combinational and sequential circuits using HDLs. (L5, L6)

Text Books:

1. M. Morris Mano, "Digital Design", 3rd Edition, PHI. (Unit I to IV)
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", 3rd Edition, McGraw-Hill (Unit V)

Reference Books:

1. Charles H. Roth, Jr, "Fundamentals of Logic Design", 4th Edition, Jaico Publishers.
2. Zvi Kohavi and Niraj K. Jha, "Switching and Finite Automata Theory, 3rd Edition, Cambridge University Press, 2010.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", 2nd Edition, Prentice Hall PTR.
4. D.P. Leach, A.P. Malvino, "Digital Principles and Applications", TMH, 7th Edition.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year I Semester

23ECE202 ELECTRONIC DEVICES AND CIRCUITS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. Verify the theoretical concepts practically from all the experiments.
2. Analyse the characteristics of Diodes, BJT, MOSFET, UJT.
3. Design the amplifier circuits from the given specifications.
4. Model the electronic circuits using tools such as PSPICE/Multisim.

List of Experiments:

Note: Any 12 experiments Shall be implemented using Hardware / Software.

1. Verification of Volt- Ampere characteristics of a PN junction diode and find static, dynamic and reverse resistances of the diode from the graphs obtained.
2. Design a full wave rectifier for the given specifications with and without filters, and verify the given specifications experimentally. Vary the load and find ripple factor. Draw suitable graphs.
3. Verify various clipping and clamper circuits using PN junction diode and draw the suitable graphs.
4. Design a Zener diode-based **voltage regulator** against variations of supply and load. Verify the same from the experiment.
5. Study and draw the **output** and **transfer** characteristics of MOSFET (Enhance mode) in Common Source Configuration experimentally. Find **Threshold voltage (V_T), g_m, & K** from the graphs.
6. Study and draw the **output** and **transfer** characteristics of MOSFET (Depletion mode) or JFET in Common Source Configuration experimentally. Find **I_{DSS}, g_m, & V_P** from the graphs.
7. Verification of the input and output characteristics of BJT in **Common Emitter** configuration experimentally and find required **h – parameters** from the graphs.
8. Study and draw the input and output characteristics of BJT in **Common Base** configuration experimentally and determine required **h – parameters** from the graphs.
9. Study and draw the Volt Ampere characteristics of UJT and determine **η, I_P, I_v, V_P, &Vv** from the experiment.
10. Design and analysis of voltage- divider bias/self-bias circuit using BJT.
11. Design and analysis of self-bias circuit using MOSFET.
12. Design a suitable circuit for switch using MOSFET/BJT.
13. Design a small signal amplifier using MOSFET (common source) for the given specifications. Draw the frequency response and find the bandwidth.
14. Design a small signal amplifier using BJT (common emitter) for the given specifications. Draw the frequency response and find the bandwidth.

Hardware Requirements:

DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

Software requirements:

Multisim/ Pspice/Equivalent simulation software tool, Computer Systems with required specifications

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand the characteristics and applications of basic electronic devices. (L2)
CO2: Plot the characteristics of electronic devices. (L3)
CO3: Analyze various biasing circuits and electronic circuits as amplifiers (L4).
CO4: Design MOSFET / BJT based amplifiers for the given specifications. (L5)
CO5: Simulate all circuits in PSPICE /Multisim. (L5).

Reference Books:

1. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuit Theory", 13th edition, Pearson, 2014.
2. Behzad Razavi, "Fundamentals of Microelectronics", 2nd edition, Wiley, 2013.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech II Year I Semester

23ECE203 DIGITAL CIRCUITS AND SIGNAL SIMULATION LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. Verify the truth tables of various logic circuits.
2. Design sequential/combinational circuit using Hardware Description Language and verify their functionality.
3. Simulate various Signals and Systems through MATLAB
4. Analyze the output of a system when it is excited by different types of deterministic and random signals.

List of Experiments:

PART A

1. Design a simple combinational circuit with four variables and obtain minimal SOP expression and verify the truth table using Digital Trainer Kit.
2. Verification of functional table of 3 to 8-line Decoder /De-multiplexer
3. 4 variable logic function verification using 8 to1 multiplexer.
4. Design full adder circuit and verify its functional table.
5. Design a four-bit ring counter using D Flip–Flops/JK Flip Flop and verify output.
6. Design a four-bit Johnson's counter using D Flip-Flops/JK Flip Flops and verify output
7. Verify the operation of 4-bit Universal Shift Register for different Modes of operation.
8. Draw the circuit diagram of MOD-8 ripple counter and construct a circuit using T-Flip-Flops and Test It with a low frequency clock and sketch the output waveforms.
9. Design MOD–8 synchronous counter using T Flip-Flop and verify the result and sketch the output waveforms.
10. (a) Draw the circuit diagram of a single bit comparator and test the output
    (b) Construct 7 Segment Display Circuit Using Decoder and7 Segment LED and test it.

Note: Any 8 experiments. Design and verify combinational and sequential circuits using Hardware Description Language

PART B

1. Write a program to generate various Signals and Sequences: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc function.
2. Perform operations on Signals and Sequences: Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
3. Write a program to find the trigonometric & exponential Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings- Plot the discrete spectrum of the signal.
4. Write a program to find Fourier transform of a given signal. Plot its amplitude and phase spectrum.
5. Write a program to convolve two discrete time sequences. Plot all the sequences.
6. Write a program to find autocorrelation and cross correlation of given sequences.
7. Write a program to verify Linearity and Time Invariance properties of a given Continuous System.

8. Write a program to generate discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
9. Write a program to find magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale.
10. Write a program to generate Complex Gaussian noise and find its mean, variance, Probability Density Function (PDF) and Power Spectral Density (PSD).
11. Generate a Random data (with bipolar) for a given data rate (say 10kbps). Plot the same for a time period of 0.2 sec.
12. To plot pole-zero diagram in S-plane of given signal/sequence and verify its stability.

Note: Any 10 experiments. All the experiments are to be simulated using MATLAB or equivalent software.

Hardware Requirements:
Logic gates, Digital ICs, DC power supplies,

Software requirements:
MATLAB, Computer Systems with required specifications

Course Outcomes:
Upon successful completion of the course, students will be able to

CO1: Verify the truth tables of various logic circuits. (L2)
CO2: Understand how to simulate different types of signals and system response. (L2)
CO3: Design sequential and combinational logic circuits and verify their functionality. (L3, L4)
CO4: Analyze the response of different systems when they are excited by different signals and plot power spectral density of signals. (L4)
CO5: Generate different random signals for the given specifications. (L5)

Reference Books:

1. M. Morris Mano, "Digital Design", 3rd Edition, PHI

2. Stephen J. Chapman, "MATLAB Programming for Engineers", Cengage, November 2012

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech II Year I Semester
Audit Course

23CHE901 ENVIRONMENTAL SCIENCE

L	T	P	C
2	0	0	0

Course Objectives:
This course enables students to

1. To make the students to get awareness of the environment.
2. To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life
3. To save the earth from the inventions by the engineers.

UNIT I MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES 6 hours

Definition, Scope, and Importance – Need for Public Awareness.
Natural Resources: Energy resources**-** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

UNIT II ECOSYSTEMS 7 hours

Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a) Forest ecosystem.
b) Grassland ecosystem
c) Desert ecosystem.
d) Aquatic ecosystems (freshwater - ponds, streams, lakes, rivers, marine ecosystem- oceans, estuaries)

Biodiversity and its Conservation : Introduction, Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Specific case studies.

UNIT III ORDERED STRUCTURES 6 hours

Definition, Cause, effects, and control measures of:
Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards
Pollution case studies - Role of an individual in the prevention of pollution

Solid Waste Management: Causes**,** effects and control measures of urban and industrial wastes
Disaster management: floods, earthquakes, cyclones and landslides.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 5 hours

Sustainable Development Goals, From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rainwater harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6 hours

Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies.

Field Work: Visit a local area to document environmental assets River/forest grassland/hill/mountain – Polluted site - Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Exploring different types of renewable and non-renewable energy sources.

CO2: Students will learn about the structure and function of different ecosystems.
CO3: Students will learn about different types of pollution (air, water, soil) and their sources, effects, and control measures.
CO4: Exploring the science behind climate change, its evidence, and its impacts on ecosystems and human societies.
CO5: Understanding demographic factors and their environmental implications.

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press, Third Edition, 2021.
2. Palaniswamy, “Environmental Studies”, Pearson Education, Second Edition, 2014.
3. S. Azeem Unnisa, “Environmental Studies” Academic Publishing Company
4. K. Raghavan Nambiar, “Textbook of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd. Second Edition, 2008.
5. A. Koushik & C. P. Koushik, Perspectives in Environmental Studies, New Age International, Fourth Edition, 2006.

Reference Books:

1. Deeksha Dave and E. Sai Baba Reddy, “Textbook of Environmental Science”, Cengage Publications, Second Edition, 2012.
2. M. Anji Reddy, “Textbook of Environmental Sciences and Technology”, BS Publication, Second Edition, 2023.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, Third Edition, 2009.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice Hall of India Private Limited, Second Edition, 2004.
5. G.R. Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House, Fourth Edition, 2014.
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science, Prentice Hall of India Private Limited, Third Edition, 2007.

Online Resources:

1. Atika Qazi; Fayaz Hussain; Nasrudin ABD. Rahim; Glenn Hardaker; Daniyal Alghazzaw, "Towards sustainable energy: a systematic review of renewable energy sources, technologies, and public opinions," 10.1109/ACCESS.2019.2906402, IEEE Access, vol. 7, pp. 63837-63851, 2019.
2. Gina Garland, Samiran Banerjee, Anna Edlinger, Emily Miranda Oliveira, Chantal Herzog, Raphaël Wittwer, Laurent Philippot, Fernando T. Maestre, Marcel G. A. van der Heijden, "A closer look at the functions behind ecosystem multifunctionality: A review," https://doi.org/10.1111/1365-2745.13511, Journal of Ecology, vol. 109, no. 2, pp. 600-613, 2021.
3. Siddiqua, A, Hahladakis, J.N. and Al-Attiya, “An overview of the environmental pollution and health effects associated with waste landfilling and open dumping,” https://doi.org/10.1007/s11356-022-21578-z, Environmental Science and Pollution Research, 29(39), pp.58514-58536, 2022.
4. Seddon N, Chausson A, Berry P, Girardin C.A, Smith A. and Turner B, “Understanding the value and limits of nature-based solutions to climate change and other global challenges,” https://doi.org/10.1098/rstb.2019.0120, Philosophical Transactions of the Royal Society B, 375(1794), p.20190120, 2020.
5. Hannes Weber and Jennifer Dabbs Sciubba, "The effect of population growth on the environment: evidence from European regions," https://doi.org/10.1007/s10680-018-9486-0, European Journal of Population, vol. 35, pp. 379-402, 2019.

Mode of Evaluation: Assignments and Mid Term Tests

II Year II Semester

B. Tech II Year II Semester

23HUM102 ECONOMICS AND FINANCIAL ACCOUNTING FOR ENGINEERS

L	T	P	C
2	0	0	2

Course Prerequisite: NIL

Course Description:

The Engineering Economics and Financial Accounting aims to provide an insight into production, cost analysis, market structure, Accounting Basic concepts and financial Statement Analysis. The course is designed to give emphasis on the application of real life examples on various fundamental issues of economics and accounts. This course introduces the accounting system, principles, types of accounts, and financial statements etc. The ratio analysis and financial analysis are useful to know the positions of financial statements are explained to know the analysis of financial matters.

Course Objectives:

This course enables students to

1. Describe the nature of engineering economics in dealing with the issues of scarcity;

2. Know the supply, demand, production and cost analysis to analyze the impact of economic events on markets;

3. Explain the different market structures and price determination in various market conditions.

4. Explain the accounting principles, types of accounting and preparation of final accounts; and

5. Describe the financial statement analysis and investment evaluation through ratios and capital budgeting techniques.

UNIT I DEMAND ANALYSIS **6 hours**

Scope and Significance of Economics- Elements of market Economy: Demand, Supply and Market Equilibrium- Theory of Demand, Elasticity of Demand, Supply and Law of Supply.

UNIT II PRODUCTION AND COST ANALYSIS **6 hours**

Production Function – Short-run and long-run production – Cost Analysis: Cost concepts - Cost Structure of Firms and Output Decision- Break-Even Analysis (BEA) – significance and Limitations of BEA - Determination of Break Even Point (Simple Problems).

UNIT III MARKET STRUCTURE AND PRICING **6 hours**

Classification of Markets - General Equilibrium and efficiency of Perfect competition, Monopoly, Monopolistic – Price determination under Perfect, Monopoly, and Monopolistic Competition, Pricing objectives- Pricing Strategies.

UNIT IV BASICS OF ACCOUNTING **6 hours**

Accounting - Double Entry System - Accounting Principles - Classification of Accounts - Rules of Debit & Credit- Accounting Cycle: Journal, Ledger, Trial Balance. Final Accounts: Trading Account - Profit & Loss Account - Balance Sheet with Adjustments, (Simple Problems).

UNIT V FINANCIAL RATIO ANALYSIS AND CAPITAL BUDGETING **6 hours**

Ratio Analysis - Liquidity, Solvency, Activity and Profitability Ratios - Capital Budgeting. (Simple Problems).

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand Engineering economics basic concepts,

CO2: Analyze the concepts of demand, elasticity, supply, Production, Cost Analysis and its essence in floating of an organization,

CO3: Compare various different market structures and identify suitable market,

CO4: Demonstrate an understanding and analyzing the accounting statements, and

CO5: Exhibit the ability to apply knowledge of ratio analysis and capital budgeting techniques in financial statement analysis and investment evaluation respectively.

Text Books:

1. Case E. Karl & Ray C. Fair, "Principles of Economics", Pearson Education, 8th Edition, 2007
2. Aryasri: Business Economics and Financial Analysis, 4/e. MGH.
3. Financial Accounting, S. N. Maheshwari, Sultan Chand, 2009
4. Varshney & Maheswari: Management Economics, Sultan Chand
5. Financial Statement Analysis, Khan and Jain, PHI, 2009
6. Financial Management, Prasanna Chandra, T.M.H, 2009

Reference Books:

1. Lipsey, R. G. & K. A. Chrystal , "Economics", Oxford University Press, 11th Edition, 2007
2. Samuelson P. A. & Nordhaus W. D. "Economics", Tata McGraw-Hill 18th Edition, 2007
3. Financial Management and Policy, Van Horne, James, C., Pearson, 2009.
4. Financial Management, I. M. Pandey, Vikas Publications

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year II Semester

23ECE105 LINEAR CONTROL SYSTEMS

L	T	P	C
2	1	0	3

Course Objectives:

1. Introduce the basic principles and applications of control systems.
2. Learn the time response and steady state response of the systems.
3. Know the time domain analysis and solutions to time invariant systems.
4. Understand different aspects of stability analysis of systems in frequency domain.
5. Understand the concept of state space, controllability and observability.

UNIT I **9 hours**

Control Systems Concepts: Open loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feedback characteristics, Effects of positive and negative feedback, Mathematical models – Differential equations of translational and rotational mechanical systems and electrical systems, Analogous Systems, Block diagram reduction methods – Signal flow graphs - Reduction using Mason's gain formula. Controller components, DC Servomotor and AC Servomotor- their transfer functions, Synchros.

UNIT II **9 hours**

Time Response Analysis: Step Response - Impulse Response - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants, Study of effects and Design of P, PI, PD and PID Controllers on second order system.

UNIT III **9 hours**

Stability Analysis in Time Domain: The concept of stability – Routh's stability criterion – Stability and conditional stability - 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.

UNIT IV **9 hours**

Frequency Response Analysis: Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram - Stability Analysis from Bode Plots. Polar Plots- Nyquist Plots- Phase margin and Gain margin-Stability Analysis.

Compensation techniques – Study of Effects and Design of Lag, Lead, Lag-Lead Compensator design in frequency Domain on a second order system.

UNIT V **9 hours**

State Space Analysis of Continuous Systems: Concepts of state, state variables and state model - differential equations & Transfer function models - Block diagrams. Diagonalization, Transfer function from state model, solving the Time invariant state Equations- State Transition Matrix and it's Properties. System response through State Space models. The concepts of controllability and observability, Duality between controllability and observability.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Summarize the basic principles and applications of control systems. (L2)
CO2: Understand the time response and steady state response of the systems. (L2)
CO3: Understand the concept of state space, controllability and observability. (L2)
CO4: Apply time domain analysis to find solutions to time invariant systems. (L3)
CO5: Analyze different aspects of stability analysis of systems in frequency domain. (L4)

Text Books:

1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 5th Edition, 2010.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited Publishers, 5th Edition, 2007.

Reference Books:

1. M. Gopal, "Control Systems Principles & Design b", 4th Edition, McGraw Hill Education, 2012.
2. B. C. Kuo and Farid Golnaraghi, "Automatic Control Systems by", John wiley and sons, 8th Edition, 2003.
3. Joseph J Distefano III, Allen R Stubberud & Ivan J Williams, "Feedback and Control Systems", 2nd Edition, Schaum's outlines, McGraw Hill Education, 2013.
4. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado, "Control System Design", Pearson, 2000.
5. Gene F. Franklin, J.D. Powell and Abbas Emami- Naeini, "Feedback Control of Dynamic Systems by", 6th Edition, Pearson, 2010.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year II Semester

23ECE106 EM WAVES AND TRANSMISSION LINES

L	T	P	C
3	0	0	3

Course Objectives:

1. To understand and analyze different laws and theorems of electrostatic fields.
2. To study and analyze different laws and theorems of magnetostatic fields.
3. Analyzing Maxwell's equations in different forms.
4. To learn the concepts of wave theory and its propagation through various mediums.
5. To get exposure to the properties of transmission lines.

UNIT I **9 hours**

Review of Co-ordinate Systems, **Electrostatics:** Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss Law and Applications, Electric Potential, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Illustrative Problems. Convection and Conduction Currents, Dielectric Constant, Poisson's and Laplace's Equations; Capacitance – Parallel Plate, Coaxial Capacitors, Illustrative Problems.

UNIT II **9 hours**

Magnetostatics: Biot-Savart 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, Ampere's Force Law, Inductances and Magnetic Energy, Illustrative Problems**.**

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer EMF, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements, Conditions at a Boundary Surface, Illustrative Problems.

UNIT III **9 hours**

EM Wave Characteristics: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations Between E & H, Sinusoidal Variations, Wave Propagation in Lossy dielectrics, lossless dielectrics, free space, wave propagation in good conductors, skin depth, Polarization & Types, Illustrative Problems.

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem, Illustrative Problems.

UNIT IV **9 hours**

Transmission Lines - I: Types, Parameters, T & π Equivalent Circuits, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line, Lossless lines, distortion less lines, Illustrative Problems.

UNIT V **9 hours**

Transmission Lines – II: Input Impedance Relations, Reflection Coefficient, VSWR, Average Power, Shorted Lines, Open Circuited Lines, and Matched Lines, Low loss radio frequency and UHF Transmission lines, UHF Lines as Circuit Elements, Smith Chart – Construction and Applications, Quarter wave transformer, Single Stub Matching, Illustrative Problems.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Learn the concepts of wave theory and its propagation through various mediums. (L2)
CO2: Understand the properties of transmission lines and their applications. (L2)
CO3: Apply the laws & theorems of electrostatic fields to solve the related problems (L3)
CO4: Gain proficiency in the analysis and application of magnetostatic laws and theorems (L4).
CO5: Analyze Maxwell's equations in different forms. (L4)

Text Books:

1. Matthew N.O. Sadiku, "Elements of Electromagnetics", 4th Edition, Oxford University Press, 2008.
2. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, 2000.

Reference Books:

1. G. S. N. Raju, "Electromagnetic Field Theory and Transmission Lines", 2nd Edition, Pearson Education, 2013.
2. William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", 7th Edition, Tata McGraw Hill, 2006.
3. John D. Krauss, "Electromagnetics", 3rd Edition, McGraw Hill, 1988.
4. John D. Ryder, "Networks, Lines, and Fields",2nd Edition, PHI publications, 2012.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year II Semester

23ECE107 ANALOG CIRCUITS

L	T	P	C
3	0	0	3

Course Objectives:

1. Understand the characteristics of Differential amplifiers, feedback and power amplifiers.
2. Analyze the response of tuned amplifiers
3. Categorize different oscillator circuits based on the application
4. Design the electronic circuits for the given specifications and for a given application.

UNIT I Multistage and Differential Amplifiers 9 hours

Introduction –Classification of Amplifiers- Distortion in amplifiers, Coupling Schemes, RC Coupled Amplifier using BJT, Cascaded RC Coupled BJT Amplifiers, Cascode amplifier, Darlington pair, the MOS Differential Pair, Small-Signal Operation of the MOS Differential Pair, The BJT Differential Pair, and other Nonideal Characteristics of the Differential Amplifier.

UNIT II Frequency Response 9 hours

Low-Frequency Response of the CS and CE Amplifiers, Internal Capacitive Effects and the High-Frequency Model of the MOSFET and the BJT, High-Frequency Response of the CS, follower, CE, CG and Cascode Amplifiers,

UNIT III Feedback Amplifiers 9 hours

Feedback Amplifiers: Introduction, The General Feedback Structure, Some Properties of Negative Feedback, The Four Basic Feedback Topologies, The Feedback Voltage Amplifier (Series-Shunt), The Feedback Transconductance Amplifier (Series-Series), The Feedback Trans-Resistance Amplifier (Shunt-Shunt), The Feedback Current Amplifier (Shunt-Series).

UNIT IV Oscillators and Tuned Amplifiers 9 hours

Oscillators: General Considerations, Phase Shift Oscillator, Wien-Bridge Oscillator, LC Oscillators, Relaxation Oscillator, Crystal Oscillators, Illustrative Problems.

Tuned Amplifiers: Basic Principle, Use of Transformers, Single Tuned Amplifiers, Amplifiers with multiple Tuned Circuits, Stagger Tuned Amplifiers.

UNIT V Power Amplifiers 9 hours

Introduction, Classification of Output Stages, Class A Output Stage, Class B Output Stage, Class AB Output Stage, Biasing the Class AB Circuit, CMOS Class AB Output Stages, Power BJTs, Variations on the Class AB Configuration, MOS Power Transistors.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand the characteristics of differential amplifiers, feedback and power amplifiers. (L2)
CO2: Examine the frequency response of multistage and differential amplifier circuits using BJT & MOSFETs at low and high frequencies. (L3)
CO3: Investigate different feedback and power amplifier circuits based on the application. (L4)
CO4: Derive the expressions for frequency of oscillation and condition for oscillation of RC and LC oscillator circuits (L4). Evaluate the performance of different tuned amplifiers (L5)
CO5: Design analog circuits for the given specifications and application. (L6)

Text Books:

1. Millman and Halkias, "Integrated Electronics", 4th Edition, McGraw Hill Education (India) Private Ltd., 2015.
2. Adel. S. Sedra and Kenneth C. Smith, "Micro Electronic Circuits," 6th Edition, Oxford University Press, 2011.

Reference Books:

1. Behzad Razavi, "Fundamentals of Micro Electronics", Wiley, 2010.
2. Donald A Neamen, "Electronic Circuits – Analysis and Design," 3rd Edition, McGraw Hill (India), 2019.
3. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory", 9th Edition, Pearson/Prentice Hall, 2006.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year II Semester

23ECE108 ANALOG COMMUNICATION

L	T	P	C
3	0	0	3

Course Objectives:

1. Understand the transmission of random signal both in time and frequency domain.
2. Analyse various amplitude modulation and demodulation techniques.
3. Evaluate the performance of angle modulation and demodulation in the presence of noise.
4. Understand sampling theorem and various analog pulse modulation techniques.
5. Understand the concepts of information theory, source coding and channel coding techniques.

UNIT I RANDOM PROCESS FOR COMMUNICATION 9 hours

Elements of an electrical communication system, Characteristics of communication channel and their mathematical modeling, Signal models: deterministic and random, Random variable, Random Process, Mean and Variance of random process, Stationary Processes, Ergodic Processes, Transmission through LTI, Principles and properties of Autocorrelation and cross correlation, Power spectral density. Gaussian process, White process, Central Limit Theorem.

UNIT II AMPLITUDE MODULATION SYSTEMS 9 hours

Amplitude modulation: Concepts of Modulation, Continuous wave (CW) modulation: amplitude modulation (AM) - double sideband (DSB); double sideband suppressed carrier (DSBSC); single sideband suppressed carrier (SSBSC) and vestigial sideband (VSB) modulation and demodulation. Noise: External and internal sources of noise, Thermal noise, Representation of narrowband noise; receiver model- Tuned radio frequency receiver, Superheterodyne receiver, signal to noise ratio (SNR), noise figure, Noise temperature, Equivalent noise bandwidth, Noise in Amplitude Modulation: DSB-SC, SSB-SC and AM system,

UNIT III ANGLE MODULATION SYSTEMS 9 hours

Angle modulation: Concepts of Instantaneous frequency and phase, phase modulation (PM) & frequency modulation (FM) and demodulation; Bandwidth of FM, Wideband and Narrowband FM, Concept of Frequency division multiplexing.

Noise in angle modulation systems: Noise in FM and PM, Pre-emphasis and De-emphasis in FM, Threshold effect in angle modulation.

UNIT IV ANALOG PULSE MODULATION SCHEMES 9 hours

Sampling process, sampling theorem, signal reconstruction, flat-top sampling of band pass signals, Analog Pulse Modulation, Types of analog pulse modulation, Method of generation and detection of PAM, PWM, PPM, Spectra of pulse modulation, concepts of pulse code modulation.

UNIT V INFORMATION THEORY & CHANNEL CAPACITY 9 hours

Measure of information, Entropy, Source Coding Theorem, Hamming weight and distance, Syndrome Coding, Shannon Fano and Huffman Coding, Discrete memory less channels, Channel Coding, Error Control Codes, Linear block code and convolutional codes, Nyquist bandwidth, Shannon-Hartley capacity theorem.

Course Outcomes:

After completing the course, the student will be able to:

CO1: Analyze the transmission of random signal both in time and frequency domain.
CO2: Analyze the amplitude modulation and demodulation techniques in communication systems
CO3: Analyze the angle modulation and demodulation techniques in communication systems
CO4: Understand the concepts of anlog pulse modulation.
CO5: Use source and channel coding technique to improve system performance.

Text Books:

1. Simon Haykin & Michael Moher, "Communication Systems", John Wiley & Sons, 5th Edition, 2010.
2. B. P. Lathi and Z. Ding, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford, 2011.

Reference Books:

1. H Taub & D. Schilling, Gautam Sahe, "Principles of Communication Systems", 3rd Edition, Tata McGraw Hill, 2007.
2. H.P. Hsu, "Analog and Digital Communication", 3rd Edition, McGraw Hill Education, 2017.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech II Year II Semester

23ECE204 ANALOG CIRCUITS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. Plot the characteristics of Differential amplifiers, feedback and power amplifiers.
2. Analyze the response of tuned amplifiers and multivibrators.
3. Categorize different oscillator circuits based on the application.
4. Design the electronic circuits for the given specifications and for a given application.

List of Experiments:

1. Design and Analysis of Darlington pair.
2. Frequency response of CE – CC multistage Amplifier
3. Design and Analysis of Cascode Amplifier.
4. Frequency Response of Differential Amplifier
5. Design and Analysis of any two topologies of feedback amplifies and find the frequency response of it
6. Design and Analysis of Class A power amplifier
7. Design and Analysis of Class AB amplifier
8. Design and Analysis of RC phase shift oscillator
9. Design and Analysis of LC Oscillator
10. Frequency Response of Single Tuned amplifier
11. Design a Bistable Multivibrator and analyze the effect of commutating capacitors and draw the wave forms at base and collector of transistors.
12. Design an Astable Multivibrator and draw the wave forms at base and collector of transistors.
13. Design a Monostable Multivibrator and draw the input and output waveforms.
14. Draw the response of Schmitt trigger for gain of greater than and less than one.

Note: At least 12 experiments shall be performed.

Faculty members who are handling the laboratory shall see that students are given design specifications for a given circuit appropriately and monitor the design and analysis aspects of the circuit.

Hardware Requirements:

Power supplies, Signal generators, Oscilloscopes, Multimeters, Component kits.

Software requirements:

SPICE like LTSpice, PSpice, or Multisim, MATLAB

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Know about the usage of equipment/components/software tools used to conduct experiments in analog circuits. (L2)

CO2: Conduct the experiment based on the knowledge acquired in the theory about various analog circuits using BJT/MOSFETs to find the important parameters of the circuit experimentally. (L3)

CO3: Analyze the given analog circuit to find required important metrics of it theoretically. (L4)

CO4: Compare the experimental results with that of theoretical ones and infer the conclusions. (L4)

CO5: Design the circuit for the given specifications. (L6)

Reference Books:

1. Paul Horowitz and Winfield Hill, "The Art of Electronics", 3rd Edition, Cambridge university press, 2015.
2. Bob Dobkin and Jim Williams, "Analog Circuit Design: A Tutorial Guide to Applications and Solutions", 1st Edition, Newnes, 1991.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech II Year II Semester

23ECE205 ANALOG COMMUNICATION LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. Understand how signals are amplitude modulated and demodulated in the transmitter and receiver, respectively, in analog communication.
2. Understand how signals are frequency modulated and demodulated in the transmitter and receiver, respectively, in analog communication
3. Understand how more than one signals are Frequency-Division multiplexed in the transmitter and how it is demultiplexed in the receiver so that the signal reaches to the intended user at the destination.
4. Understand how analog signals are converted into pulses of varying characteristics in communication
5. Understand the effect of noise communication in analog communication.

List of Experiments:

1. Amplitude Modulation and Demodulation
2. DSB-SC Modulation and Demodulation
3. SSB-SC Modulation and Demodulation
4. Frequency Modulation and Demodulation
5. Study of spectrum analyzer and analysis of AM and FM Signals
6. Pre-emphasis and De-emphasis Filter
7. Frequency Division Multiplexing & De multiplexing
8. Sampling and Reconstruction
9. Pulse Amplitude Modulation & Demodulation
10. Pulse Width Modulation & Demodulation
11. Pulse Position Modulation & Demodulation
12. Design and analysis of analog RC filter using MATLAB
13. Study and simulation of signals in the presence of noise using MATLAB
14. Analysis of Linear Block Codes using MATLAB

Hardware Requirements:

Signal Generators, Modulation and Demodulation kits, Oscilloscopes, Communication trainer kits.

Software requirements:

MATLAB, Computer Systems with required specifications

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Analyse various amplitude modulation and demodulation techniques
CO2: Analyse frequency modulation and demodulation
CO3: Apply Frequency Division Multiplexing and Demultiplexing for communication
CO4: Analyse pulse modulation techniques, such as PAM, PWM, PPM
CO5: Analyse analog communication system in the presence of noise.

Reference Books:

1. Simon Haykin and Michael Moher, "Analog Communication Systems", 5th Edition, Wiley, 2010.

2. Michael P. Fitz, "Fundamentals of Communication Systems", 1st Edition, McGraw-Hill Education, 2012.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

III Year I Semester

B. Tech III Year I Semester

23ECE109 ANALOG AND DIGITAL IC APPLICATIONS

L	T	P	C
2	1	0	3

Course Objectives:

1. To introduce the classification of Integrated Circuits, internal blocks and characteristics of Op-Amp.
2. To analyze linear and non-linear applications of Op-Amp.
3. To gain knowledge on active filters, timers and phased locked loops.
4. To understand the working of Voltage Regulators and Converters.
5. To study about different types of Digital ICs and their applications.

UNIT I ICs AND OP-AMP 9 hours

Integrated Circuits and Operational Amplifier: Introduction, Classification of IC's, IC chip size and circuit complexity, basic information of Op-Amp IC741 and its features, the ideal Operational amplifier, Op-Amp internal circuit, Op-Amp characteristics - DC and AC, Features of 741 Op-Amp.

UNIT II APPLICATIONS OF OP-AMP 9 hours

Linear Applications of Op-Amp: Inverting, non-inverting, Differential amplifiers, adder, subtractor, Instrumentation amplifier, AC amplifier, V to I and I to V converters, Integrator and differentiator.

Non-Linear Applications of Op-Amp: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multi vibrators, Triangular and Square waveform generators, Oscillators.

UNIT III ACTIVE FILTERS AND OTHER ICs 9 hours

Active Filters: Introduction, Butterworth filters – 1^{st} order, 2^{nd} order low pass and high pass filters, band pass, band reject and all pass filters.

Timer and Phase Locked Loops: Introduction to IC 555 timer, description of functional diagram, monostable and a stable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage-controlled oscillator (IC 566), low pass filter, monolithic PLL and applications of PLL.

UNIT IV VOLTAGE REGULATORS AND CONVERTERS 9 hours

Voltage Regulator: Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator.

D to A and A to D Converters: Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters - parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

UNIT V DIGITAL ICs **9 hours**

CMOS Logic: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic.

Combinational Logic IC's: Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs - Code Converters, Decoders, Encoders, Priority Encoders, Multiplexers, Demultiplexers, Parallel Binary Adder/ Subtractor, Magnitude Comparators.

Sequential Logic IC's: Familiarity with commonly available 74XX & CMOS40XX Series ICs - All Types of Flip-flops, Synchronous Counters, Decade Counters, Shift Registers.

Course Outcomes:

Upon successful completion of the course, students will be able to
CO1: Understand the classification of Integrated Circuits, internal blocks and characteristics of Op-Amp. (L2)
CO2: Analyze linear and non-linear applications of Op-Amp. (L3)
CO3: Gain knowledge on active filters, timers and phased locked loops. (L4)
CO4: Understand the working of Voltage Regulators and Converters. (L4)
CO5: Know about different types of Digital ICs and their applications. (L5)

Text Books:

1. D. Roy Choudhury, Shail B. Jain, "Linear Integrated Circuit", 4th edition (2012), New Age International Pvt. Ltd., New Delhi, India
2. Floyd, Jain, "Digital Fundamentals", 8th edition (2009), Pearson Education, New Delhi.
3. S. Salivahanan, V. S. Kanchana Bhaaskaran, "Linear Integrated Circuits", 2nd edition, (2016), Tata McGraw Hill, New Delhi.

Reference Books:

1. Ramakant A. Gayakwad, "OP-AMP and Linear Integrated Circuits", 4th edition (2012), Prentice Hall / Pearson Education, New Delhi.
2. Sergio Franco (1997), "Design with operational amplifiers and analog integrated circuits", McGraw Hill, New Delhi.
3. Gray, Meyer (1995), "Analysis and Design of Analog Integrated Circuits", Wiley International, New Delhi.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year I Semester

23ECE110 DIGITAL COMMUNICATION

L	T	P	C
3	0	0	3

Course Objectives:

1. Gain the knowledge of fundamental operations e.g., sampling, quantization, and coding to convert analog waveforms into coded pulses.
2. Characterize the baseband signal modulation in time and frequency domains and to design the optimum receiver for it.
3. Develop understanding of digital passband transmission techniques (i.e., BPSK, BASK, BFSK, QAM, QPSK) and their transmission and reception.
4. Determine the performance of various digital bandpass modulation techniques in terms of bit-error-rate and capacity.
5. Analyze the effects of inter-symbol-interference of digital modulation techniques in band limited channel and design the equalizer to mitigates the effects of ISI.

UNIT I CONVERSION OF ANALOG WAVEFORMS INTO CODED PULSES **9 hours**

Review of Sampling theory, Nyquist criterion, Aliasing effect, Quantization: Uniform and nonuniform quantization, Pulse code modulation (PCM), Quantization noise and signal to quantization noise ratio, Differential PCM (DPCM), Delta modulation, Adaptive delta modulation, Noise in delta modulation: Granular and slope overload distortions. Time division multiplexing (TDM), Digital telephony: T1 carrier system.

UNIT II DIGITAL BASEBAND TRANSMISSION AND RECEPTIONS **9 hours**

Concepts of line coding & its properties. NRZ & RZ types, signaling format for unipolar, polar, bipolar (AMI) & Manchester coding and their power spectra. Optimum receiver for baseband in additive white Gaussian noise (AWGN): Matched filter, derivation of its impulse response and peak signal to noise ratio, matched filter as correlator receiver.

UNIT III DIGITAL BANDPASS TRANSMISSION AND RECEPTION **9 hours**

Types of digital modulation, waveforms and mathematical expressions for amplitude, frequency and phase shift keying, Concepts of constellation diagram, method of generation and detection of binary ASK, FSK & PSK, differential phase shift keying, M-ary PSK (M-PSK), M-ary quadrature amplitude modulation (M-QAM).

UNIT IV PERFORMANCE ANALYSIS OF DIGITAL BANDPASS SYSTEMS **9 hours**

Probability of error for BPSK, BASK and BFSK. Performance comparison of various digital modulation techniques. Shannon- Hartley capacity theorem, BW efficiency of different modulation schemes, Modulation & coding trade-offs, bandwidth- SNR trade-off.

UNIT V EQUALIZATION AND CARRIER RECOVERY TECHNIQUES **9 hours**

Inter Symbol Interference (ISI) – Nyquist criterion for distortion less transmission – Raised cosine spectrum – Correlative coding – Eye pattern, Equalization- zero forcing and basics of adaptive linear equalizers, **Synchronization and Carrier Recovery for Digital modulation.**

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Acquire the knowledge of fundamental operations sampling, quantization, and encoding for conversion of analog waveforms into coded pulses. (L2)
CO2: Understand the concept of optimal receiver filter for digital baseband modulation. (L2)
CO3: Analyse the time and frequency domain representations of digital bandpass modulation. (L4)
CO4: Determine the bit error rate performance of various digital bandpass modulations. (L5)
CO5: Understand the effects of inter-symbol interference due to bandlimited channel and mitigates the effects by equalization techniques to improve the performance. (L2, L3)

Text Books:

1. S. Haykin, *Digital Communication Systems*, 1st edition, Wiley, 2013

2. B. P. Lathi and Z. Ding, *Modern Digital and Analog Communication Systems*, 4th edition, Oxford, 2011

Reference Books:

1. B. Sklar and P. K. Ray, *Digital Communications: Fundamentals and Applications*, 2nd edition, Pearson, 2009

2. J. G. Proakis and M. Salehi, *Digital Communications*, 5th edition, McGraw Hill, 2014

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year I Semester

23ECE111 MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	C
3	0	0	3

Course Objectives:

1. To comprehend the architecture, operation, and configurations of the 8086 microprocessors.
2. To get familiar with 8086 programming concepts, instruction set, and assembly language development tools.
3. To study the interfacing of 8086 with memory, peripherals, and controllers for various applications.
4. To learn the architecture, instruction set, and programming of the 8051 microcontrollers.
5. To understand microcontroller interfacing techniques, peripheral programming, and processor comparisons

UNIT I 8086 ARCHITECTURE 9 hours

Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

UNIT II 8086 PROGRAMMING 9 hours

Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

UNIT III 8086 INTERFACING 9 hours

Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

UNIT IV 8051 ARCHITECTURE AND PROGRAMMING 9 hours

Microcontroller - Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

UNIT V 8051 INTERFACING AND APPLICATIONS 9 hours

Interfacing Microcontroller - Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Gain knowledge on the architecture, operation, and configurations of the 8086 microprocessors.
CO2: Get familiar with 8086 programming concepts, instruction set, and assembly language development tools.
CO3: Know the interfacing of 8086 with memory, peripherals, and controllers for various applications.
CO4: Learn the architecture, instruction set, and programming of the 8051 microcontrollers.
CO5: Understand microcontroller interfacing techniques, peripheral programming, and processor comparisons.

Text Books:

1. Douglas V Hall and SSSP Rao, *Microprocessors and Interfacing – Programming and Hardware* by, Tata McGraw Hill Education Private Limited, 3rd Edition,1994.

2. K M Bhurchandi, A K Ray, *Advanced Microprocessors and Peripherals,* 3rd edition, McGraw Hill Education, 2017.

3. Raj Kamal, *Microcontrollers: Architecture, Programming, Interfacing and System Design*, 2nd edition, Pearson, 2012.

Reference Books:

1. Ramesh S Gaonkar, *Microprocessor Architecture Programming and Applications with the 8085*, 6th edition, Penram International Publishing, 2013.

2. Kenneth J. Ayala, *The 8051 Microcontroller*, 3rd edition, Cengage Learning, 2004.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B.Tech III Year I Semester

23PHY102 INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives:

The main objectives of the course is to

1. Introduce fundamental quantum concepts like superposition and entanglement.
2. Understand theoretical structure of qubits and quantum information.
3. Explore conceptual challenges in building quantum computers.
4. Explain principles of quantum communication and computing.
5. Examine real-world applications and the future of quantum technologies.

UNIT I INTRODUCTION TO QUANTUM THEORY AND TECHNOLOGIES 9 hours

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison,Quantum states and measurement: nature of observation,Overview of quantum systems: electrons, photons, atoms,The concept of quantization: discrete energy levels,Why quantum? Strategic, scientific, and technological significance,A snapshot of quantum technologies: Computing, Communication, and Sensing,National and global quantum missions: India's Quantum Mission, EU, USA, China

UNIT II THEORETICAL STRUCTURE OF QUANTUM INFORMATION SYSTEMS 9 hours

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract,The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences,Philosophical implications: randomness, determinism, and observer role

UNIT III BUILDING A QUANTUM COMPUTER – THEORETICAL CHALLENGES AND REQUIREMENTS 9 hours

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers:

Why maintaining entanglement is difficult,Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison),Superconducting circuits, Trapped ions, Photonics, Visionvs reality: what's working and what remains elusive,The role of quantum software in managing theoretical complexities

UNIT IV **QUANTUM COMMUNICATION AND COMPUTING – THEORETICAL PERSPECTIVE** **9 hours**

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD),Role of Entanglement in Communication,The Idea of the Quantum Internet – Secure Global Networking,Introduction to Quantum Computing,Quantum Parallelism (Many States at Once),Classical vs Quantum Gates, Challenges: Decoherence and Error Correction,Real-World Importance and Future Potential

UNIT V **APPLICATIONS, USE CASES, AND THE QUANTUM FUTURE** **9 hours**

Real-world application domains: Healthcare (drug discovery),Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, PsiQuantum,Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization,Emerging careers in quantum: roles, skillsets, and preparation pathways,Educational and research landscape – India's opportunity in the global quantum race

Course Outcomes:

CO1: Explain core quantum principles in a non-mathematical manner.
CO2: Compare classical and quantum information systems.
CO3: Identify theoretical issues in building quantum computers.
CO4: Discuss quantum communication and computing concepts.
CO5: Recognize applications, industry trends, and career paths in quantum technology.

Text Books:

1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
3. Chris Bernhardt, *Quantum Computing for Everyone*, MIT Press, 2019.

Reference Books:

1. David McMahon, *Quantum Computing Explained*, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, *An Introduction to Quantum Computing*, Oxford University Press, 2007.
3. Scott Aaronson, *Quantum Computing Since Democritus*, Cambridge University Press, 2013.
4. **Alastair I.M. Rae**, *Quantum Physics: A Beginner's Guide*, Oneworld Publications, Revised Edition, 2005.
5. **Eleanor G. Rieffel, Wolfgang H. Polak**, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
6. **Leonard Susskind, Art Friedman**, *Quantum Mechanics: The Theoretical Minimum*, Basic Books, 2014.
7. **Bruce Rosenblum, Fred Kuttner**, *Quantum Enigma: Physics Encounters Consciousness*, Oxford University Press, 2nd Edition, 2011.

8. **GiulianoBenenti, GiulioCasati, GiulianoStrini**, *Principles of Quantum Computation and Information, Volume I: Basic Concepts*, World Scientific Publishing, 2004.
9. **K.B. Whaley et al.**, *Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document*, Quantum Flagship, European Commission, 2020.
10. **Department of Science & Technology (DST), Government of India**, *National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers*, MeitY/DST Publications, 2020 onward.

Online Learning Resources:

1. IBM Quantum Experience and Qiskit Tutorials
2. Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
3. edX – The Quantum Internet and Quantum Computers
4. YouTube – Quantum Computing for the Determined by Michael Nielsen
5. Qiskit Textbook – IBM Quantum

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year I Semester

23ECE206 DIGITAL COMMUNICATION LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

This course enables students to

1. Understand how the analog signals are converted into binary data using pulse code modulation and delta modulation
2. Understand how Time Division Multiplexing and Demultiplexing is used in communication to send signals from many users on a single channel/medium and distributed to the intended user at the destination
3. Understand how the binary data is modulated in the transmitter and demodulated in the receiver using different modulation and demodulation techniques
4. Understand how A-Law & μ-Law are applied for companding signals in PCM
5. Understand the need for channel coding and how the data is encoded in the transmitter and decoded in the receiver

List of Experiments:

1. Pulse Code Modulation and Demodulation
2. Differential Pulse Code Modulation and Demodulation
3. Delta Modulation and Demodulation
4. Time Division Multiplexing & De multiplexing
5. ASK, FSK, PSK Modulation and Demodulation
6. Differential PSK (DPSK) Modulation and Demodulation
7. Quadrature PSK (QPSK) Modulation and Demodulation
8. Quadrature Amplitude Modulation (QAM) and Demodulation
9. Digital Companding (A-Law & μ-Law)
10. Linear Block Code- Encoder and Decoder
11. Convolutional Code- Encoder and Decoder
12. Performance comparison of Line Coding techniques using MATLAB
13. BER Performance analysis of digital modulation schemes using MATLAB

ADDITIONAL EXPERIMENT:

1. Simulation and Analysis of OFDM for LTE communication

Note: Any 12 experiments shall be implemented using Hardware or Software.

Hardware Requirements:
PCM, DPCM, DM, TDM, ASK, FSK. PSK, DPSK, QPSK, QAM modulation and Demodulation kits

Software requirements:
MATLAB software

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Analyse pulse code modulation and delta modulation used in communication
CO2: Apply Time Division Multiplexing and Demultiplexing for signals in communication
CO3: Analyse various pass band modulation and demodulation techniques
CO4: Apply A-Law & μ-Law companding of signals
CO5: Understand various channel decoding and encoding for communication

Reference Books:

1. S. Haykin, *Digital Communication Systems*, 1st edition, Wiley, 2013

2. B. P. Lathi and Z. Ding, *Modern Digital and Analog Communication Systems*, 4th edition, Oxford, 2011

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech III Year I Semester

23ECE207 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. To become skilled in 8086 Assembly Language programming.….
2. To understand the detailed software and hardware structure of the microprocessor.
3. Learn interface various peripheral chips to 8086 microprocessors.
4. Learn the basic operation of various Peripherals
5. Gain hands on experience in writing assembly language programs for 8051-microcontroller.
6. Learn interface various peripheral chips to 8051 microcontrollers.

List of Experiments:

1. Programs for 16 Bit Arithmetic Operations (Using various addressing modes)
    a. Write an ALP to Perform Addition and Subtraction of Multi precision numbers.
    b. Write an ALP to Perform Multiplication and division of signed and unsigned Hexadecimal numbers.
    c. Write an ALP to find square, cube and factorial of a given number
2. Programs Involving Bit Manipulation Instructions
    a) Write an ALP to find the given data is positive or negative.
    b) Write an ALP to find the given data is odd or even.
    c) Write an ALP to find Logical ones and zeros in a given data.
3. Programs on Arrays for 8086
    a) Write an ALP to find Addition/subtraction of N numbers.
    b) Write an ALP for finding largest/smallest no.
    c) Write an ALP to sort given array in Ascending/descending order.
4. Programs on String Manipulations for 8086
    a) Write an ALP to find String length.
    b) Write an ALP for Displaying the given String.
    c) Write an ALP for Comparing Two Strings.
    d) Write an ALP to reverse String and Checking for palindrome.
5. Programs for Digital Clock Design Using 8086
    a) Write an ALP for Designing clock using INT 21H Interrupt.
    b) Write an ALP for Designing clock using DOS Interrupt Functions.
    c) Write an ALP for Designing clock by reading system time.
6. Assembly Language Program to perform Code conversions
    a) Hexadecimal to Decimal and vice-versa.
    b) Grey code to Binary and vice-versa
7. Interfacing Stepper Motor with 8086
    a. Write an ALP to 8086 processors to Interface a stepper motor and operate it in clockwise by choosing variable step-size.
    b. Write an ALP to 8086 processors to Interface a stepper motor and operate it in Anti-clockwise by choosing variable step-size.
8. Interfacing ADC/DAC with 8086
    a) Write an ALP to 8086 processors to Interface ADC.
    b) Write an ALP to 8086 processors to Interface DAC and generate Square Wave/Triangular Wave/Step signal.
9. Programs using Arithmetic and Logical Instructions for 8051

a) Write an ALP to 8051 Microcontroller to perform Arithmetic operations like addition, subtraction, Multiplication and Division.
b) Write an ALP to 8051 Microcontroller to perform Logical operations like AND, OR and XOR. Programs related to Register Banks.

10. Interfacing of Traffic Light Controller with 8051microcontroller.
11. Interfacing of ADC/DAC with 8051 microcontroller.
12. Interfacing LCD with 8051
    a) Develop and execute the program to interface16*2 LCD to 8051.
    b) Develop and execute the program to interface LCD to 8051 in 4-bit or 8-bit mode.

ARM Microcontroller Experiments:

13. Interfacing of Stepper Motor for running in forward and reverse direction
14. Interfacing of LCD to display Digital clock

Note: Any 12 experiments shall be implemented using Hardware or Software.

Hardware Requirements:
8086, 8051 trainer kits, Interfacing cards 8051, ADC, DAC, Traffic Light Controller.

Software requirements:
STM 32 CUBE IDE

Course Outcomes:

Upon successful completion of the course, students will be able to
CO1: Develop assembly language programs using 8086 microprocessors.
CO2: Design and interface peripherals with 8086 microprocessors.
CO3: Understand the basic operation of Peripherals.
CO4: Develop assembly language programs using 8051 microcontrollers.
CO5: Interface peripheral devices with 8051.

Reference Books:

1. Kenneth. J. Ayala, *The 8051 microcontroller*, 3rd edition, Cengage learning, 2010.

2. A. K. Ray and K. M. Bhurchandani, *Advanced microprocessors and peripherals*, TMH, 2nd edition 2006.

3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems: Using Assembly and C*, Second Edition.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech III Year I Semester

23ECE501 TINKERING LABORATORY

L	T	P	C
0	0	2	1

Course Description:

The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge. These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

Course Objectives:

1. Encourage Innovation and Creativity
2. Provide Hands-on Learning and Impart Skill Development
3. Foster Collaboration and Teamwork
4. Enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship
5. Impart Problem-Solving mind-set

List of Experiments:

1. Make your own parallel and series circuits using breadboard for any application of your choice.
2. Design and 3D print a Walking Robot
3. Design and 3D Print a Rocket.
4. Temperature & Humidity Monitoring System (DHT11 + LCD)
5. Water Level Detection and Alert System
6. Automatic Plant Watering System
7. Bluetooth-Based Door Lock System
8. Smart Dustbin Using Ultrasonic Sensor
9. Fire Detection and Alarm System
10. RFID-Based Attendance System
11. Voice-Controlled Devices via Google Assistant
12. Heart Rate Monitoring Using Pulse Sensor
13. Soil Moisture-Based Irrigation
14. Smart Helmet for Accident Detection
15. Milk Adulteration Detection System
16. Water Purification via Activated Carbon
17. Solar Dehydrator for Food Drying
18. Temperature-Controlled Chemical Reactor

19. Ethanol Mini-Plant Using Biomass
20. Smart Fluid Flow Control (Solenoid + pH Sensor)
21. Portable Water Quality Tester
22. AI Crop Disease Detection
23. AI-based Smart Irrigation
24. ECG Signal Acquisition and Plotting
25. AI-Powered Traffic Flow Prediction
26. Smart Grid Simulation with Load Monitoring
27. Smart Campus Indoor Navigator
28. Weather Station Prototype
29. Firefighting Robot with Sensor Guidance
30. Facial Recognition Dustbin
31. Barcode-Based Lab Inventory System
32. Growth Chamber for Plants
33. Biomedical Waste Alert System
34. Soil Classification with AI
35. Smart Railway Gate
36. Smart Bin Locator via GPS and Load Sensors
37. Algae-Based Water Purifier
38. Attendance via Face Recognition

Note: The students can also design and implement their own ideas, apart from the list of experiments mentioned above.

Note: A minimum of 8 to 10 experiments must be completed by the students.

Course Outcomes:

After completion of the course, Students will be able to

CO1: Apply the principles of design thinking to identify real-world problems and develop feasible solutions.

CO2: Demonstrate proficiency in using basic tools, components, and digital fabrication technologies (e.g., Arduino, sensors, 3D printing, etc.).

CO3: Develop functional prototypes through iterative design, fabrication, and testing.

CO4: Collaborate effectively in multidisciplinary teams to brainstorm, plan, and execute tinkering projects.

CO5: Document the development process, evaluate outcomes, and communicate project results clearly using oral, visual, and written formats.

Reference Books:

1. "Make: Getting Started with Arduino" by Massimo Banzi, Maker Media Publications.

Online Resources:

1. https://aim.gov.in/pdf/equipment-manual-pdf.pdf

2. https://atl.aim.gov.in/ATL-Equipment-Manual/

3. https://aim.gov.in/pdf/Level-1.pdf

4. https://aim.gov.in/pdf/Level-2.pdf

5. https://aim.gov.in/pdf/Level-3.pdf

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

III Year II Semester

B. Tech III Year II Semester

23ECE112 DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

Course Objectives:

1. To get familiar with the properties of discrete time signals, systems and z-transform.
2. To learn the importance of FFT algorithm for computation of Discrete Fourier Transform and Fast Fourier Transform with decimations.
3. To understand the implementations of digital filter structures.
4. To analyze the FIR filter design using Fourier series and windowing methods.
5. To gain the knowledge on Programmable DSP Devices.

UNIT I DISCRETE TIME SIGNALS & SYSTEMS 9 hours

Introduction to discrete time signals and systems: Introduction to digital signal processing, Review of discrete-time signals and systems, Filtering long data sequences: overlap-save, overlap-add method, Analysis of discrete-time linear time invariant systems

Z–Transform: Definition, ROC, Properties, Poles and Zeros in Z-plane, the inverse Z Transform, System analysis, Transfer function, Solution of difference equations with initial conditions, Analysis of linear time-invariant systems in the z-domain, Pole-Zero Stability.

UNIT II FREQUENCY DOMAIN TOOLS FOR SIGNAL PROCESSING IN DIGITAL DOMAIN 9 hours

Discrete Fourier Transform: Concept of Frequency domain sampling and Reconstruction of discrete time Signals, Discrete Fourier Transform, Inverse Discrete Fourier Transform - deriving DFT from DTFT, properties of Discrete Fourier Transform, Linear and Circular convolution, convolution using DFT, sampling, Quantization effects.

Fast Fourier Transform (FFT) algorithms: Introduction, Fast Fourier Transform, Radix-2 Decimation-in-time algorithm and Decimation-in-frequency algorithm and Inverse FFT (Radix-2).

UNIT III INFINITE IMPULSE RESPONSE (IIR) FILTER DESIGN 9 hours

IIR Filters: Introduction to digital filters, Analog filter approximations – Butterworth and Chebyshev filter, Design of IIR filters from analog filters (LPF, HPF, BPF), Design of IIR Digital filters from analog filters by Impulse invariant and bilinear transformation methods, Frequency transformation in the analog domain,

Structure of IIR filter - Direct form – I, Direct form - II, Cascade form and parallel form realizations.

UNIT IV FINITE IMPULSE RESPONSE (FIR) FILTER DESIGN 9 hours

Introduction, Characteristics of FIR filters with linear phase, Frequency response of linear phase FIR filters, Design of FIR filters using Fourier series and windowing methods (Rectangular, Hanning, Hamming, & Blackman), Comparison of IIR & FIR filters, Basic Structures of FIR Filters – Direct form, Cascade form, Linear phase realizations.

UNIT V DIGITAL SIGNAL PROCESSOR 9 hours

Architectures for Programmable DSP Devices: Architecture of TMS320C5X: Introduction, Bus Structure, Functional units of CPU of TMS320C5X Processors – Parallel Logic Unit (PLU), Central Arithmetic Logic Unit (CALU), Auxiliary Register ALU, Program Controller & some flags in the Status Register (ST0 & ST1), Addressing Mode of TMS320C5X Processor, On- chip Memory in TMS320C5X Processor, Pipelining on TMS320C5X Processors, On-chip peripherals of TMS320C5X Processors.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Summarize the properties of discrete-time signals and systems, and Z-transform. (L2)
CO2: Apply the Fast Fourier Transform (FFT) algorithm to compute the Discrete Fourier Transform (DFT) using decimation techniques. (L3)
CO3: Analyze the implementation and characteristics of digital filter structures. (L4)
CO4: Analyze the FIR filter design using Fourier series and windowing methods. (L4)
CO5: Evaluate the features and performance of Programmable DSP Devices for various signal processing applications. (L5)

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing, Principles, Algorithms, and Applications*, Pearson Education, 4th edition, 2014.
2. A. V. Oppenheim and R.W. Schaffer, *Discrete Time Signal Processing*,PHI.
3. Rulph Chassaing, Donald Reay, *Digital Signal Processing and Applications with TMS320C6713 and TMS320C6416 DSK*, 2nd Edition, Wiley India, 2014.

Reference Books:

1. S. K. Mitra, *Digital Signal Processing – A practical approach*, 2nd Edition, Pearson Education, New Delhi, 2004.
2. MH Hayes, *Digital Signal Processing*, Schaum's Outline series, TATA Mc-Graw Hill, 2007.
3. Robert J. Schilling, Sandra L. Harris, *Fundamentals of Digital Signal Processing using Matlab*, Thomson, 2007.
4. Emmanuel Ifeachor, Barrie W. Jervis, *Digital Signal Processing: A Practical Approach*, 2nd Edition, Pearson Education, 2002.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year II Semester

23ECE113 MICROWAVE AND OPTICAL COMMUNICATIONS

L	T	P	C
3	0	0	3

Course Objectives:

1. To analyse different modes of operation in rectangular wave guides, circular wave guides and resonators.
2. To study and analyse various microwave components and microwave sources.
3. To gain knowledge on different microwave semiconductor devices and microwave measurements procedures.
4. To analyse different optical fiber modes and to study different types of distortions and losses in optical communication.
5. To study various optical sources, optical detectors and to analyse various optical links.

UNIT I WAVEGUIDES 9 hours

Introduction, Rectangular waveguides, Field expressions for TE and TM modes, Wave propagation in the guide, Phase and group velocities, Power transmission and attenuation, Waveguide current and mode excitation, Circular waveguide – TE and TM modes (Wave propagation, Cavity resonators

UNIT II MICROWAVE PASSIVE DEVICES AND VACUUM TUBE DEVICES 9 hours

Passive Microwave Devices: Introduction to scattering parameters and their properties, Terminations, Variable short circuit, Attenuators, Phase shifters, Hybrid Tees (H-plane, E-plane, Magic Tees), Directional Couplers – Bethe hole and Two-hole Couplers, Deriving Scattering matrix for Microwave passive devices. Microwave propagation in Ferrites, Gyrator, Isolator, Circulator.

Microwave Amplifiers and Oscillators: Microwave Tubes: Linear Beam Tubes – Two cavity Klystron amplifier -velocity modulation, bunching process, output power, Reflex Klystron oscillator, power output and efficiency, Travelling Wave Tube (TWT) – Bunching process and amplification process. Crossed Field Tubes – Magnetron oscillator, pi-mode operation, power output and efficiency, Hartree Condition.

UNIT III MICROWAVE SEMICONDUCTOR DEVICES AND MEASUREMENTS 9 hours

Microwave Semiconductor Devices: Gunn Oscillator – Principle of operation, Characteristics, Two valley model, IMPATT, TRAPATT diodes.

Microwave Measurements: Description of Microwave bench-different blocks and their features, errors and precautions, Microwave power measurements, Measurement of attenuation, frequency, VSWR (low, medium, high), Measurement of 'Q' of a cavity, Impedance measurements.

UNIT IV OPTICAL FIBER FUNDAMENTALS AND TRANSMISSION CHARACTERISTICS 9 hours

Introduction to Optical Fibers and Transmission Characteristics - The propagation of light in optical waveguides – Classification of optical fibers – Numerical aperture, Step index and Graded index fiber – Modes in cylindrical fiber – Linearly polarized modes, Attenuation: Absorption, Scattering, Bending losses. Modal dispersion and chromatic dispersion – Single mode fiber - waveguide dispersion– MFD – PMD

UNIT V OPTICAL SOURCES, DETECTORS, AND LINK DESIGN 9 hours

Optical Transmitters and Receivers: Optical Sources: - Light source materials – LED homo and hetero structures – surface and edge emitters – Quantum efficiency – Injection Laser Diode – Modes and threshold condition – Structures and Radiation Pattern. Optical detectors: – Physical principles – PIN and APD diodes – Photo detector noise

Optical Link Design: Point- to- point links – System considerations – Link Power budget – Rise time budget.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Analyze different modes of operation in rectangular wave guides, circular wave guides and resonators (L3).

CO2: Understand and analyze various microwave components and microwave sources (L3).

CO3: Gain knowledge on different microwave semiconductor devices and microwave measurements procedures (L2).

CO4: Analyze different optical fiber modes and to study different types of distortions and losses in optical communication (L3).

CO5: Understand study various optical sources, optical detectors and to analyze various optical links (L2).

Text Books:

1. David M. Pozar, ‖ *Microwave Engineering* John Wiley & Sons, Inc. 4th edition, 2012

2. Samuel Y. Liao, *Microwave Devices and Circuits*, PHI publications, Third Edition, 1997.

3. Gerd Keiser, *Optical Fiber Communications*, McGraw Hill, Third Edition, 2000.

Reference Books:

1. R. E. Collin, *Foundations for Microwave Engineering*, Wiley Student Edition, Second Edition, 2009.

2. Om. P. Gandhi, *Microwave: Engineering and Applications*, Kai Fa Book Company, 1981.

3. Reich H. J., et al, *Microwave Principles*, MIT Press, 1972.

4. F E Terman, *Electronic and Radio Engineering*, McGraw Hill, 4th Edition, 1984

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year II Semester

23ECE114 VLSI DESIGN

L	T	P	C
3	0	0	3

Course Objectives:

1. To understand the steps involved in fabrication of ICs using MOS transistor technology.
2. To learn about the VLSI design processes, Stick diagrams and Layouts.
3. To gain knowledge on the Gate Level Design concepts.
4. To learn the design of various subsystems with different VLSI Design styles.
5. To get familiar with CMOS testing techniques.

UNIT I INTRODUCTION TO IC TECHNOLOGY 9 hours

Brief Introduction to IC technology MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. Basic Electrical Properties of MOS and BiCMOS Circuits: IDS - VDS relationships, MOS transistor Threshold Voltage, figure of merit, Transconductance, Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT II VLSI CIRCUIT DESIGN PROCESSES 9 hours

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Lambda(λ)-based design rules for wires, contacts and Transistors, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

UNIT III GATE LEVEL DESIGN 9 hours

Logic gates and other complex gates, Switch logic, Alternate gate circuits. Basic Circuit Concepts: Sheet Resistance Rs and its concepts to MOS, Area Capacitances calculations, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out

UNIT IV SUBSYSTEM DESIGN 9 hours

Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Counters. VLSI Design styles: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices, parameters influencing low power design.

UNIT V CMOS TESTING 9 hours

Need for testing, Design for testability - built in self-test (BIST) – testing combinational logic –testing sequential logic – practical design for test guide lines – scan design techniques.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand the steps involved in fabrication of ICs using MOS transistor technology. (L2)
CO2: Learn about the VLSI design processes, Stick diagrams and Layouts. (L3)
CO3: Gain knowledge on the Gate Level Design concepts. (L4)
C04: Learn the design of various subsystems with different VLSI Design styles. (L4)
CO5: Familiar with CMOS testing techniques. (L5)

Text Books:

1. Kamran Eshraghian, Eshraghian Dougles, A. Pucknell, *Essentials of VLSI Circuits and Systems*, PHI, 2005.
2. Wayne Wolf, *Modern VLSI Design,* 3rd Ed., Pearson Education, 1997.
3. Neil H.E Weste, David Harris, Ayan Banerjee, *CMOS VLSI Design-A Circuits and Systems Perspective,* 3rd Ed., Pearson, 2009.

Reference Books:

1. Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, McGraw Hill, 2003.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, *Digital Integrated Circuits*‖, Prentice-Hall of India Pvt. Ltd, 2nd edition, 2009.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

B. Tech III Year II Semester

23ECE208 MICROWAVE AND OPTICAL COMMUNICATIONS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. To understand the working of microwave bench set up and characteristics of microwave sources.
2. To verify the characteristics of various microwave components and to draw the radiation pattern of antennas.
3. To verify the characteristics of optical sources & detectors and to study about losses in optical fiber.

List of Experiments:

PART-A: Microwave Lab - Any Seven (7) Experiments

1. Reflex Klystron Characteristics
2. Gunn Diode Characteristics
3. Attenuation Measurement
4. Directional Coupler Characteristics
5. VSWR Measurement
6. Impedance Measurements
7. Frequency and Wavelength measurement
8. Scattering Parameters of Directional coupler
9. Scattering Parameters of Magic TEE
10. Radiation pattern measurement of a Antenna
11. Antenna gain measurement

Part B: Optical Fiber Lab - Any five (5) Experiments

1. Characterization of LED
2. Characterization of Laser Diode
3. Intensity Modulation of Laser output through Optical fiber
4. Measurement of data rate for digital Optical link
5. Measurement of Numerical Aperture.
6. Measurement of Losses for Analog optical link

Course Outcomes:

At the end of this course, the students will be able to

CO1: Understand the working of microwave bench setup and characteristics of microwave sources such as Reflex Klystron and Gunn Diode.

CO2: Measure and analyze parameters like attenuation, VSWR, and impedance in microwave systems.

CO3: Verify the characteristics of microwave passive components like directional couplers and Magic TEEs using scattering parameters.

CO4: Draw and interpret the radiation pattern and gain of microwave antennas.

CO5: Analyze the characteristics of optical sources and detectors, and evaluate losses and data transmission performance in optical fiber links.

Text Books:

1. Samuel Y. Liao, *Title:* Microwave Devices and Circuits (3rd Edition), *Publisher:* Pearson Education.
2. David M. Pozar, *Title:* Microwave Engineering (4th Edition), *Publisher:* Wiley.
3. Gerd Keiser, *Title:* Optical Fiber Communications (5th Edition), *Publisher:* McGraw-Hill Education.
4. John M. Senior, *Title:* Optical Fiber Communications: Principles and Practice (3rd Edition), *Publisher:* Pearson Education.

Reference Books:

1. R.L. Yadava, *Title:* Microwave Engineering, *Publisher:* PHI Learning.
2. Anand Kumar, *Title:* Microwave Engineering, *Publisher:* PHI Learning.
3. Govind P. Agrawal, *Title:* Fiber-Optic Communication Systems (4th Edition), *Publisher:* Wiley.
4. Joseph C. Palais, *Title:* Fiber Optic Communications (5th Edition), *Publisher:* Pearson Education.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech III Year II Semester

23ECE209 VLSI DESIGN LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. To design a logic circuit using CMOS transistor using 180 nm technology in terms of schematic, symbol, test bench, DC and AC analysis.
2. To evaluate different schematics &output responses for AOI logic by using different software tools.
3. To design CMOS circuits using Full & Semi custom IC designs for analyzation.
4. To design different layouts using different software tools for analog circuits.

List of Experiments:

*(Any **TEN of the following experiments** are to be conducted)*

1. Design and Analysis of CMOS Inverter

a) Implement CMOS inverter schematic using 180 nm technology and design its symbol.
b) Implement test bench for CMOS inverter and check its output response.
c) Perform DC and AC analysis for CMOS inverter.
d) Check the performance of CMOS inverter using parametric sweep.

2. Design and Analysis of NAND and NOR Logic Gates

a) Implement NAND/NOR schematic using 180 nm technology and design its symbol.
b) Implement test bench for NAND/NOR and check its output response.
c) Perform DC and AC analysis for NAND/NOR.
d) Check the performance of NAND/NOR using parametric sweep.

3. Design and Analysis of XOR and XNOR Logic Gates

a) Implement XOR/XNOR schematic using 180 nm technology and design its symbol.
b) Implement test bench for XOR/XNOR and check its output response.
c) Perform DC and AC analysis for XOR/XNOR.
d) Check the performance of XOR/XNOR using parametric sweep.

4. Design of AOI Logic Circuits

a) Design schematic for AB + C'D and check its output response.
b) Design schematic for AB' + C'D and check its output response.
c) Design schematic for (A + B')(C + D) and check its output response.
d) Design schematic for (A + B')(C' + D) and check its output response.

5. Design and Analysis of Full Adder

a) Design full adder using full custom IC design.
b) Design full adder using semi-custom IC design.

6. Analysis of NMOS and PMOS Characteristics

a) Implement test bench for NMOS/PMOS transistor.
b) Perform DC and AC analysis for NMOS/PMOS transistor.
c) Check the performance of NMOS/PMOS transistor using parametric sweep.

7. Design and Analysis of Common Source (CS) Amplifier

a) Implement CS amplifier schematic using 180 nm technology and design its symbol.
b) Implement test bench for CS amplifier and check its output response.
c) Perform DC and AC analysis for CS amplifier.
d) Check the performance of CS amplifier using parametric sweep.

8. Design and Analysis of Common Drain (CD) Amplifier

a) Implement CD amplifier schematic using 180 nm technology and design its symbol.
b) Implement test bench for CD amplifier and check its output response.
c) Perform DC and AC analysis for CD amplifier.
d) Check the performance of CD amplifier using parametric sweep.

9. Design of MOS Differential Amplifier

a) Design differential amplifier schematic using 180 nm technology and its symbol.
b) Implement test bench for differential amplifier and check its output response.
c) Perform DC and AC analysis for differential amplifier.
d) Check the performance of differential amplifier using parametric sweep.

10. Design of Differential Amplifier using FET/BJT

a) Design differential amplifier using FET/BJT schematic using 180 nm technology and its symbol.
b) Implement test bench for two-stage differential amplifier and check its output response.
c) Perform DC and AC analysis for differential amplifier.
d) Check the performance of differential amplifier using parametric sweep.

11. Design of Inverter Layout

a) Design and implement inverter schematic.
b) Design the layout for inverter using 180 nm tech file.
c) Perform LVS for schematic and layout.
d) Check and remove all DRC violations.
e) Extract parasitic R and C in layout.

12. Design of NAND/NOR Layout

a) Design and implement NAND/NOR schematic.
b) Design the layout for NAND/NOR using 180 nm tech file.
c) Perform LVS for schematic and layout.
d) Check and remove all DRC violations.
e) Extract parasitic R and C in layout.

Hardware Requirements:

The students are required to design the schematic diagrams using CMOS logic and to draw the layout diagrams to perform the experiments with the Industry standard EDA Tools.

Software requirements:

i. Mentor Graphics/ Synopsis/ Cadence / Equivalent Industry Standard Software.
ii. Personal computer system with necessary software to run the programs and to implement.

Course Outcomes:

At the end of this course, the students will be able to

CO1: Describe the fundamental concepts of CMOS technology and design flow using 180 nm process for digital logic circuits. (L2)

CO2: Implement and simulate AOI logic circuits using schematic capture and simulation tools to observe output responses. (L3)

CO3: Analyze CMOS circuits through full and semi-custom IC design methodologies using industry-relevant EDA tools. (L4)

CO4: Examine various analog circuit layouts by applying different layout design strategies in multiple software platforms. (L4)

CO5: Evaluate the performance parameters of designed circuits through DC and AC analysis for optimization and verification. (L5)

Text Books:

1. **Neil H.E. Weste, David Money Harris,** *Title: CMOS VLSI Design: A Circuits and Systems Perspective* (4^{th}/5^{th} Edition), *Publisher:* Pearson.
2. **R. Jacob Baker,** *Title: CMOS: Circuit Design, Layout, and Simulation* (3^{rd} Edition), *Publisher:* Wiley IEEE Press.

Reference Books:

1. **Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolić,** *Title: Digital Integrated Circuits: A Design Perspective* (2^{nd} Edition), *Publisher:* Pearson.
2. **Behzad Razavi,** *Title: Design of Analog CMOS Integrated Circuits, Publisher:* McGraw-Hill Education.
3. **Sung-Mo Kang and Yusuf Leblebici,** *Title: CMOS Digital Integrated Circuits: Analysis and Design* (4^{th} Edition), *Publisher:* McGraw-Hill.

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

B. Tech III Year II Semester

23ENG901 TECHNICAL PAPER WRITING AND IPR

L	T	P	C
2	0	0	0

Pre-requisite: None

Course Objectives:

1. To enable the students to practice the basic skills of research paper writing
2. To make the students understand the importance of IP and to educate them on the basic concepts of Intellectual Property Rights.
3. To practice the basic skills of performing quality literature review
4. To help them in knowing the significance of real life practice and procedure of Patents.
5. To enable them learn the procedure of obtaining Patents, Copyrights, & Trade Marks

UNIT I **6 hours**

Principles of Technical Writing: styles in technical writing; clarity, precision, coherence and logical sequence in writing-avoiding ambiguity- repetition, and vague language - highlighting your findings-discussing your limitations -hedging and criticizing -plagiarism and paraphrasing.

UNIT II **6 hours**

Technical Research Paper Writing: Abstract- Objectives-Limitations-Review of Literature- Problems and Framing Research Questions- Synopsis

UNIT III **6 hours**

Process of research: publication mechanism: types of journals- indexing- seminars- conferences- proof reading –plagiarism style; seminar & conference paper writing; Methodology-discussion-results-citation rules.

UNIT IV **6 hours**

Introduction to Intellectual property: Introduction, types of intellectual property, International organizations, ncies and treaties, importance of intellectual property rights

de Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting evaluating trade mark, trade mark registration processes.

UNIT V **6 hours**

Law of copy rights: Fundamentals 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. Patent law, intellectual property audits.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Identify key secondary literature related to their proposed technical paper writing.
CO2: Explain various principles and styles in technical writing
CO3: Use the acquired knowledge in writing a research/technical paper

CO4: Analyse rights and responsibilities of the holder of Patent, Copyright, Trademark, International Trademark etc.
CO5: Evaluate different forms of IPR available at National & international levels
CO6: Develop skill of making search of various forms of IPR by using dern tools and techniques.

Text Books:

1. Deborah. E. Bouchoux, Intellectual Property Rights, Cengage Learning India, 2013

2. Meenakshi Raman, Sangeeta Sharma. Technical Communication: Principles and Practives. Oxford.

Reference Books:

1. R.Myneni, Law of Intellectual Property, 9th Ed, Asia law House, 2019.

2. Prabuddha Ganguli, Intellectual Property Rights Tata Mcgraw Hill, 2001

3. P.Naryan, Intellectual Property Law, 3rd Ed ,Eastern Law House, 2007.

4. Adrian Wallwork. English for Writing Research Papers Second Edition. Springer Cham Heidelberg New York ,2016

5. Dan Jones, Sam Dragga, Technical Writing Style

Online Learning Resources

1. https://theconceptwriters.com.pk/principles-of-technical-writing/
2. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriti ng.html
3. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriti ng.html
4. https://www.manuscriptedit.com/scholar-hangout/process-publishing-research-paper- journal/
5. https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf
6. https://lawbhoomi.com/intellectual-property-rights-notes/
7. https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf

Mode of Evaluation: Assignments and Mid Term Tests

OPEN ELECTIVE – I

Open Elective – I

23HUM301 INDIAN KNOWLEDGE SYSTEM

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Objectives:

The main objectives of the course is to

1. To introduce the scope, significance, and interdisciplinary nature of Indian Knowledge Systems and their relevance in the modern world.
2. To explore the philosophical and epistemological foundations of Indian Knowledge Systems, including key concepts like Pramāṇa, Dharma, and Rta.
3. To examine the scientific contributions of ancient India in fields such as mathematics, astronomy, medicine, and engineering.
4. To understand Indian perspectives on society, governance, literature, and aesthetics through classical texts and traditions.
5. To appreciate the cultural richness, ethical values, and traditional educational systems that shaped Indian civilization.

UNIT I INDIAN KNOWLEDGE SYSTEM: AN INTRODUCTION 9 hours

Indian Knowledge System: An Overview- Historical evolution and contemporary Relevance-Interdisciplinary approach and integration in education-The Vedic Corpus, The Four Vedas and their components, Oral transmission and cultural continuity--Philosophical Systems, Orthodox (Āstika) and Heterodox (Nāstika) schools, Logic, metaphysics, and epistemology in Indian philosophy -Wisdom through the Ages- Scientific and Mathematical Contributions, Ayurveda, Astronomy, Metallurgy, Mathematics, Key scholars: Charaka, Sushruta, Aryabhata, Bhaskaracharya

UNIT II FOUNDATIONAL CONCEPTS IN INDIAN KNOWLEDGE SYSTEMS 9 hours

Shaping India's intellectual traditions- Ancient Indian linguistics, highlighting phonetics, grammar, and language philosophy-traditional number systems, units of measurement, and their practical applications in science and trade -indigenous frameworks for organizing and classifying knowledge, offering insights into how Indian scholars approached learning, epistemology, and the systemic cultivation of wisdom across disciplines.

UNIT III SCIENCE AND TECHNOLOGY IN INDIAN KNOWLEDGE SYSTEMS 9 hours

India’s classical achievements in mathematics, astronomy, architecture, and science. Learners explore ancient texts and applications—highlighting concepts like zero, planetary motion, and structural design. integration of science with philosophy and sustainability. Through notable scholars and indigenous techniques, how Indian scientific thought continues to influence contemporary innovations-offering wisdom for solving modern challenges.

UNIT IV HUMANITIES AND SOCIAL SCIENCES IN INDIAN KNOWLEDGE SYSTEMS 9 hours

Indian insights on leadership, wellbeing, and governance through ancient texts like the Srimad Bhagavad Gita. Topics include holistic management principles, psychological well-being, ethical governance, and traditional administrative models—emphasizing their relevance to modern society, personal growth, and nation-building.

UNT V CULTURAL, EDUCATIONAL, AND ETHICAL DIMENSIONS OF INDIAN KNOWLEDGE SYSTEMS **9 hours**

Art, Architecture, and Aesthetics-Temple architecture and sculpture-Music, dance, and literary traditions-**Education Systems and Institutions,** Gurukula system and pedagogical practices, Ancient universities: Nalanda, Takshashila-**Ethics and Values in Indian Thought**-Dharma, Karma, Moksha — principles of righteous living, Sustainability, harmony, and spiritual ecology-**Contemporary Relevance and Global Influence,** Indian knowledge systems in modern science and culture, Resurgence through NEP 2020 and academic initiatives

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Learners will be able to **describe** the scope and interdisciplinary relevance of Indian Knowledge Systems in contemporary contexts.

CO2: Learners will be able to **analyze** foundational philosophical concepts such as *Pramāṇa*, *Dharma*, and *Rta* within Indian epistemology.

CO3: Learners will be able to **apply** ancient Indian scientific principles to understand traditional practices in mathematics, astronomy, and medicine.

CO4: Learners will be able to **evaluate** classical Indian texts to interpret perspectives on governance, society, and aesthetics.

CO5: Learners will be able to **design** culturally informed ethical frameworks and educational models inspired by traditional Indian systems.

Reference Books:

1. Introduction to Indian knowledge system: concepts and applications
   By B. Mahadevan , Nagendra Pavana , Vinayak Rajat Bhat, PHI publications
2. Bhagavad Gita: As It Is" by A.C. Bhaktivedanta Swami Prabhupada Published by The Bhaktivedanta Book Trust
3. "Indian Philosophy, Volume 1 and 2 by S. Radhakrishnan Published by Oxford university press.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23MAT301 ADVANCED NUMERICAL METHODS

L	T	P	C
3	0	0	3

Pre-requisite: 23MAT101, 23MAT102

Course Description:

This course reviews and continues the study of computational techniques for evaluating interpolations, derivatives and integrals; solving system of algebraic equations, transcendental equations, ordinary differential equations and partial differential equations. The course emphasizes on numerical and mathematical methods of solutions with appropriate error analysis.

Course Objectives:

The main objectives of the course is to

1. To introduce computation methods of solving algebraic and transcendental equations.
2. To avail the basics of numerical techniques for solving the system of linear equations.
3. To familiarize the knowledge of interpolation and numerical calculus.
4. To use numerical calculus for solving ordinary differential equations.
5. To introduce the computational techniques for solving partial differential equations.

UNIT I SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS 9 hours

Errors, sources of errors, floating point arithmetic, significant digits, relative error, propagation of errors, how to avoid loss of significant digits, evaluation of polynomial. Bisection method, False-position method, Secant method, Fixed-point iteration method, Newton's method – single and multiple roots, Order of convergence of the methods.

UNIT II SOLUTIONS OF SYSTEM OF ALGEBRAIC EQUATIONS 9 hours

LU decomposition, Thomas algorithm for the tridiagonal systems, Norms-Euclidean, mini-maxi, Frobenius and 1-,2- and ∞-norms, Condition numbers and errors in computed solutions. Jacobi's method, Gauss-Seidel method, Power method for obtaining eigenvalues and eigenvectors of matrices.

UNIT III INTERPOLATION & NUMERICAL CALCULUS 9 hours

Existence and Uniqueness of interpolating polynomial, Lagrange polynomials, Divided differences, Evenly spaced points, Error of interpolation, cubic spline, Inverse interpolation, Derivatives from difference table, Higher order derivatives, Trapezoidal rule, Simpsons rule, a composite formula, Gaussian Quadrature.

UNIT IV NUMERICAL SOLUTIONS TO ORDINARY DIFFERENTIAL EQUATIONS 9 hours

Taylor series method, Euler and Modified Euler's method, Runge-Kutta methods for initial value problems, Shooting method, Finite difference method for boundary value problems.

UNIT V NUMERICAL SOLUTIONS TO PARTIAL DIFFERENTIAL EQUATIONS 9 hours

Laplace and Poisson equations (five-point formula), Finite difference methods for one-dimensional Heat and Wave equations.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Solve the system of algebraic and transcendental equations.

CO2: Apply the numerical techniques to find the solution to system of equations.

CO3: Calculate and analyze the rate of variations and numerical sum of such changes using numerical calculus relevant to the field of Engineering.

CO4: Find the accurate numerical solutions to ordinary differential equations representing some Engineering problems.

CO5: Compute the solutions for engineering problems represented by partial differential equations.

Text Books:

1. Curtis F. Gerald, Patrich O. Wheatley, Applied Numerical Analysis, Pearson Education, 7th Edition, 2003.

2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, 43rd edition (2014), Khanna publishers.

2. Burden and Faires, Numerical Analysis 7th ed., Thomson Learning, 2001.

3. E. Kreyszig, Advanced Engineering Mathematics, 10th ed., Wiley, 2010.

4. Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven C. Chapra, 3rd ed., Mc Graw Hill, 2012.

5. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering, New Age International Ltd., 5th Edition, 2010.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23MAT302 ENGINEERING OPTIMIZATION

L	T	P	C
3	0	0	3

Pre-requisite: 23MAT101, 23MAT102, 23MAT104

Course Description:
Unconstrained and constrained optimization, Linear programming problem, transportation and assignment problems, dynamic programming problem, project management and queuing models.

Course Objectives:
The main objectives of the course is to

1. Understand the optimization techniques for solving engineering problems.
2. Formulate and solve linear programming problem.
3. Obtain the optimal solution for transportation and assignment problems.
4. Avail knowledge to apply the game theory and project management techniques to find the solutions to the complex problems.
5. Understand the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.

UNIT I CLASSICAL OPTIMIZATION 9 hours

Introduction to optimization, unconstrained optimization with single variable and multi variable. Constrained multivariable optimization with equality constraints- Lagrange multipliers method, constrained multivariable optimization with inequality constraints - Kuhn-Tucker conditions.

UNIT II LINEAR PROGRAMMING PROBLEM 9 hours

Linear Programming Problem (LPP), Mathematical formulation, graphical solution, simplex method. Artificial variable technique - Big M-method and two phase simplex method. Duality, dual Simplex method.

UNIT III TRANSPORTATION PROBLEM AND ASSIGNMENT PROBLEM 9 hours

Transportation problem: definition and algorithm, transshipment problem. Assignment problem, travelling salesman problem.

UNIT IV GAME THEORY AND PROJECT MANAGEMENT 9 hours

Formulation of games, Two Person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property. Network analysis: Network representation, Critical Path Method (CPM) and Project Evolutionary and Review Technique (PERT).

UNIT V QUEUING MODELS 9 hours

Introduction to queuing system, Birth and Death processes, Single and multiple server queueing models, Little's formula - Finite Calling Population Queuing Models – Multi-Phase Service Queuing Model.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understood the importance of unconstrained and constrained optimization to solve engineering problems.

CO2: Get an idea about the linear programming techniques.

CO3: Solve transportation and assignment problems in engineering situations.

CO4: Analyze the problems of network analysis for project management and game theory.

CO5: Apply the Queuing system models to solve problems in engineering & industry.

Text Books:

1. J K Sharma, Operations Research: Theory and Practice, Macmillan Publishers India Ltd, 5th edition,2013.

2. B.S. Grewal, Higher Engineering Mathematics, 43rd edition (2014), Khanna publishers.

Reference Books:

1. Hamdy A Taha, Operations Research: An Introduction, Pearson Education, 9/E, 2011.

2. FS Hillier and GJ Lieberman, Introduction to Operations Research, TMH, 8/E, 2006.

3. JC Pant, Introduction to Optimization: Operations Research, Jain Brothers, New, 6/E, 2004.

4. A Ravindran, DT Philips and JJ Solberg, Operations Research: Principles and Practice, John Wiley& Sons, Singapore, 2nd edition.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23PHY301 LASER PHYSICS AND ADVANCED LASER TECHNOLOGY

L	T	P	C
3	0	0	3

Pre-requisite: Basic knowledge of atomic structure at intermediate (10+2) level is sufficient

Course Description:

Laser usage is rampant in various technological applications. Several fields gaining attention in the usage of lasers. This course covers the introduction to the theory and mechanism of laser action, various types of lasers and their applications and future use.

Course Objectives:

The main objectives of the course is to

1. Make the student to understand the detailed principles of various lasers.
2. Profound understanding of different variety of lasers will provide them to think of superior selection and usage of lasers in practical technological applications.
3. Students are aware of latest developments in certain areas of Laser technology which have important applications for societal needs.
4. Explain how material processing is accomplished with lasers. Estimate laser operation parameters for material processing.
5. Exposure about Lasers applications in engineering, communications, spectroscopy and material process etc.

UNIT I INTRODUCTION TO LASER TECHNOLOGY 9 hours

Laser characteristics, The Einstein Coefficients, Absorption and Emission Cross Sections, Spontaneous and Stimulated emission of radiation, Population inversion, Methods of Population Inversion, Laser Rate Equations, stable two minor optical resonators, Mode selection, Gain in the regenerative laser cavity.

UNIT II GASES AND LIQUIDS LASING MEDIUM 9 hours

Energy levels & Radiative properties of Atoms and molecules**;** *Atomic lasers*: He-Ne laser, Argon Ion laser**;** *Molecular Lasers*: Carbon dioxide laser, Liquid energy levels and their radiative properties, Organic Dye laser.

UNIT III SOLID STATE LASERS 9 hours

Energy Levels in solids-dielectric medium, Solid-state lasing materials, Narrow line width laser materials, broad band line width laser materials, solid state lasers: Nd:YAG, Nd:YLF; Ti:Sapphire (introduction only)

Energy Levels in solids-semiconductor medium, direct and indirect band gap semiconductors, Semiconductor diode laser, Quantum dot lasers (Introduction only)

UNIT IV PULSED OPERATION OF LASERS 9 hours

Nanosecond: Q-Switching, Techniques of Q-Switching: electro-optic, Acousto-Optic.Femtosecond: Relationship between pulse duration and Spectral Width, Passive mode-locking, Active mode locking, Kerr lens mode locking, Amplification of femtosecond pulses.

UNIT V LASER APPLICATIONS 9 hours

Laser processing of materials: laser cutting, laser drilling, welding; Lasers in metrology- Accurate measurement of length, light wave communications; Laser spectroscopy: Laser fluorescence and Raman scattering.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the principle of phenomenon of laser and identify the operating principle involved in various type of lasers.

CO2: Estimate stability requirements in producing laser light by different types of sources

CO2: CO3: Differentiate or list the various types of lasers and their means of excitation.

CO4: Assess (Identify) which laser would best meet the need for a particular industrial or research task.

CO5: Student can knowledge of latest technological developments in laser technology. Femtosecond laser etc.

Text Books:

1. Laser Fundamentals: William T Silfvast. Cambridge Publication.

2. Laser Theory and Applications: A.K. Ghatak and K. Thyagarajan, Springer

3. Femtosecond Laser Pulses Principles and Experiments: Claude Rulli`ere, Springer

4. Principles of Laser: O. Svelto

5. Laser Physics: Peter W Miloni, Joseph H Eberly.

Reference Books:

1. Solid State Laser Engineering: Walter Koechner. Springer series in optical sciences.

2. Ultrafast Optics, Andrew M. Weiner

3. Laser spectroscopy: Demtroder

4. Laser Applications: Monte Ross

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23PHY302 THIN FILM TECHNOLOGY AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:

Nucleation, crystallization, surface energy, various thin film coating processes including both physical vapour deposition such as evaporation, sputtering, pulsed laser deposition and chemical vapour deposition, spray coating, and other methods such as spin-coating, plasma polymerization, Langmuir Blodgett, transport phenomena in thin films, various properties of thin films, techniques and method to characterize thin films, current application of thin film, introduction to fabrication of thin film devices

Course Objectives:

The main objectives of the course is to

1. To provide students with a comprehensive overview on the fundamentals of thin film preparation and characterization.
2. To enable the students to develop a thorough understanding of how core physics can be used to understand thin film deposition processes.
3. To establish the correlation between processing variables and materials characteristics and performance within the framework of key modern technologies.
4. To realize thin film applications to science and technology

UNIT I PHYSICS OF THIN FILMS 8 hours

Introduction - Role of thin films in devices - Thin film definition - Crystalline and amorphous films - Crystal defects - Nucleation and growth - film formation.

UNIT II THIN FILM DEPOSITION TECHNIQUES 10 hours

Physical methods of films deposition-evaporation, e-beam, sputter deposition, pulsed laser, molecular beam epitaxy. Chemical methods of film deposition -Deposition of Inorganic films from Solutions-Chemical vapour deposition - Electrolysis, Anodization, Spray pyrolysis, Other techniques: Langmuir Blodgett and Spin Coating.

UNIT III PROPERTIES OF THIN FILMS 8 hours

Structural-Optical-Electrical-Magnetic-Mechanical and Thermal properties of thin films

UNIT IV CHARACTERIZATION OF THIN FILMS 10 hours

Imaging Techniques (SEM, AFM, TEM) - Structural Techniques (XRD, Raman)-Optical Techniques (UV-Vis-NIR, PL)-Electrical Techniques (Hall Effect, IV, CV)-Magnetic Techniques (EPR, H-V curve)-Mechanical Techniques (Hardness testing)-Thickness measurement (profilometer, ellipsometry).

UNIT V APPLICATIONS OF THIN FILMS 9 hours

Transparent conducting coating - Optical coating – Solar cells – Photocatalytic – Sensors - Superconductivity- Superhard coatings – Thin film transistors.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Discuss the differences and similarities between different vacuum based deposition techniques, evaluate and use models for nucleating and growth of thin films.

CO2: Asses the relation between deposition technique, film structure, and film properties.

CO3: Know the typical thin film applications.

CO4: Motivate selection of deposition techniques for various applications.

Text Books:

1. Thin Film Deposition: Principles and Practice, *Donald L. Smith,* McGraw Hill, Singapore, 2001.

2. Maissel, L.I and Glang. R, "Handbook of thin film technology", McGraw Hill, 1970.

Reference Books:

1. Thin film phenomena / *Kasturi L. Chopra,* New York: McGraw-Hill, c1969.

2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications" Imperial College Press, 2004.

3. An introduction to physics and technology of thin films / *Alfred Wagendristel, Yuming Wang,* Singapore: World Scientific, c1994.

4. Thin film processes, *John L Vossen, Werner Kehn* editors, Academic Press, New York, 1978.

5. Thin film physics / *O.S. Heavens,* London: Methuen, c1970.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23PHY303 WASTE TO SUSTAINABLE ENERGY AND ENERGY SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: Basic knowledge of Physics and chemistry at the intermediate (10+2) level is sufficient

Course Description:

This course covers waste-to-energy conversion and energy storage technologies, including thermal, biological, and chemical methods. It introduces relevant policies, case studies, and trends to help students design sustainable energy solutions aligned with the circular economy and climate goals.

Course Objectives:

The main objectives of the course is to

1. Understand various methods of energy generation from waste.
2. To explore thermal, biological, and chemical conversion technologies.
3. To examine modern energy storage devices and their integration with waste-to-energy systems.
4. To analyse the techno-economic feasibility of these systems for sustainable development.
5. To develop interdisciplinary skills in waste-to-energy technologies, enhancing student employability in sustainable energy and environmental sectors.

UNIT I INTRODUCTION TO WASTE PROCESSING, TRANSPORT, AND MANAGEMENT **9 hours**

Types of Wastes, Agricultural Residues, and Wastes Including Animal Wastes, Industrial Wastes, Municipal Solid Wastes and Characterization. Waste Processing Types and Composition of Various Types of Wastes- Industrial Waste and Biomedical Waste- Waste Collection and Transportation- Waste Processing- Size Reduction, Separation- Waste Management Hierarchy- Waste Minimization and Recycling of Municipal Solid Waste.

UNIT II THERMAL WASTE CONVERSION TECHNOLOGIES **9 hours**

Combustion, incineration, pyrolysis, gasification, Process parameters, design considerations, Emission control, energy recovery, and Case studies of WTE (Waste to Energy) plants in India and abroad

UNIT III BIOLOGICAL AND CHEMICAL CONVERSION **9 hours**

Bio gasification: Biomethanation process, biogas digester types. Chemical Conversion: Hydrolysis & hydrogenation; solvent extraction of hydrocarbons; solvolysis of wood, bio crude, biodiesel production via chemical process; transesterification methods; Chemicals from biomass.

UNIT IV ENERGY STORAGE SYSTEMS **9 hours**

Introduction to Energy Storage Systems - Types of energy storage- electrical, mechanical, chemical, thermal; Batteries (Li-ion, lead-acid, flow batteries), Supercapacitors and hybrid storage, Hydrogen storage and fuel cells.

UNIT V WASTE MANAGEMENT AND ENERGY RECOVERY **9 hours**

Characteristics and Perspectives of Waste, Unit Operations & Transformation Technologies, Waste Disposal, Hazardous Waste Management & Waste Recycling

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: To understand various methods of energy recovery from waste.

CO2: To explore thermal conversion technologies.

CO3: To explore biological and chemical conversion technologies

CO4: To examine modern energy storage devices and their integration with waste-to-energy systems.

CO5: To analyse the techno-economic feasibility of these systems for sustainable development.

Text Books:

1. Waste-to-Energy. Technologies and Project Implementation by Marc J. Rogoff And Francois Screve (Auth.) Publisher: William Andrew, 2011/2019
2. Robert C. Brown Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power, John Wiley and Sons, 2019.
3. Sergio Capareda, Introduction to Biomass Energy Conversions, CRC Press, 2013.
4. Fundamentals of Energy Storage, J. Jensen, B. Squrensen, John Wiley, NY
5. Techobanoglous, Theisen, and Vigil, "Integrated Solid Waste Management", 2d Ed. McGraw-Hill, New York, 1993.

Reference Books:

1. Industrial and Urban Waste Management in India, TERI Press
2. B. Lal and M. Patwardhan, "Wealth from Waste: Trends and Technologies", TERI Press
3. Municipal Solid Waste to Energy Conversion Processes: Processes Technical, and Renewable comparisons, by Gary C. Young, ISBN:9780470539675, Publisher: John Wiley & Sons, Publication Date: June 2010.
4. Parker Colin, and Roberts, "Energy from Waste – An Evaluation of Conversion Technologies", Elsevier Applied Science, London, 1985.
5. La Grega, M., et al., "Hazardous Waste Management", McGraw-Hill, c. 1200 pp., 2nd ed.,2001

Journals & Reviews:

1. Updated Journals and Reviews of the last 5 Years
2. Home (https://swayam.gov.in) > Courses (https://swayam.gov.in/explorer) > Waste to Energy Conversion, By Prof. P. Mondal | IIT Roorkee

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23CHE301 CHEMISTRY OF POLYMERS AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives:

The main objectives of the course is to

1. To understand the basic principles of polymers
2. To understand natural polymers and their applications.
3. To impart knowledge to the students about synthetic polymers, their preparation and importance.
4. To enumerate the applications of hydogel polymers
5. To enumerate applications of conducting and degradable polymers in engineering.

UNIT I POLYMERS-BASICS AND CHARACTERIZATION:- 9 hours

Basic concepts: monomers, repeating units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: addition, condensation, copolymerization and coordination polymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution. Measurement of molecular weight: End group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

UNIT II NATURAL POLYMERS & MODIFIED CELLULOSICS 9 hours

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEA.

UNIT III SYNTHETIC POLYMERS 9 hours

Addition and condensation polymerization processes– Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers based on different types of monomers, Olefin polymers(PE,PVC), Butadiene polymers(BUNA-S,BUNA-N), nylons, Urea-formaldehyde, phenol – formaldehyde, Melamine Epoxy and Ion exchange resins.

UNIT IV HYDROGELS OF POLYMER NETWORKS 9 hours

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

UNIT V CONDUCTING AND DEGRADABLE POLYMERS: 9 hours

Conducting polymers: Introduction, Classification, Mechanism of conduction in Poly Acetylene, Poly Aniline, Poly Thiophene, Doping, Applications.

Degradable polymers: Introduction, Classifications, Examples, Mechanism of degradation, poly lactic acid, Nylon-6, Polyesters, applications.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Classify the polymers, explain polymerization mechanism, differentiate addition, condensation polymerizations, Describe measurement of molecular weight of polymer

CO2: Describe the physical and chemical properties of natural polymers and Modified cellulosics.

CO3: Differentiate Bulk, solution, Suspension and emulsion polymerization, describe fibers and elastomers, Identify the thermosetting and thermo polymers.

CO4: Identify types of polymer networks, describe methods involve in hydrogel preparation, Explain applications of hydrogels in drug delivery,

CO5: Explain classification and mechanism of conducting and degradable polymers.

Text Books:

1. A Text book of Polymer science, Billmayer
2. Polymer Chemistry – G.S.Mishra
3. Polymer Chemistry – Gowarikar

Reference Books:

1. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
2. Advanced Organic Chemistry, B.Miller, Prentice Hall
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

Online Learning Resources

1. https://nptel.ac.in/courses/104105124

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23CHE302 GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives:

The main objectives of the course is to

1. Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry
2. Sensitize the students in redesigning of chemicals, industrial processes and products by means of catalysis.
3. Understand the use of alternatives assessments in using environmentally benign solvents.
4. Emphasize current emerging greener technologies and the need of alternative energies.
5. Learn to adopt green chemistry principles in practicing Nanoscience

UNIT I PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY 9 hours

Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation.

UNIT II CATALYSIS AND GREEN CHEMISTRY 9 hours

Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites: Catalytic cracking, ZSM-5 catalyst and high silica zeolites, TS1 Oxidation catalyst, Catalytic Converters, Homogeneous catalysis: Hydrogenation of alkenes using wilkinson's catalyst, Phase transfer catalysis: Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide.

UNIT III ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS 9 hours

Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbondioxide, super critical water and water as a reaction solvent: water based coatings, Ionic liquids as catalyst and solvent.

UNIT IV EMERGING GREENER TECHNOLOGIES AND ALTERNATIVE ENERGY SOURCES 9 hours

Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Fuel Cells(Hydrogen—oxygen fuel cell), Photochemical Reactions: Advantages of and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions(caprolactum), Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry.

UNIT V GREEN PROCESSES FOR GREEN NANOSCIENCE 9 hours

Introduction and traditional methods in the nanomaterials synthesis, Translating green chemistry principles for practicing Green Nanoscience. Green Synthesis of Nanophase Inorganic Materials and Metal Oxide Nanoparticles: Hydrothermal Synthesis, Reflux Synthesis, Microwave-Assisted Synthesis, Other methods for Green synthesis of metal and metal oxide nanoparticles, Green chemistry applications of Inorganic nanomaterials

Course Outcomes:

Upon completion of this course the students should:

CO1: Recognize green chemistry concepts and apply these ideas to develop respect for the interconnectedness of our world and an ethic of environmental care and sustainability.
CO2: Understand and apply catalysis for developing eco-friendly processes.
CO3: Be in a position to use environmental benign solvents where ever possible.
CO4: Have knowledge of current trends in alternative energy sources.
CO5: Apply green chemistry principles in practicing green Nanoscience.

Text Books:

1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4th Edition, Oxford University Press, USA

Reference Books:

1. Edited by Alvise Perosa and Maurizio Selva , Hand Book of Green chemistry Volume 8: Green Nanoscience, wiley-VCH
2. Advanced Organic Chemistry, B.Miller, Prentice Hall
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

Online Learning Resources

1. https://nptel.ac.in/courses/104105124

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23CHE303 CHEMISTRY OF ENERGY SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course Objectives:

1. To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
2. To understand the basic concepts of processing and limitations of Fuel cells & their applications.
3. To impart knowledge to the students about fundamental concepts of photo chemical cells, reactions and applications
4. Necessasity of harnessing alternate energy resources such as solar energy and its basic concepts.
5. To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method.

UNIT I ELECTROCHEMICAL SYSTEMS 9 hours

Galvanic cell, Nernst equation, standard electrode potential, application of EMF, electrical double layer, polarization, Batteries- Introduction ,Lead-acid ,Nickel- cadmium, Lithium ion batteries and their applications**.**

UNIT II FUEL CELLS 9 hours

Fuel cell- Introduction, Basic design of fuel cell, working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency and applications.

UNIT III PHOTO AND PHOTO ELECTROCHEMICAL CONVERSIONS 9 hours

Photochemical cells Introduction and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions and their applications.

UNIT IV SOLAR ENERGY 9 hours

Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells and applications.

UNIT V HYDROGEN STORAGE 9 hours

Hydrogen storage and delivery: State-of-the art, Established technologies, Chemical and Physical methods of hydrogen storage, Compressed gas storage, Liquid hydrogen storage, Other storage methods, Hydrogen storage in metal hydrides, metal organic frameworks (MOF), Metal oxide porous structures, hydrogel , and Organic hydrogen carriers.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Solve the problems based on electrode potential, Describe the Galvanic Cell Differentiate between Lead acid and Lithium ion batteries, Illustrate the electrical double layer

CO2: Describe the working Principle of Fuel cell, Explain the efficiency of the fuel cell Discuss about the Basic design of fuel cells, Classify the fuel cell

CO3: Differentiate between Photo and Photo electrochemical Conversions, Illustrate the photochemical cells, Identify the applications of photochemical reactions, Interpret advantages of photoelectron catalytic conversion.

CO4: Apply the photo voltaic technology, Demonstrate about solar energy and prospects Illustrate the Solar cells, Discuss about concentrated solar power

CO5: Differentiate Chemical and Physical methods of hydrogen storage, Discuss the metal organic frame work, Illustrate the carbon and metal oxide porous structures
Describe the liquification methods.

Text Books:

1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins

Reference Books:

1. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services And corporation)
2. Hand book of solar energy and applications by ArvindTiwari and Shyam.
3. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
4. Hydrogen storage by Levine Klebonoff

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23CE301 DISASTER MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisites: None

Course Description:

The goal of this course is to expose the undergraduate students to different types of disasters and the preparedness needed to mitigate their effects. The course matrix will cover various natural, biological, chemical, and emerging hazards and risks that may cause property loss, loss of lives, and livestock. Thus, the future engineers will understand the social responsibility for the preparedness and mitigation of the damages caused by the disasters.

Course Objectives:

1. To make the students aware of disasters and their impact on living beings.
2. To ensure the students understand vulnerability, disasters, disaster prevention, and risk reduction.
3. To gain a preliminary understanding of approaches for the Disaster Risk Reduction (DRR)
4. To enhance awareness of institutional processes available in the country for disaster risk mitigation.
5. To make the students aware of development activities and case studies.

UNIT I INTRODUCTION 8 hours

Introduction, Etymology of disaster, Concepts and definitions: disaster, hazard, vulnerability, risks, Resilience, prevention, and mitigation.

UNIT II TYPES OF DISASTERS 10 hours

Types of Disaster; natural disasters (earthquakes, volcanoes, forest fires and explosions, heat and cold waves, floods, draught, cyclones, tsunami, landslides, soil erosion); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.), hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT III DISASTER IMPACTS 9 hours

Disaster Impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT IV DISASTER RISK MITIGATION MEASURES 9 hours

Disaster Risk Reduction (DRR) - Disaster management- four phase approach; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications), DRR programmers in India and the activities of National Disaster Management Authority. Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction.

UNIT V IMPACT OF DEVELOPMENTAL ACTIVITIES 9 hours

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization, etc.), sustainable and environmental friendly recovery; reconstruction and development methods. Different GIS software, basic data types and coordinate systems. Case studies.

Course Outcomes:

The students after completing the course will be able to:

CO1: Explain various disaster concepts
CO2: Differentiate between categories of disasters
CO3: Analyze the impact of various types of disasters
CO4: Select disaster risk mitigation measures
CO5: Identify the impact of development activities

Text Books:

1. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

Reference Books:

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster Management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
6. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23CE302 GREEN BUILDINGS

L	T	P	C
3	0	0	3

Pre-requisites: None

Course Description:

The course covers various aspects of bioclimatic architecture like climate-sensitive design, passive solar architecture, Water management, green building materials and construction techniques

Course Objectives:

1. To introduce concepts of sustainability and bioclimatic design in planning, Construction and life of buildings.
2. To equip students with technical knowledge of energy-efficient Green Buildings.
3. To guide students, through projects, to apply concepts and ideas for the design of a green building by introducing them to green initiatives and ratings.
4. To initiate students in basics of functional design and drawing of the various buildings using the above concepts.
5. To understand different evaluation criteria with various green building rating systems

UNIT I GREEN BUILDING CONCEPTS 9 hours

Introduction to bioclimatic architecture- Sustainability in building science and Functional planning- Orientation- Elements of building design and drawing- Building regulations and by-laws
Traditional and Vernacular Architecture- Climate zones- Design Charts- sun path diagram- Solar angles- Indices of thermal comfort- Vernacular buildings in different climate zones.

UNIT II CLIMATE RESPONSIVE SCIENTIFIC PROCESS OF DESIGN 9 hours

Introduction- various steps in Site planning- Plan for Building envelope- Land form-Topography-vegetation- water bodies; Orientation- S/V ratio- P/A ratio- Walls, Fenestration- Roof and floors- Active and passive solar strategies- Passive solar architecture.

UNIT III THERMAL FLOW IN BUILDINGS 9 hours

Calculation of thermal conductance- Heat flow through different building elements- Ventilation and day lighting- Design and placement of openings- Water management in buildings- Techniques to recycle, reuse and harvest water.

UNIT IV GREEN BUILDING MATERIALS AND CONSTRUCTION 9 hours

Material properties- Energy efficiency using various materials- emerging new materials, Construction techniques- Techniques for roof, wall and foundations.

UNIT V ECONOMY OF GREEN BUILDING 9 hours

Cost of building- operation and maintenance- Green building rating system- Evaluation criteria of LEED- TERI - GRIHA case studies- Case studies in different climate zones.

Course Outcomes:

After successful completion of this course, the student will be able to:

CO1: Use various regulations and by-laws for green building construction.
CO2: Do site planning, active and passive for Green Building.
CO3: Compute thermal flow through different building elements.
CO4: Identify energy efficient building materials and construction techniques for building components.
CO5: Compute cost of building/operation and maintenance, evaluation criteria for different case studies.

Text Books:

1. Krishnan, A., Baker, N., Yannas, S., & Szokolay, S. (Eds.). (2001). Climate responsive architecture, a design handbook for energy efficient buildings. New Delhi: Tata McGraw Hill Publishing Company.
2. TERI & ICAEN (InstitutCatalad'Energia). (2004). Sustainable building design manual (Vol II). New Delhi: The Energy and Resources Institute (TERI) Press

Reference Books:

1. Bureau of Indian Standards. (1995). SP:41, Handbook on functional requirements of Buildings (other than industrial buildings) (First reprint ed.). New Delhi: Bureau of Indian Standards.
2. Indian Green Building Council, LEED-India. (2011). LEED 2011 for India- Green building rating system, abridged reference guide for new construction and major renovations (LEED India NC). Hyderabad: Indian Green Building Council
3. Koenigsberger, O., ingersoll, T. G., Mayhew, A., & Skozolay, S. V. (2011). Manual of Tropical Housing and Building. Hyderabad: Universities Press
4. Prabhu, Balagopal T S, K Vincent Paul, and C Vijay an. Building Design and Drawing. Calicut: Spades Publishers, 2008
5. Szokolay, S. V. (2008). Introduction to Architectural Science- The Basis of sustainable Design (Second ed.). Architectural Press/Elsevier
6. The Energy and Resources Institute (TERI). (2011). Green Rating for Integrated Habitat Assessment (GRIHA) manual. New Delhi: TERI press
7. Journals: Energy and Buildings, Building and Environment, Other relevant publications.
8. National Building Code, Bureau of Indian Standards: New Delhi. 2005; Building Bye laws and building rules of selected Indian urban and rural areas
9. Swamy, N. K., & Rao, A. K. (2013). Building planning and Drawing, New Delhi, Charothar Publishing House

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23ME301 MATERIALS SCIENCE FOR ENGINEERS

L	T	P	C
3	0	0	3

Pre-requisite: 23PHY101 ENGINEERING PHYSICS

Course Objectives:

This course is designed to:

1. Understand the fundamental classification and properties of engineering materials.
2. Explore the structure, properties, and applications of metals and alloys.
3. Gain knowledge on composite materials and their relevance in engineering fields.
4. Learn about the structure and characteristics of ceramics and polymers.
5. Develop an appreciation of smart and advanced materials for modern technologies.

UNIT I CLASSIFICATION OF MATERIALS **9 hours**

Introduction to materials science, Classification: Metals, Ceramics, Polymers, Composites, Semiconductors, Biomaterials, Properties: Mechanical, Electrical, Thermal, Optical, Magnetic, Atomic structure and bonding, Crystal structures and defects, Structure–property relationships, Materials selection charts for engineering design.

UNIT II METALS AND ALLOYS **9 hours**

Types of metals: Ferrous and non-ferrous, Microstructure of metals, Phase diagrams (binary alloys), Heat treatment of steels, Corrosion and prevention methods, Mechanical behavior and testing: Stress-strain, hardness, fatigue, Common engineering alloys and their applications.

UNIT III COMPOSITES **9 hours**

Definition and classification: Particle-reinforced, fiber-reinforced, structural composites, Matrix materials: Polymer, metal, and ceramic matrix, Manufacturing techniques: Hand lay-up, pultrusion, Powder Metallurgy, Slurry Infiltration and Sintering, Properties and performance, Applications in aerospace, automotive, construction, and electronics.

UNIT IV CERAMICS AND POLYMERS **9 hours**

Structure and types of ceramics: Crystalline and amorphous, Properties: Thermal resistance, brittleness, conductivity, Processing of ceramics: Sintering, slip casting, hot pressing, Types of polymers: Thermoplastics, thermosets, elastomers, Polymerization processes: Addition and condensation, Mechanical and thermal properties, Applications in electronics, biomedical, and structural sectors.

UNIT V SMART AND ADVANCED MATERIALS **9 hours**

Definition and need for smart materials, Shape memory alloys, piezoelectric materials, magnetostrictive materials, Electroactive polymers, self-healing materials, photonic crystals, Nanomaterials and carbon-based materials (graphene, CNTs), Biomaterials and biocompatibility, Materials for electronics, aerospace, and green energy systems, Emerging trends and future directions.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Identify and classify materials based on their properties and structure.
CO2: Understand the behaviour and applications of metals and alloys in engineering.
CO3: Compare the types and uses of composites in structural and functional applications.
CO4: Understand the processing and properties of ceramics and polymers.
CO5: Identify the emerging applications of smart and advanced materials in multidisciplinary domains.

Text Books:

1. Callister, W. D., & Rethwisch, D. G. (2020). Materials science and engineering: An introduction (10th ed.). Wiley.
2. Smith, W. F., Hashemi, J., & Prakash, R. (2021). Materials science and engineering (6th ed., SI units). McGraw Hill Education.
3. Upadhyaya, G. S., & Upadhyaya, A. (2022). Materials science and engineering (Revised ed.). Viva Books.

Reference Books:

1. Raghavan, V. (2018). Materials science and engineering (6th ed.). Prentice Hall of India.
2. C. Barry Carter and M. Grant Norton, Ceramic Materials: Science and Engineering, Springer, 3rd Edition, 2023.
3. Bhattacharya, D. (2023). Smart materials and structures (2nd ed.). Oxford University Press.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective – I

23ME302 SUSTAINABLE ENERGY TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives:

This course is designed to:

1. Introduce the global and national energy scenario and emphasize the importance of sustainability in energy systems.
2. Explain the principles and technologies associated with solar and wind energy systems.
3. Familiarize students with hydropower, wave, and tidal energy generation systems and their real-world applications.
4. Describe bioenergy and geothermal systems, including design considerations and environmental implications.
5. Evaluate the economics of renewable energy projects and explore integration techniques including storage and smart grids.

UNIT I INTRODUCTION TO SUSTAINABLE ENERGY SYSTEMS 9 hours

Energy demand and supply scenario – global and Indian context, Environmental impacts of conventional energy sources, Concept of sustainability and carbon footprint, Overview of renewable energy sources, Policy frameworks and SDGs.

UNIT II SOLAR AND WIND ENERGY TECHNOLOGIES 9 hours

Solar radiation basics, types of solar collectors (thermal and photovoltaic), Photovoltaic cell operation, efficiency factors, MPPT basics, Solar thermal applications: water heating, drying, Wind resource assessment, turbine types and operation, Onshore vs offshore wind power.

UNIT III HYDROPOWER, WAVE, AND TIDAL ENERGY 9 hours

Types of hydropower plants, turbine types, site selection, Ocean energy: wave and tidal principles, design concepts, Challenges in marine energy utilization, Case studies from India and abroad.

UNIT IV BIOENERGY AND GEOTHERMAL TECHNOLOGIES 9 hours

Biomass types, anaerobic digestion, biodiesel, bioethanol, Biogas plant design and efficiency, Geothermal energy basics, types of geothermal systems, Environmental and economic impacts.

UNIT V ECONOMICS AND INTEGRATION OF RENEWABLE ENERGY 9 hours

Economic analysis: LCOE, payback, IRR, Energy storage technologies: batteries, pumped hydro, Grid integration issues and smart grids, Future trends: hybrid systems, microgrids, hydrogen. Concept of waste to wealth.

Course Outcomes:

At the end of the course, the student will be able to:

CO1: Explain the global and Indian energy scenario, sustainability concepts, and the role of renewable energy in achieving SDGs. (L2)

CO2: Analyze the working principles, components, and efficiency factors of solar and wind energy systems. (L3)

CO3: Illustrate the operation and site requirements of hydropower, wave, and tidal energy systems with relevant case studies. (L2)

CO4: Apply basic design and performance analysis for bioenergy and geothermal energy systems considering environmental aspects. (L3)

CO5: Evaluate the techno-economic feasibility of renewable energy systems and their integration into smart grids with energy storage. (L3)

Text Books:

1. Boyle, G. (2021). Renewable energy: Power for a sustainable future (4th ed.). Oxford University Press.
2. Twidell, J., & Weir, T. (2021). Renewable energy resources (4th ed.). Routledge.
3. Kothari, D. P., Singal, K. C., & Ranjan, R. (2020). Renewable energy sources and emerging technologies (3rd ed.). PHI Learning.

Reference Books:

1. Sorensen, B. (2019). Renewable energy: Physics, engineering, environmental impacts, economics & planning (5th ed.). Academic Press.
2. Kalogirou, S. A. (2022). Solar energy engineering: Processes and systems (3rd ed.). Academic Press.
3. Lund, H. (2021). Renewable energy systems: A smart energy systems approach to the choice and modeling of 100% renewable solutions (4th ed.). Academic Press.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective - I

23EEE301 ELECTRICAL SAFETY PRACTICES AND STANDARDS

	L	T	P	C
Pre-requisite: 23EEE101	**3**	**0**	**0**	**3**

Course Objectives:

1. To introduce the fundamentals of electrical safety, hazards of electric shock, arc, blast, and failure causes.
2. To explain the function and importance of electrical safety components, voltage classification, and protection devices.
3. To impart knowledge on grounding systems, bonding, and arc hazard categorization to ensure workplace safety.
4. To develop awareness about safety practices across various environments including residential, industrial, and special installations.
5. To familiarize students with relevant electrical safety standards, statutory regulations, and compliance requirements.

UNIT I INTRODUCTION TO ELECTRICAL SAFETY: **9 hours**

Fundamentals of Electrical safety-Electric Shock- physiological effects of electric current - Safety requirements –Hazards of electricity- Arc - Blast- Causes for electrical failure.

UNIT II SAFETY COMPONENTS **9 hours**

Introduction to conductors and insulators- voltage classification -safety against over voltages- safety against static electricity-Electrical safety equipment‘s - Fire extinguishers for electrical safety.

UNIT III GROUNDING **9 hours**

General requirements for grounding and bonding- Definitions- System grounding-Equipment grounding - The Earth - Earthing practices- Determining safe approach distance-Determining arc hazard category.

UNIT IV SAFETY PRACTICES **9 hours**

General first aid- Safety in handling hand held electrical appliances tools- Electrical safety in train stations-swimming pools, external lighting installations, medical locations-Case studies.

UNIT V STANDARDS FOR ELECTRICAL SAFETY **9 hours**

Electricity Acts- Rules & regulations- Electrical standards-NFPA 70 E-OSHA standards-IEEE standards-National Electrical Code 2005 – National Electric Safety code NESC-Statutory requirements from electrical inspectorate.

Course Outcomes:

CO1: Understand the fundamental principles of electrical safety and the physiological effects of electric shock-L2

CO2: Apply knowledge of electrical safety components and protective devices to mitigate over-voltages and static hazards -L3

CO3: Analyze equipment grounding, system grounding, and arc flash hazard categories in practical installations -L4

CO4: Implement appropriate safety procedures in varied environments such as homes, public spaces, and medical areas- L4

CO5: Evaluate the applicability and compliance of electrical systems with respect to national and international safety standards-L5

Text Books:

1. Massimo A.G.Mitolo, ―Electrical Safety of Low-Voltage Systems‖, McGraw Hill, USA, 2009.
2. Mohamed El-Sharkawi, ―Electric Safety - Practice and Standards‖, CRC Press, USA, 2014.

Reference Books:

1. Kenneth G.Mastrullo, Ray A. Jones, ―The Electrical Safety Program Book‖, Jones and Bartlett Publishers, London, 2nd Edition, 2011.
2. Palmer Hickman, ―Electrical Safety-Related Work Practices‖, Jones & Bartlett Publishers, London, 2009.
3. Fordham Cooper, W., ―Electrical Safety Engineering‖, Butterworth and Company, London, 1986.
4. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, ―Electrical Safety Hand book, McGraw-Hill, New York, USA, 4th edition, 2012.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective-I

23EEE302 INTRODUCTION TO MEMS

L	T	P	C
3	0	0	3

Pre-requisite 23EEE101

Course Objectives:

This course enables students to

1. To provide foundational knowledge on MEMS, its historical development, working principles, and scaling effects.
2. To understand the operation of micro sensors and actuators, and their integration into MEMS structures.
3. To explore MEMS materials and comprehend various microfabrication and micromachining techniques.
4. To develop competency in modeling MEMS devices using simulation methods such as FEM for sensor and actuator behavior.
5. To examine various applications of MEMS in different domains including RF, optical, microfluidic, and robotics systems.

UNIT I INTRODUCTION **9 hours**

Overview – History and industry perspectives – Working principles – Mechanics and dynamics Scaling law

UNIT II MICRO SENSORS & ACTUATORS **9 hours**

Micro sensors: Pressure sensors, accelerometers, gyroscopes-Micro actuators: comb drive actuators – Micro-electromechanical systems.

UNIT III MICRO MANUFACTURING **9 hours**

Materials for MEMS and Microsystems- Micro fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition- Physical Vapour Deposition, Micro manufacturing: Bulk micromachining, surface micromachining, LIGA Process- Packaging.

UNIT IV MODELING IN MEMS **9 hours**

Micro system design: Finite Element Methods-– Modeling of simulation – piezoelectric, Gyroscope

UNIT V MEMS APPLICATIONS **9 hours**

Micro fluids-sensors for turbulence measurement and control, micro-actuators for flow control, RFMEMS- filters, Oscillators and phase shifters, Optical MEMS, micro robotics – Case studies

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Explain the history, structure, operating principles, and scaling challenges of MEMS – L2

CO2: Describe the working of micro sensors and actuators and their roles in MEMS – L2

CO3: Analyze the materials and various microfabrication techniques used in MEMS manufacturing – L4

CO4: Apply modeling techniques like FEM to simulate MEMS device behavior such as gyroscopes and piezoelectric sensors – L3

CO5: Evaluate MEMS applications in RF, fluidics, optics, and robotics through real-world case studies – L5

Text Book(s)

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006

2. G.K. Ananthsuresh et al ,'Micro and Smart Systems', Wiley, India, 2010

Reference Books

1. NadimMaluf, "An introduction to Micro electro mechanical system design", ArtechHouse, 2000

2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2000.

3. James J.Allen, micro electro mechanical system design, CRC Press published in 2005

4. Stephen D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Open Elective – 1

23CSE301 JAVA PROGRAMMING

		L	T	P	C
Pre-requisite	NIL	**3**	**0**	**0**	**3**

Course Objectives:

The learning objectives of this course are to:

1. Identify Java language components and how they work together in applications.
2. Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
3. Learn how to extend Java classes with inheritance and interfaces in Java applications.
4. Understand how to use Java packages, Exceptions and I/O Streams for program development.
5. Understand how to design applications with threads in Java.
6. Understand how to use Java APIs for program development

UNIT I **9 hours**

Object Oriented Programming: Basic concepts, Principles,

Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, **Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

Control Statements: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

UNIT II **9 hours**

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, this and static Keywords.

Methods: Introduction, Defining Methods, Overloaded Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods

UNIT III **9 hours**

Arrays: Introduction, Declaration and Initialization of Arrays, Operations on Array Elements, Assigning Array to Another Array, Two-dimensional Arrays, Arrays of Varying Lengths

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes,

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNIT IV **9 hours**

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class.

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

UNIT V **9 hours**

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer**.**

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Analyze problems, design solutions using OOP principles, and implement them efficiently in Java.

CO2: Design and implement classes to model real-world entities, with a focus on attributes, behaviours, and relationships between objects.

CO3: Demonstrate an understanding of inheritance hierarchies and polymorphic behaviour, including method overriding and interface concept.

CO4: Apply Competence in handling exceptions and errors to write robust and fault-tolerant code.

CO5: Develop multithreaded applications with synchronization.

Text Books:

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.

Reference Books:

1. The complete Reference Java, 11thedition, Herbert Schildt,TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson
3. JAVA for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105191/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective - I

23CST301 OPERATING SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite NIL

Course Description:

This course introduces the fundamental concepts and principles of operating systems, covering process and thread management, CPU scheduling, synchronization, deadlocks, memory management, file systems, and system protection mechanisms. Students will gain practical understanding of how modern operating systems function, focusing on process coordination, resource allocation, and system-level design. Through theoretical insights and hands-on exposure, learners will be equipped to analyze, design, and optimize OS components for better performance and reliability in computing systems.

Course Objectives:

The main objectives of the course is to make student

1. Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection
2. Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
3. Illustrate different conditions for deadlock and their possible solutions.

UNIT I OPERATING SYSTEMS OVERVIEW 9 hours

Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems **System Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging

UNIT II PROCESS AND THREADS 9 hours

Processes: Process Concept, Process scheduling, Operations on processes, Inter-process communication. **Threads and Concurrency:** Multithreading models, Thread libraries, Threading issues. **CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

UNIT III SYNCHRONIZATION 9 hours

Synchronization Tools: The Critical Section Problem, Peterson‘s Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization. **Deadlocks:** system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

UNIT IV MEMORY MANAGEMENT 9 hours

Memory- Management Strategies: Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. **Virtual Memory Management:** Introduction, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing. **Storage Management:** Overview of Mass Storage Structure, HDD Scheduling.

UNIT V FILE SYSTEM 9 hours

File System: File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File System Mounting, Partitions and Mounting, File Sharing. **Protection:** Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.

Course Outcomes:

After completion of the course, students will be able to

CO1: Describe the basics of the operating systems, mechanisms of OS to handle processes, threads, and their communication.

CO2: Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection.

CO3: Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.

CO4: Illustrate different conditions for deadlock and their possible solutions.

CO5: Able to design and implement file systems, focusing on file access methods, directory structure, free space management, and also explore various protection mechanisms.

Text Book(s)

1. Operating System Concepts, Silber schatz A, Galvin P B, Gagne G, 10th Edition, Wiley, 2018.

2. Modern Operating Systems, Tanenbaum A S, 4th Edition, Pearson , 2016

Reference Books

1. Operating Systems -Internals and Design Principles, Stallings W, 9th edition, Pearson, 2018

2. Operating Systems: A Concept Based Approach, D.M Dhamdhere, 3rd Edition, McGraw- Hill, 2013

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Open Elective – I

23CAI301 MOBILE COMPUTING

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objectives of the course is to

1. To understand the basic concepts of mobile computing.
2. To learn the basics of mobile telecommunication system.
3. To be familiar with the network layer protocols and Ad-Hoc networks.
4. To know the basis of transport and application layer protocols.
5. To gain knowledge about different mobile platforms and application development.

UNIT I INTRODUCTION **9 hours**

Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA

UNIT II MOBILE TELECOMMUNICATION SYSTEM **9 hours**

Introduction to Cellular Systems - GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS- UMTS – Architecture – Handover - Security

UNIT III MOBILE NETWORK LAYER **9 hours**

Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV, Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks (VANET) –MANET Vs VANET – Security.

UNIT IV MOBILE TRANSPORT AND APPLICATION LAYER **9 hours**

Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML

UNIT V MOBILE PLATFORMS AND APPLICATIONS **9 hours**

Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Explain the basics of mobile telecommunication systems

CO2: Illustrate the generations of telecommunication systems in wireless networks

CO3: Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network

CO4: Explain the functionality of Transport and Application layers

CO5: Develop a mobile application using android/blackberry/ios/Windows SDK

Text Books:

1. Jochen Schiller, Mobile Communications, Addison-Wesley, Second Edition, 2009.
2. Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt.Ltd, New Delhi – 2012

Reference Books:

1. Dharma Prakash Agarval, Qing and an Zeng, "Introduction to Wireless and Mobile systems",Thomson Asia Pvt Ltd, 2005.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.
3. Windows Phone DevCenter : http://developer.windowsphone.com

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective - I

23CSD301 INTRODUCTION TO DATA SCIENCE

L	T	P	C
3	0	0	3

Pre-requisite: **None**

Course Objectives:

The main objectives of the course is to

1. Knowledge and expertise to become a data scientist.
2. Essential concepts of statistics and machine learning that are vital for data science;
3. Significance of exploratory data analysis (EDA) in data science.
4. Critically evaluate data visualizations presented on the dashboards
5. Suitability and limitations of tools and techniques related to data science process

UNIT I **9 hours**

Introduction to Data science, benefits and uses, facets of data, data science process in brief, big data ecosystem and data science.

Data Science process: Overview, defining goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory analysis, model building, presenting findings and building applications on top of them.

UNIT II **9 hours**

Applications of machine learning in Data science, role of ML in DS, Python tools like sklearn, modelling process for feature engineering, model selection, validation and prediction, types of ML, semi-supervised learning

Handling large data: problems and general techniques for handling large data, programming tips for dealing large data, case studies on DS projects for predicting malicious URLs, for building recommender systems

UNIT III **9 hours**

NoSQL movement for handling Bigdata: Distributing data storage and processing with Hadoop framework, case study on risk assessment for loan sanctioning, ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling.

UNIT IV **9 hours**

Tools and Applications of Data Science: Introducing **Neo4j**for dealing with graph databases, graph query language **Cypher**, Applications graph databases, Python libraries like nltk and SQLite for handling Text mining and analytics, case study on classifying Reddit posts.

UNIT V **9 hours**

Data Visualization and Prototype Application Development: Data Visualization options, Crossfilter, the JavaScript MapReduce library, Creating an interactive dashboard with dc.js, Dashboard development tools.

Applying the Data Science process for real world problem solving scenarios as a detailed case study.

Course Outcomes:

At the end of this course students will demonstrate the ability to
CO1: Understand the fundamental concepts and applications of data science.
CO2: Apply machine learning techniques to solve data science problems.
CO3: Compare and contrast relational and NoSQL databases.
CO4: Utilize graph databases for data analysis.
CO5: Create interactive data visualizations.

Text Books:

1. Davy Cielen, Arno D.B.Meysman, and Mohamed Ali, "Introducing to Data Science using Python tools", Manning Publications Co, Dreamtech press, 2016

2. Prateek Gupta, "Data Science with Jupyter" BPB publishers, 2019 for basics

Reference Books:

1. Joel Grus, "Data Science From Scratch", OReilly, 2019

2. Doing Data Science: Straight Talk From The Frontline, 1 st Edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013

Online Learning Resources

1. https://www.coursera.org/specializations/introduction-data-science

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Open Elective - I

23CSM301 AI FOR EVERYONE

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course Objectives:

The objectives of the course are to

1. Understand the basics of artificial intelligence and its subfields.
2. Explore real-world applications of AI across different industries.
3. Gain insights into the ethical, social, and economic implications of AI.
4. Develop an appreciation for the potential of AI to drive innovation and transformation.

UNIT I INTRODUCTION **9 hours**

Introduction to Artificial Intelligence (AI): Significance, Historical Overview & Evolution, Artificial Intelligence: Types, Applications, Challenges & Opportunities, Introduction to Intelligent Agents, Branches of AI: Machine Learning, NLP, Robotics, Expert Systems, Deep Learning: Concept of Neural Networks, AI vs Human Intelligence.

UNIT II APPLICATIONS OF AI **9 hours**

AI in Everyday Life: Smart Assistants, Chatbots, Recommendation Systems, AI in Engineering: Robotics, Predictive Maintenance, AI in Healthcare, Education, Agriculture, Transport, Real-World AI Systems: Google Maps, Siri, Amazon, Tesla.

UNIT III PROBLEM SOLVING AND CASE STUDIES **9 hours**

How AI Solves Problems: Search, Logic, Pattern Recognition, Introduction to Rule-Based Systems. Case Studies: Smart Speaker, Self-Driving Car, AI in Climate Monitoring, AI in Disaster Response Example Roles of an AI Team, Survey of Major AI Application Areas.

UNIT IV AI AND SOCIETY **9 hours**

Impact of AI on Jobs and Employment, AI in Governance and Public Services, Human-AI Collaboration: Assistive AI, Digital Divide and Accessibility Challenges, AI in Developing Countries – Opportunities and Challenges, Case Studies on Social Applications.

UNIT V ETHICAL AND SOCIAL IMPLICATIONS OF AI **9 hours**

Bias And Fairness in AI Systems, Privacy and Data Protection Concerns, Responsible AI: Policies and Frameworks, AI and Social inequality, Ethical Guidelines and Responsible AI Practices, AI and Innovation, Emerging Trends and Future Directions in AI, AI and Creativity: Generative Models and Artistic Applications

Course Outcomes:

At the end of this course students will be able to

CO1: Apply basic AI concepts and identify different types and branches of AI.
CO2: Analyze how AI is used in real-life applications across various fields.
CO3: Apply AI techniques to understand how problems are solved using real-world case studies.
CO4: Analyze the impact of AI on jobs, governance, and social development.
CO5: Analyze ethical issues in AI and understand the importance of responsible AI practices.

Text Books:

1. "Artificial Intelligence A Guide for Thinking Humans", Melanie Mitchell .
2. "Artificial Intelligence: The Basics", Kevin Warwick, Routledge, 2011.

Reference Books:

1. "AI for Everyone: The Essential Guide", Dale Lane, Wiley, 2021.
2. "Artificial Intelligence Basics: A Non-Technical Introduction", Tom Taulli, Apress, 2019

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

PROFESSIONAL ELECTIVES

Professional Elective – II

23ECE401 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

L	T	P	C
3	0	0	3

Course Objectives:

1. To know about the performance characteristics of instruments and measurement of electrical quantities.
2. To understand the construction, working and applications of different types of CRO's.
3. To analyze the working of different types of bridges.
4. To study the working of signal & function generators and analyzers.
5. To analyze the working of sensors and transducers in measuring physical parameters.

UNIT I PERFORMANCE CHARACTERISTICS OF INSTRUMENTS 9 hours

Static characteristics, Accuracy, Precision, Resolution, Sensitivity, static and dynamic calibration, Errors in Measurement, and their statistical analysis, dynamic characteristics-speed of Response, fidelity, Lag and dynamic error. DC ammeters, DC voltmeters-multirange, range extension/solid state and differential voltmeters, AC voltmeters–multirange, range extension. Thermocouple type RF ammeter, ohm meters, series type, shunt type, multimeter for voltage, current and resistance measurements.

UNIT II OSCILLOSCOPES 9 hours

Introduction, Basic Principle, Standard specifications of CRO, CRT features, vertical and horizontal amplifiers, horizontal and vertical deflection systems, sweep trigger pulse, delay line, sync selector circuits, probes for CRO – active, passive, and attenuator type, triggered sweep CRO, and Delayed sweep, dual trace/beam CRO, Measurement of amplitude, frequency and phase (Lissajous method). Principles of sampling oscilloscope, storage oscilloscope, and digital storage oscilloscope, Digital frequency counters, time & Period measurements.

UNIT III BRIDGES 9 hours

DC Bridges for Measurement of resistance: Wheat stone bridge, Kelvin's Bridge, AC Bridges for Measurement of inductance- Maxwell's bridge, Hay's Bridge, Anderson bridge. Measurement of capacitance- Schearing Bridge, Wien Bridge. Errors and precautions in using bridges.

UNIT IV SIGNAL GENERATORS 9 hours

Signal generator-fixed and variable, AF oscillators, function generators, pulse, random noise, sweep, and arbitrary waveform generators, their standards, specifications and principles of working (Block diagram approach). Wave analyzers, Harmonic distortion analyzers, Spectrum analyzers, and Logic analyzers.

UNIT V SENSORS AND TRANSDUCERS 9 hours

Active and passive transducers: Measurement of displacement (Resistance, capacitance, inductance; LVDT) Force (strain gauges) Pressure (piezoelectric transducers) Temperature (resistance thermometers, thermocouples and thermistors), Velocity, Acceleration, Vibration, pH measurement Signal Conditioning Circuits.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Learn about the performance characteristics of instruments and measurement of electrical quantities. (L2)
CO2: Understand the construction, working and applications of different types of CRO's. (L3)
CO3: Compare the working of different types of bridges. (L4)
CO4: Know the working of signal & function generators and analyzers. (L4)
CO5: Grasp the working of sensors and transducers in measuring physical parameters. (L5)

Text Books:

1. A.D. Helfrick and W.D. Cooper, *Modern Electronic Instrumentation and Measurement Techniques*, 5th Edition, PHI, 2002.
2. H.S.Kalsi, *Electronic Instrumentation*, 2nd edition, Tata McGraw Hill, 2004.

Reference Books:

1. David A. Bell, *Electronic Instrumentation & Measurements*, 2nd Edition, PHI, 2003.
2. K. Lal Kishore, *Electronic Measurements & Instrumentations*, Pearson Education, 2009.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Professional Elective – II

23ECE402 EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

Course Objectives:

1. Introduce the building blocks in embedded hardware and firmware design
2. Explore Real-Time Operating Systems (RTOS) and their implementation.
3. Understand multitasking, scheduling, and real-time constraints.
4. Design embedded applications using ARM Cortex architecture.
5. Apply software/hardware co-design and UML modeling techniques.

UNIT I FUNDAMENTALS OF EMBEDDED SYSTEMS 9 hours

Embedded System Overview & Characteristics, Embedded vs General Purpose Systems, Embedded Processors: RISC, CISC, DSP, ARM Cortex-M, Memory Architecture: Flash, SRAM, EEPROM; Sensors, Actuators, ADC / DAC Interfaces, Case Studies of Consumer and Industrial Embedded Systems.

UNIT II EMBEDDED SOFTWARE DEVELOPMENT & RTOS BASICS 9 hours

Embedded C: Startup Code, Interrupts, GPIOs, Timers; IDEs, Cross Compilers, Linkers, Debuggers, Operating System Concepts, Real-Time Operating System (RTOS) Introduction, RTOS Concepts: Task Scheduling, Context Switching, Preemptive vs Cooperative Scheduling, Task Creation, Priorities, Stack Management, Multitasking: Processes, Threads, Scheduling (Round Robin, Priority-based), RTOS Examples: FreeRTOS, Zephyr RTOS,Mbed OS (Concepts only).

UNIT III INTERFACING, COMMUNICATION AND RTOS SERVICES 9 hours

Interfacing with Peripherals: UART, SPI, I2C; Semaphores, Mutexes, Message Queues, Pipes; Shared Memory and Synchronization Issues; ISRs and Event flags, Device Drivers Basics (Polling, Interrupts), Choosing and Porting RTOS to Microcontrollers.

UNIT IV FIRMWARE DEVELOPMENT AND ARM ARCHITECTURE 9 hours

Firmware Boot Process, Startup Code, Linker Scripts, Memory Map, Startup Routine, ARM Cortex-M Architecture Overview, System Control Block (SCB), NVIC, Systick Timer, Memory Protection Unit (MPU), Exception Handling, Real-world Applications of ARM-based Embedded Systems.

UNIT V EMBEDDED SYSTEM DESIGN AND MODELING 9 hours

System Design Cycle: Requirement Analysis to Testing, Hardware/Software Partitioning, UML for Embedded Design: Use Case, Sequence, Activity Diagrams, Co-design Techniques, Co-simulation Tools, Single-Core vs Multi-Core Embedded Systems, Performance Metrics, Power Optimization in Embedded Systems.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Describe the structure and functionality of embedded systems. (L2)
CO2: Develop embedded programs using C and understand RTOS principles. (L3)
CO3: Design multitasking embedded applications using RTOS mechanisms. (L4)
CO4: Implement firmware with real-time constraints on ARM microcontrollers. (L4)
CO5: Apply UML and co-design techniques for embedded system modeling. (L5)

Text Books:

1. Mazidi M.A., Mazidi J.G., *The 8051 Microcontroller and Embedded Systems*, Pearson Education, 2013.
2. Sloss, A.N., Symes, D., *ARM System Developer's Guide*, Morgan Kaufmann, 2004.
3. Jonathan Valvano, *Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers*, CreateSpace, 2017.

Reference Books:

1. Steve Furber, *ARM System-on-Chip Architecture*, Pearson, 2000.
2. Jack Ganssle, *The Art of Designing Embedded Systems*, Newnes, 2008.
3. Heath S., *Embedded Systems Design*, Elsevier, 2009.
4. Joseph Yiu, *The Definitive Guide to ARM Cortex-M3/M4 Processors*, Newnes.
5. Peter Marwedel, *Embedded System Design*, Springer.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Professional Elective – II

23ECE403 WIRELESS SENSOR NETWORKS

L	T	P	C
3	0	0	3

Course Objectives:

1. To introduce the fundamental concepts and architecture of wireless sensor networks.
2. To explore various network architectures, optimization techniques, and design principles for wireless sensor networks.
3. To study MAC protocols, routing techniques, and addressing mechanisms for efficient sensor network communication.
4. To understand the infrastructure establishment of sensor networks, including topology control and synchronization.
5. To provide knowledge on sensor network platforms, programming challenges, and simulation tools

UNIT I INTRODUCTION TO WIRELESS SENSOR NETWORKS 9 hours

Overview of Wireless Sensor Networks: Single-Node Architecture - Hardware Components Network Characteristics- unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks- Types of wireless sensor networks.

UNIT II WIRELESS SENSOR NETWORK ARCHITECTURES 9 hours

Architectures: Network Architecture- Sensor Networks-Scenarios- Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT III NETWORKING AND COMMUNICATION PROTOCOLS 10 hours

Networking Sensors: MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - SMAC, - B-MAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy-Efficient Routing, Geographic Routing.

UNIT IV INFRASTRUCTURE AND MANAGEMENT IN WSNs 9 hours

Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT V PLATFORMS, TOOLS, AND PROGRAMMING FOR WSNs 9 hours

Sensor Network Platforms and Tools: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Learn the fundamental concepts and architecture of wireless sensor networks.

CO2: Explore various network architectures, optimization techniques, and design principles for wireless sensor networks.

CO3: Gain knowledge of MAC protocols, routing techniques, and addressing mechanisms for efficient sensor network communication.

CO4: Understand the infrastructure establishment of sensor networks, including topology control and synchronization.

CO5: Grasp the knowledge on sensor network platforms, programming challenges, andsimulation tools.

Text Books:

1. Holger Karl & Andreas Willig, *Protocols and Architectures for Wireless Sensor Networks*, John Wiley, 2005.

2. Feng Zhao & Leonidas J.Guibas, *Wireless Sensor Networks-An Information Processing Approach*, Elsevier, 2007.

Reference Books:

1. Waltenegus Dargie, Christian Poellabauer, *Fundamentals of Wireless Sensor Networks Theory And Practice*, John Wiley & Sons Publications, 2011.

2. Kazem Sohraby, Daniel Minoli, &Taieb Znati, *Wireless Sensor Networks-Technology, Protocols, and Applications*, John Wiley, 2007.

3. Anna Hac, *Wireless Sensor Network Designs*, John Wiley, 2003.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Professional Elective – III

23ECE404 RADAR ENGINEERING

L	T	P	C
3	0	0	3

Course Objectives:

1. To understand the basic working principle of Radar and target detection procedure.
2. To learn about the working and applications of CW and Frequency Modulated Radar.
3. To comprehend the working and applications of MTI and Pulse Doppler Radar.
4. To understand different methods of tracking a target and their limitations.
5. To analyze the effect of noise at the receiver and the uses of phased array antennas and navigational aids.

UNIT I BASICS OF RADAR 9 hours

Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems. Radar Equation: SNR, Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Display types, Illustrative Problems.

UNIT II CW AND FREQUENCY MODULATED RADAR 9 hours

Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Illustrative Problems. FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.

UNIT III MTI AND PULSE DOPPLER RADAR 9 hours

Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, And Staggered PRFs. Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar.

UNIT IV TRACKING RADAR 9 hours

Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two-coordinates), Phase Comparison Monopulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT V DETECTION OF RADAR 9 hours

Detection of Radar Signals in Noise: Introduction, Noise Figure and Noise Temperature, Matched Filter Receiver – Response Characteristics and Derivation, Correlation detection, Detection criteria, Detector Characteristics, Automatic Detection, Constant False Alarm Rate Receiver. Introduction to Software Defined Radio, Introduction to Stealth Technology.

Radar Receivers: Introduction to Phased Array Antennas- Basic Concepts, Electronically Steered Phased Array Antennas, Phase Shifters, Frequency – scan Arrays, Radiation for Phased Array, Architecture for Phased Arrays. Radiation Pattern. Beam Steering and Beam Width changes. Navigational Aids: Direction Finder, VOR, ILS and Loran.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Learn the basic working principle of Radar and the target detection procedure. (L2)
CO2: Know the working and applications of CW and Frequency Modulated Radar. (L2/L3)
CO3: Gain knowledge of MTI and Pulse Doppler Radar. (L2)
CO4: Understand different methods of tracking a target and their limitations. (L4)
CO5: Analyze the effect of noise at the receiver and the use of phased array antennas and navigational aids. (L4/L5)

Text Books:

1. Merrill I. Skolnik, *Introduction to Radar Systems*, 2nd Edition, TMH Special Indian Edition, 2007.

2. Byron Edde, *Radar Principals, Technology, Applications*, Pearson Education, 1992.

Reference Books:

1. Peebles, *Radar Principles*, Wiley, New York, 1998.

2. G. S. N. Raju, *Radar Engineering and Fundamentals of Navigational Aid*, I. K. International Pvt. Ltd.

3. G. Sasi Bhushan Rao, *Microwave and Radar Engineering*, Pearson Education, 2014.

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Professional Elective – III

23ECE405 COMMUNITY RADIO TECHNOLOGY

L	T	P	C
3	0	0	3

Course Objectives:

The main objectives of the course are to

1. Associate the concept of fundamentals in Community Radio in Local Communication and development.
2. Gain knowledge of Studio technology and operations including Soundboards, Microphones, Recording, scheduling, content creation, and team coordination.
3. Develop skills in Audio Pre-production and post-production such as recording, editing, and mixing audio content.
4. Categorize the Radio Transmission Technology comprising signal requirements aligning with factors affecting Coverage and Shadow Areas.
5. Explore Radio Transmission technology essentials and understand the technical aspects of setting up and maintaining an FM transmitter.

UNIT I COMMUNITY RADIO CONCEPT AND CR STATION 9 hours

Introduction to Radio Broadcasting - Evolution of Community Radio (CR) - CR Policy Guidelines and Implications – CR Technology and Equipment; Components of a CR Station - Studios for Community Radio- Power Consumption and Conservation- Alternative Sources of Energy

UNIT II STUDIO TECHNOLOGY & OPERATIONS 9 hours

Basics of Sound - Components of Sound - Propagation of Sound Waves - Components of the Audio Chain - Audio Chain in a typical Broadcast Studio - Studio Acoustics; Techniques of Handling Various Tools - Types of Connectors & Audio Cables - Preventive and Corrective Maintenance - Content Distribution: Internet, Wireless Mesh Networking (WiMesh) & Mobile Telephony

UNIT III AUDIO PRE & POST PRODUCTION 9 hours

Audio Cables and Connectors– Recording Audio in the Field - Audio Cables and Connectors - Open Source Software for CR - Conventional Landline Systems- GSM/CDMA - Voice Over Internet Protocol (VoIP); Sound Recording and Editing - Mixing and Mastering - File Formats and Compression Transmission - Storing and Retrieval

UNIT IV RADIO TRANSMISSION TECHNOLOGY 9 hours

Transmission Chain Overview – Connectivity & Audio Processor/Limiter - Antenna (Types and Polarization) – Transmitter Maintenance and Fault Diagnosis - Antenna and Coaxial Cable - Antenna System - Propagation and Coverage – Field Strength Measurements and Drawing an Actual Coverage Map

UNIT V FM TRANSMITTER SETUP 9 hours

Mounting and Connecting the Transmitter- Interpretation of the Transmitter Meter Readings and Indications - Mounting and Connecting the Transmitter - Reporting on the Basis of Visual Observation - Checking Earth Conductivity - Transmitter Operation and Upkeep Issues

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Interpret the evolution with a framework of Community Radio with Technical Principles and essential Radio Spectrums. (L2)

CO2: Apply Studio Technology and Operational practices with the components of the Audio Chain including Acoustics and Equipment maintenance. (L3)

CO3: Conduct Comprehensive Audio Pre & Post-production to operate field Recordings with Hardware and Open-source software to manage sound recording, editing, mixing, mastering and file compression. (L4)

CO4: Infer the principles of FM transmission, Antenna systems, Radio wave propagation and factors affecting coverage. (L5)

CO5: Demonstrate knowledge of the connecting audio feeds for Transmitter setup by resolving operational Issues with corrective maintenance. (L6)

Text Book(s)

1. Pooja Murada R. Sreedher, *Community Radio in India*, Aakar Books, 2019.

2. Prof. Raj Misra, *Community Radio By the people, For the People*, Orange Books Publication, 2022

3. Fraser, Colin, and Sonia Restrepo Estrada, *Community radio handbook*. Paris: Unesco, 2001.

Reference Books

1. Juliet Fox, *Community Radio's Amplification of Communication for Social Change*, 7th Edition, Palgrave Macmillan (Springer International Publishing.), 2019.
2. Kanchan K. Malik, Vinod Pavarala, *Community Radio in South Asia: Reclaiming the Airwaves*, Routledge India, 2020.

Online Material links:

1. "Certificate in Community Radio Technology (CCRT)" **https://www.cemca.org/resources/certificate-community-radio-technology-ccrt-0**

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

Professional Elective – III

23ECE406 SATELLITE COMMUNICATIONS

L	T	P	C
3	0	0	3

Course Objectives:

1. To learn the principles of Orbital Mechanics& Satellite launch system with performance parameters.
2. To describe the elements of Communication Satellite design for matching reliability.
3. To know the working concepts of various Multiple Access techniques and On board processing.
4. To analyse the Satellite links design with Communication links.
5. To evaluate the working of Earth station design with Satellite Broadcasting.

UNIT I ORBITAL MECHANICS AND LAUNCH SYSTEMS 9 hours

Orbital Dynamics: Kepler's laws, Orbital equations, Perturbations, sidereal/solar day calculations.

Launch Technology: Multistage Rocket Performance Parameters, Orbital Injection/correction Strategies.

UNIT II SATELLITE DESIGN AND RELIABILITY ENGINEERING 9 hours

Elements of Communication Satellite Design. Spacecraft subsystems. Reliability considerations. Spacecraft Integration.

UNIT III MULTIPLE ACCESS AND ON BOARD PROCESSING 9 hours

Multiple access techniques. FDMA, TDMA, CDMA. Random access techniques. Satellite onboard processing.

UNIT IV NETWORK DESIGN AND EMERGING SYSTEMS 9 hours

Satellite link design: Performance requirements and standards. Design of Satellite links – DOMSAT, INSAT, INTELSAT and INMARSAT. Satellite - based Personal Communication links.

UNIT V EARTH SEGMENT OPERATIONS 9 hours

Earth station design. Configurations. Antenna and tracking systems. Satellite broadcasting

Course Outcomes:

At the end of the course, the students will be able to

CO1: Acquire the principles of orbital mechanics & satellite launch system with performance parameters. (L2)
CO2: Describe the elements of communication satellite design for matching reliability. (L2)
CO3: Develop knowledge on various multiple access techniques and On board processing. (L3)
CO4: Investigate the Satellite links design with Communication Links. (L4)
CO5: Assess the working of Earth station design with Satellite Broadcasting. (L4)

Text Books:

1. Roddy, D. *Satellite Communication*, 4th ed. (McGraw-Hill, 2009)

2. Pratt, T. & Bostian, C. *Satellite Communication* (Wiley, 2000)

Reference Books:

1. Agrawal, B.N. *Design of Geosynchronous Spacecraft* (Prentice-Hall, 1986)

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination.

SKILL ENHANCEMENT COURSES

Skill Enhancement Course - I

23CSE601 PYTHON PROGRAMMING

L	T	P	C
1	0	2	2

Course Objectives:

The main objectives of the course are to

1. Introduce core programming concepts of Python programming language.
2. Learn to solve problems using Python conditional and loops.
3. Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
4. Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications.
5. Demonstrate to do input/output with files in Python.

UNIT I DATA TYPES, EXPRESSIONS AND CONTROL FLOW STATEMENTS — 6 hours

Introduction: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a program to swap two numbers without using a temporary variable.
3. Demonstrate the following Operators in Python with suitable examples.

i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators

UNIT II LISTS & DICTIONARIES — 6 hours

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Dictionaries: Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Sample Experiments:

1. Write a program to perform the given operations on a list:
   i. Addition ii. Insertion iii. slicing
2. Write a program to perform any 5 built-in functions by taking any list.
3. Write a program to sum all the items in a given dictionary.

UNIT III TUPLES AND SETS — 6 hours

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

Sample Experiments:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).
3. Write a program to check if a given key exists in a dictionary or not.

UNIT IV FUNCTIONS & STRINGS 6 hours

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.
Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Sample Experiments:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.

UNIT V FILES HANDLING IN PYTHON 6 hours

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

Sample Experiments:

1. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
2. Implement a Python program to print each line of a file in reverse order.
3. Write a Python program to compute the number of characters, words and lines in a file

Course Outcomes:

After completion of the course, students will be able to

CO1: Understand to adept command of Python syntax, deftly utilizing variables, data types, and control structures.
CO2: Interpret Strings, functions, modules, exception handling to engineer robust and efficient code solutions.
CO3: Apply Python programming concepts like Lists and Dictionary to solve a variety of computational problems.
CO4: Build and manipulate fundamental data structures such as tuples and sets.
CO5: Demonstrate file handling concepts in python.

Text Books:

1. Gowri shankar S, Veena A., Introduction to Python Programming, CRC Press.

2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024.

Reference Books:

1. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.
2. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.

Online Resources:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

Mode of Evaluation: Continuous Internal Evaluation, Assignments, Mid Term Tests and End Semester Examination.

Skill Enhanced Course – II

23ENG601 SOFT SKILLS

L	T	P	C
1	0	2	2

Course Objectives:

1. To encourage all round development of the students by focusing on soft skills
2. To make the students aware of critical thinking and problem-solving skills
3. To enhance healthy relationship and understanding within and outside an organization
4. To function effectively with heterogeneous teams

UNIT I SOFT SKILLS & COMMUNICATION SKILLS 6 hours

Soft Skills - Introduction, Need - Mastering Techniques of Soft Skills – Communication Skills - Significance, process, types - Barriers of communication - Improving techniques.

Activities:

Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self- expression – articulating with felicity.

(The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)

Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.

Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.

Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation

UNIT II CRITICAL THINKING 6 hours

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking - Positive thinking - Reflection

Activities:

Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues –placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

UNIT III PROBLEM SOLVING & DECISION MAKING 6 hours

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Team building - Effective decision making in teams – Methods & Styles

Activities:

Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.

Case Study & Group Discussion

UNIT IV EMOTIONAL INTELLIGENCE & STRESS MANAGEMENT 6 hours

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

Activities:
Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.
Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation,
Organizing Debates

UNIT V CORPORATE ETIQUETTE 6 hours

Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette, benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction- Cell phone etiquette - Dining etiquette - Netiquette - Job interview etiquette -Corporate grooming tips -Overcoming challenges

Activities

Providing situations to take part in the Role Plays where the students will learn about bad and good manners and etiquette - Group Activities to showcase gender sensitivity, dining etiquette etc. - Conducting mock job interviews - Case Study - Business Etiquette Games

Note:

1. The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to the prescribed skill.
2. Case studies may be given wherever feasible for example for Decision Making- The decision of King Lear.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: List out various elements of soft skills (L1, L2)
CO2: Describe methods for building professional image (L1, L2)
CO3: Apply critical thinking skills in problem solving (L3)
CO4: Analyse the needs of an individual and team for well-being (L4)
CO5: Assess the situation and take necessary decisions (L5).
CO6: Create a productive workplace
atmosphere using social and work-life skills ensuring personal and emotional well-being (L6)

Text Books:

1. Mitra Barun K, Personality Development and Soft Skills, Oxford University Press, Pap/Cdr edition 2012.
2. Dr Shikha Kapoor, Personality Development and Soft Skills: Preparing for Tomorrow, I K International Publishing House, 2018.

Reference Books:

1. Sharma, Prashant, Soft Skills: Personality Development for Life Success, BPB Publications 2018
2. Alex K, Soft Skills S.Chand & Co, 2012 (Revised edition)
3. Gajendra Singh Chauhan & Sangeetha Sharma, Soft Skills: An Integrated Approach to Maximise Personality Published by Wiley, 2013
4. Pillai, Sabina & Fernandez Agna, Soft Skills and Employability Skills, Cambridge University Press, 2018.

5. Soft Skills for a Big Impact (English, Paperback, Renu Shorey) Publisher: Notion Press
6. Dr. Rajiv Kumar Jain, Dr. Usha Jain, Life Skills (Paperback English) Publisher : Vayu Education of India, 2014

E Books:

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
3. https://youtu.be/-Y-R9hDl7lU
4. https://youtu.be/gkLsn4ddmTs
5. https://youtu.be/2bf9K2rRWwo
6. https://youtu.be/FchfE3c2jzc
7. https://www.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
9. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

Mode of Evaluation: Continuous Internal Evaluation, Assignments, Mid Term Tests and End Semester Examination..

B. Tech III Year I Semester (SEC-III)

23ECE601 PCB DESIGN AND PROTOTYPE DEVELOPMENT

L	T	P	C
1	0	2	2

Course Objectives:

1. Study the fundamental steps involved in PCB design.
2. Understand the concept of designing single layer and multilayer PCB.
3. Study the different design considerations of PCB Fabrication.
4. Obtain knowledge of various EDA tools for PCB designing.
5. Study various standards in PCB testing.

UNIT I INTRODUCTION TO PCB 6 hours

Evolution of PCBs, PCB materials, PCB design tools, PCB development process, PCB soldering tools, soldering flux, soldering wires, and cleaning materials.

Sample Experiments:

1. Introduction to Printed circuit board: Fundamental of electronic components.
2. Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, crosstalk, check and inspection of artwork

UNIT II FUNDAMENTALS OF PRINTED CIRCUIT BOARDS 6 hours

Components of PCB, Basic Electronic Circuits, Classification of PCBs, Manufacturing of PCBs, Single sided, double sided, Multilayer, and Flexible Boards, Challenges in PCB design and Manufacturing, Standards on PCB.

Sample Experiments:

1. Practice following PCB Design steps
    i. Schematic Design: Familiarization of the Schematic Editor, Schematic creation, Annotation, Netlist generation.
    ii. Layout Design: Familiarization of Footprint Editor, Mapping of components, Creation of PCB layout Schematic.
    iii. Create new schematic components.
    iv. Create new component footprints.
2. Regulator circuit using 7805
3. Inverting Amplifier or Summing Amplifier using op-amp

UNIT III LAYOUT DESIGN CONSIDERATIONS 6 hours

General PCB design Consideration, Mechanical Design Consideration, Electrical Design Consideration, Conductor Patterns, Component Placement Rules, Fabrication and Assembly Consideration, Environmental Factors, Cooling Requirements and Package Density.

Sample Experiments:

1. Full-wave Rectifier
2. Astable multivibrator using IC555
3. Monostable multivibrator using IC555

UNIT IV ELECTRONIC DESIGN AUTOMATION TOOLS 6 hours

Introduction to Electronic design automation (EDA) tools for PCB designing: Brief Introduction of various simulators, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto-routing and manual

routing. Assigning specific text (silkscreen) to design, creating design report, and creating manufacturing data (GERBER) for design.

Sample Experiments:

1. RC Phase-shifter oscillator using transistor.
2. Wein-bridge Oscillator using op- amp
3. Full-Adder using half-adders.
4. 4-bit binary /MOD N counter using D-Flip flops.

UNIT V QUALITY, RELIABILITY, AND ACCEPTABILITY ASPECT 6 hours

Quality assurance, Teasing for Quality Control, Quality Control Methods, Testing of Printed Circuit Boards, Reliability Testing, Acceptability of PCBs, and Useful Standards.

Sample Experiments:

1. One open-ended (analog/ digital/mixed circuit) experiments of similar nature and magnitude to the above are to be assigned by the teacher
   (Student is expected to solve and execute/simulate independently).
2. Design an 8051 Development board having Power section consisting of IC7805, capacitor, resistor, headers, LED.
3. Design an 8051 Development board having Serial communication section consisting of MAX 232, Capacitors, DB9 connector, Jumper, LEDs
4. Design an 8051 Development board having Reset & Input/output sections consisting of 89C51 Microcontroller, Electrolytic Capacitor, Resistor, Jumper, Crystal Oscillator, Capacitors
5. Fabricate a single-sided PCB, mount the components and assemble them in a cabinet for any one of the circuits mentioned in the above exercises.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand the fundamental process in PCB design.
CO2: Understand the design and manufacturing techniques of PCB.
CO3: Create and Fabricate PCB using EDA tools.
CO4: Comprehend the standards involved in PCB design.
CO5: Evaluate and test the PCB for the designed circuits.

Text Books:

1. RS Khandpur, Printed Circuit Board, Tata McGraw Hill Education Pvt Ltd., New Delhi,2006

2. C. Coombs, Printed Circuits Handbook, McGraw-Hill Professional, 6 editions, 2007

Reference Books:

1. Jon Varteresian, *Fabricating Printed Circuit Boards*, z, 2002

2. R. Tummala, *Fundamentals of Microsystems Packaging*, McGraw-Hill 2001

3. C. Robertson. *PCB Designer´s Reference*. Prentice Hall, 2003

4. Open-source EDA Tool KiCad Tutorial:
http://kicad-pcb.org/help/tutorials/

PCB Fabrication user guide page:
http://www.wikihow.com/Create-Printed-Circuit-Boards

http://www.siongboon.com/projects/2005-09-07_home_pcb_fabrication/
http://reprap.org/wiki/MakePCBInstructions#Making_PCBs_yourself

PCB Fabrication at home(video):
https://www.youtube.com/watch?v=mv7Y0A9YeUc,
https://www.youtube.com/watch?v=imQTCW1yWkg

Mode of Evaluation: Continuous Internal Evaluation, Assignments, Mid Term Tests and End Semester Examination

Skill Enhancement Course – III

23ECE602 INTERNET OF THINGS

L	T	P	C
1	0	2	2

Course Objectives:

1. To understand the Architecture, Development & Design of IoT.
2. To Optimize the complexity of IoT systems, ensuring efficient data collection, processing, and analysis of an IoT solution.
3. To know about the loT standards, communication technologies and protocols for IoT devices.
4. To provide scalable, reliable, and secure storage and processing of vast amounts of data generated by IoT devices.
5. To Implement case studies using the tools and techniques of IoT Platform.

UNIT I INTRODUCTION TO INTERNET OF THINGS (IoT) 6 hours

Introduction to IOT, Architecture of Internet of Things, Major functional components of IoT, Physical Design & Logical Design of IoT, IoT Enabling Technologies, Applications of IoT, Design Methodology for IOT Products.

Sample Experiments:

1. Study on IoT Platform-Getting information and study of IoT microcontrollers (Arduino, Raspberrypi)
2. Study on IoT Platform
   a) Getting information about Sensors (IR, temperature, LDR, Gas sensor)
   b) Getting information about actuators. (Electric actuator, Hydraulic actuator)

UNIT II IoT LEVELS & DEPLOYMENT TOOLS 6 hours

IoT Levels

Software Tools:

IoT Platforms: Cloud platforms like AWS IoT, Google Cloud IoT, and Things Board provide services for device management, data collection, and application development.

Programming Languages: Basics of Python

Hardware Tools:

Development Boards: Arduino, Raspberry Pi, ESP8266, and ESP32

Sensors: Various sensors for measuring temperature, humidity, pressure, light and distance

Sample Experiments:

1. Programming with Arduino platform
   a) Installation of Arduino in computer and verifying any errors in connection.
   b) Control LED using Arduino
   c) Traffic Light Control
2. Programming with Arduino platform and Reading from Sensors
   a) Build Intrusion Detection System with Arduino by interfacing Ultrasonic sensors to Arduino board.
   b) Design a System using Arduino to know the flue gas concentration with the condition that if threshold value of gas concentration is greater than 300 then blink RED LED else if gas concentration is less than 300 switch off RED LED.
3. Programming with Raspberrypi
   a) Displaying Date on Serial Monitor
   b) Monitor the Surrounding light intensity using appropriate sensor and automatically turn ON/OFF the high intensity LED's by taking some predefined threshold light intensity value

UNIT III IoT TECHNOLOGIES, STANDARDS, TOOLS & M2M NETWORK **6 hours**

Fundamental characteristics and high-level requirements of IoT, IoT Reference models; Introduction to Communication Technologies & Protocols of IoT: BLE, Wi-Fi, LoRA, 3G/4G Technologies and HTTP, MQTT, CoAP protocols, M2M Network, SDN (Software Defined Networking) & NFV (Network Function Virtualization) for IoT

Sample Experiments:

1. Connect Arduino with Mobile Device Using the Bluetooth Module.
2. Integrating Ethernet Shield. Read data from sensor and send it to a requesting client using socket communication. Note: The client and server should be connected to same local area network.
3. Creating Mobile App-Create a mobile app to control an LED.

UNIT IV IoT PLATFORM, CLOUD COMPUTING PLATFORMS & DATA ANALYTICS FOR IoT DEVELOPMENT **6 hours**

IOT Platform Architecture (IBM Internet of Things & Watson Platforms); API Endpoints for Platform Services; Devices Creation and Data Transmission; Introduction to NODE-RED and Application deployment, Introduction to Data Analytics Apache Hadoop, Apache Oozie, Spark & Storm

Sample Experiments:

1. Interfacing Cloud-Push sensor data to cloud - Use Arduino to Upload data from Environmental Sensors to Cloud Server
2. Data analysis and Visualization-Access the data pushed from sensor to cloud and apply any data analytics or visualization services.

UNIT V CASE STUDY OF IoT APPLICATIONS **6 hours**

Introduction, models, technology used: Industrial internet of things, connected vehicles, Agriculture and IOT. Heath care and IOT, Smart grid system, Smart cities IoT Wearables, Health care systems and Allied sectors

Sample Experiments:

1. Social media with IoT Creating Program for Local host Web Server for controlling devices and Update status on Twitter through Arduino.
2. **Mini Project:** Identify a problem in your local area or college which can be solved by integrating the things you learned so far and create a prototype to solve it.

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand the Architecture, Development & Design of IoT (L2).
CO2: Optimize the complexity of IoT systems, ensuring efficient data collection, processing, and analysis of an IoT solution (L5).
CO3: Know about the IoT standards, communication technologies and protocols for IoT devices (L2).
CO4: Provide scalable, reliable, and secure storage and processing of vast amounts of data generated by IoT devices (L2).
CO5: Implement case studies using the tools and techniques of IoT Platform (L3).

Text Books:

1. Arsheep Bahga, Vijay Madisetti, *Internet of Things: A Hands-On Approach*‖, 1st Edition, VPT, 2014.
2. Adrian McEwen, Hakim Cassimally, *Designing the Internet of Things*, Wiley Publications, 2013
3. Hanes, David, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, and Jerome Henry. *IoT fundamentals: Networking technologies, protocols, and use cases for the internet of things,* Cisco Press, 2017.

Reference Books:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, *The Internet of Things: Key applications and Protocols*, 2nd Edition, Wiley Publications, 2012.
2. Raj, Pethuru, and Anupama C. Raman. *The Internet of Things: Enabling technologies, platforms, and use cases,* Auerbach Publications, 2017.

Mode of Evaluation: Continuous Internal Evaluation, Assignments, Mid Term Tests and End Semester Examination.

Skill Enhancement Course – IV

23ECE603 MATLAB FOR ENGINEERS

L	T	P	C
1	0	2	2

Course Objectives:

The main objectives of the course are to

1. Understand basic MATLAB commands and elementary functions
2. Study and implement mathematical operations and matrices manipulation
3. Understand MATLAB functions and expressions
4. Apply flow control and files in MATLAB
5. Understand Plotting and Simulink blocks in MATLAB

UNIT I MATLAB BASICS **6 hours**

Introduction, Matlab environment, Matlab as a calculator, Matlab Online, Syntax and Semantics, Help, Data Types-Matrix, string, cell and structure, Variables and Arrays, **Initializing Variables,** Multidimensional Arrays, Sub arrays, Special Values, Displaying Output Data, Data Files, Scalar and Array Operations, Hierarchy of Operations, Built-in MATLAB Functions, Debugging MATLAB Programs

Sample Experiments:

- Swap the values in two variables without using temporary variable. For example, the variable 'x' contains the value '5' and the variable 'y' contains the value '10'. The program should swap the values in the variable's 'x' and 'y'. After the execution of the program the value in the variable 'x' should be '10' and the value in the variable 'y' should be '5'. This should be accomplished without using the temporary variable.
- Write a function which should return either maximum or minimum value of the element in an array.
- Write a code to find whether the given number is even or not.
- Write a function that should sort the elements in the array either in the ascending order or descending order.
- Write a program which should count the number of occurrences of particular element in the array.

UNIT II MATRICES AND OPERATORS **6 hours**

Introduction, Colon Operator, Accessing Parts of a Matrix, Combining and Transforming Matrices, Arithmetic operations

Sample Experiments:

- Write a program to find the maximum and minimum value of the elements of the matrix
- Write a program to compute the sum of diagonal elements of the given matrix
- Write a program to test whether the given matrix is symmetric or not?

- Obtain the rank of the following matrices (i) $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ (ii) $\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$ and comment on the result.
- Write a program to check whether the given matrix is invertible or not? {Hint: A matrix is invertible if is not singular. The determinant of the matrix should not be equal to zero}
- Write a program to check the given matrix is orthogonal or not?
- Use the built-in function to compute the eigen value and the eigen vector of the given matrix. From the eigen value is it possible to find whether the given matrix is (i) Positive definite (ii) Positive semidefinite.
- Create a vector 'x' that should contain elements from 1 to 10. Write a code to perform the following operation
  - (i) Add a constant (say 3) to each element of 'x'.
  - (ii) Make all the even indexed elements to zero.
  - (iii) Make all the odd indexed elements to zero.
  - (iv) Generate 'y' which should contain elements in the reverse order of 'x'.
  - (v) Generate 'y' such that it should have first five elements of 'x' and the remaining elements to zero
  - (vi) Add the constant to odd indexed elements of 'x'.
  - (vii) Add the constant to the even indexed elements of 'x'
- Write a program to solve the linear algebraic equation
  - (i) 5x-3y+2z = 10
  - (ii) -3x+8y+4z = 20
  - (iii) 2x+4y-9z = 9
- Write a program to determine the eigen vector and eigen values of A = [1 2 3; 4 5 6; 7 8 9]

UNIT III FUNCTIONS AND EXPRESSIONS 6 hours

Introduction, Function I/O, Formal Definition of Functions, Sub functions, Scope, Advantages of Functions, Scripts, and Problem-Solving File Input-Output, Expressions, write a function which returns the "median" of the array of elements.

Sample Experiments:

- Write a code to print the prime numbers from one to hundred.
- Write a function which accepts the radius of the circle as input and returns the area and perimeter of the circle.
- Write a code which will compute sum of integers ranging from 1 to 100.
- Write a code to compute the "body mass index". The input to the code should be (i) Weight and (ii) Height of the person. The output of the program should be "body mass index (bmi)"
- Write a program to convert the temperature in degrees to Celsius.
- Write a program to check whether the given string (word) is palindrome or not?
- Write a program to compute the factorial of the given number.
- Find the roots of the polynomial

$f(x) = 3x^6 + 15x^5 + 10x^3 + 4x$

- An R-L-C circuit has R = 180 ohms, C = 1/280 farads, L = 20 Henries and an applied voltage E(t) = 10 sin t. Assuming that no charge is present but an initial current of I ampere is flowing at t = 0 when the voltage is first applied, find q and $i = \frac{dq}{dt}$ at any time t. q is given by the differential equation.

$$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{c} = E(t)$$

- The function sin(x) can be written as a Taylor series by:

$\sin x = \sum_{k=0}^{\alpha} \frac{(-1)^k x^{2k+1}}{(2k+1)!}$ Write a user-defined function file that calculates sin(x) by using the Taylor series.

UNIT IV FLOW CONTROL AND FILES 6 hours

For – Loops, While – Loops, Break Statements, Logical Indexing, Pre allocation. Data Types: Introduction, Strings, Structs, Cells. Selection, If – Statements, Relational and Logical Operators, Nested If – Statements, Variables Number of Function, Arguments, Robustness, Persistent Variables. switch and case statement, while statement, break, Continue. Files- File Input/ Output: File I/O, Excel Files, Text Files, Binary Files.

Sample Experiments:

- Without using the **max** command, find the maximum value of matrix (a) where a =[11 3 14;8 6 2;10 13 1]

- Let x=[2 6; 1 8], y=[.8 -0.3 ; -0.1 0.2], prove that y is not the inverse matrix of x
- The value of s could be calculated from the equation below:

$$s = \begin{cases} \sqrt{y^2 - 4xz} & if\ y \geq 4xz \\ \alpha & if\ y > 4xz \end{cases}$$

write a MATLAB program in M-File to do the following steps: -

a) input the value of x, y, z

b) calculate s

c) print the output as shown below

x = . . .

y = . . .

z = . . .

s = . . .

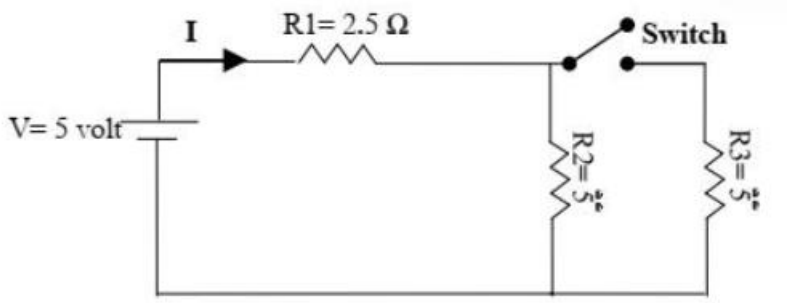
- Use a for-end loop in a script file to calculate the sum of the first n terms of the series:

$\sum_{k=1}^{n} \frac{(-1)^k k}{2^k}$ Execute the script file for n = 4 and n = 20.

- Write a program to find the current I in the circuit shown below

a) By using conditional statements.

b) Without using any conditional statements.



UNIT V PLOTTING AND SIMULINK 6 hours

Two – Dimensional Plots - Plot, fplot, Multiple Graphs, Formatting, Logarithmic Axes, Error Bars, Special Graphics, Histograms, Polar Plots, Multiple Plots on The Same Page, Multiple Figure Windows, Three-Dimensional Plots- Line Plots, Mesh and Surface Plots, Special Graphics, View Command. Simulink: Getting Started, Simulink Library Browser, Basic Elements-Blocks, Lines, building a System-Gathering Blocks, Modifying the Blocks, Connecting the Blocks, Running Simulations, Specification, Toolboxes, Building Systems.

Sample Experiments:

- The expression for sine wave is given by $x(t) = A\sin(2\pi ft + \phi)$ .Write a code which accepts the input as (i) Amplitude (A) (ii) Frequency (f) and (iii) Phase(ϕ) and generates the sine wave. Plot the sine wave.
- Write a program to convert the sine wave to (i) Half wave rectified sine wave and (ii) Full wave rectified sine wave.
- Write a program which converts the sine wave to a square wave [Equivalent to that of "zero-crossing detector" or "comparator" concept in "Linear Integrated Circuits"].
- Write a program to generate three-phase sinusoidal signal. [The student should know what is the phase difference between three phases in a three-phase sinusoidal signal and the importance of three phase power]
- Design a Simulink block for power electronic circuits

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Interpret the MATLAB commands and elementary functions
CO2: Solve mathematical operations and matrices manipulation
CO3: Apply MATLAB functions and expressions
CO4: Execute implementation of flow controls and files in MATLAB
CO5: Demonstrate Plotting and Simulink blocks in MATLAB

Text Book(s)

1. Getting Started with MATLAB, Rudra Pratap Oxford University Press, 1st edition, 2019
2. MATLAB for Beginners: A Gentle Approach, Kattan, Peter Issa, Petra books, 2008

Reference Books

1. MATLAB for Engineering Applications, William Palm, Mcgraw Hill,4th edition, 2019.
2. MATLAB for Engineers**,** Holly Moore, Pearson Education,5th edition,2018

Mode of Evaluation: Continuous Internal Evaluation, Assignments, Mid Term Tests and End Semester Examination.

Skill Enhancement Course – IV

23ECE604 DIGITAL SIGNAL PROCESSOR

L	T	P	C
1	0	2	2

Course Objectives:

The main objectives of the course are to

1. Understand various digital signal processor's architecture and tools.
2. Ability to apply knowledge of mathematics, science and engineering: Generation of signals using DSP Kit
3. Implement various convolutions using DSP Kit.
4. Understand the basic concepts of discrete signal representation such as Fourier transforms, discrete time representations. And design and implementations of IIR and FIR filtering algorithms and structures.
5. Understand the concept of Multi-rate signal processing and sample rate conversion

UNIT I STUDY OF DSP PROCESSOR AND ITS ARCHITECTURE 6 hours

Architecture and DSP tools, features and instructions of fixed point and floating point processors. (TMS 320C25 and TMS320300), Applications of DSP, basics of speech and image processing.

Sample Experiments:

1. Introduction to the Digital Signal Processing Kit (DSK) and the Code Composer Studio (CCS)
2. MAC operation using various addressing modes

UNIT II REVIEW OF SIGNALS AND SYSTEMS 6 hours

Review of signals and systems: Z-Transformation, properties, Inverse Z-transformation; Transform analysis of LTI System. Basic Signals

Sample Experiments:

1. Generation of signals and sequences using TMS320C6713DSK

UNIT III DISCRETE FOURIER TRANSFORM 6 hours

Properties of DFT: Linearity, Circular shift of a sequence, Symmetry properties, Circular convolution, Linear Convolution using DFT

Sample Experiments:

1. Linear Convolution using DSP Kit
2. Circular Convolution using DSP Kit

UNIT IV IIR AND FIR FILTER DESIGN 6 hours

Design of IIR filters from analog filters, Design based on numerical solution of differential equations, bilinear transformations. Properties of FIR digital filters, Different types of windows: Rectangular, Barlett, Hanning, Hamming, Blackman and Kaiser windows, Design of FIR filters using above windows, A comparison of FIR and IIR filters.

Sample Experiments:

1. FFT Implementation using DSP Kit
2. IIR & FIR Implementation using DSP Kit

UNIT V FINITE WORD LENGTH EFFECTS IN FIR AND IIR DIGITAL FILTERS **6 hours**

Quantization, round off errors and overflow errors. Multi rate digital signal processing: Concepts, design of practical sampling rate converters, Decimators, interpolators.

Sample Experiments:

1. Study of Finite Word Length Effect using DSP Kit

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Understand various DSP processor's architecture and tools.
CO2: Generate various signals using DSP Kit.
CO3: Realize various convolutions using DSP Kit.
CO4: Analyse spectrum of DT signals using transform domain mathematical tools such as DFT, FFT. And also Design and Realize IIR filters and FIR filters for Filtering Application
CO5: Analyse Multirate Structures for Sampling Rate Conversion (Interpolation, Decimation, Fractional Rate Conversion)

Text Book(s)

1. Sen M. Kuo, Woon-Seng S. Gan, "Digital Signal Processors – Architectures, Implementations and Applications", Pearson/Prentice Hall, 2005
2. Rulph Chassaing, Donald Reay, "Digital Signal Processing and Applications with TMS320C6713 and TMS320C6416 DSK", 2nd Edition, Wiley India, 2014.

Reference Books

1. S. K. Mitra, "Digital Signal Processing: A Computer based Approach", 4th Edition, McGraw Hill, 2013.
2. J. G. Proakis, D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", 4th Edition, Pearson Education Asia/Prentice Hall of India, 2014.
3. Emmanuel Ifeachor, Barrie W. Jervis, "Digital Signal Processing: A Practical Approach", 2nd Edition, Pearson Education, 2002

Mode of Evaluation: Continuous Internal Evaluation, Assignments, Mid Term Tests and End Semester Examination.

Minor in Electronics and Communication Engineering

Stream Name: Communication Systems (CS)

(Applicable to CE, ME, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

Minor

23MDECE101 SIGNALS AND SYSTEMS

L	T	P	C
3	0	0	3

Course Objectives:

1. Study the mathematical description and representation of discrete and continuous signals and systems.
2. Obtain the response of an LTI system and convert a continuous-time signal to the discrete-time using sampling.
3. Study the frequency domain analysis of continuous time and discreate-time signals and systems using Fourier transform.
4. Analyze the continuous-time systems using Laplace transform.
5. Analyze the discrete-time systems using z-transform

UNIT I INTRODUCTION TO SIGNALS AND SYSTEMS 9 hours

Signals – Continuous-time (CT) & Discrete-Time (DT) signals –Basic CT & DT Signals, Signal Operations, Representation of signals in terms of impulse function, Classification of CT &DT Signals: - Energy and power signals, Even and Odd signals, Periodic and Aperiodic signals, — Systems – Classifications of CT & DT systems: – static & dynamic, causal & non-causal, linear & non-linear, time variant & time invariant, and stable & unstable systems. Application of signal and systems in various field of engineering.

UNIT II LINEAR TIME INVARIANT (LTI) SYSTEMS 9 hours

LTI Systems, Properties of LTI systems – causality and stability. Convolution and its properties, Convolution Integral of CT-LTI systems, Convolution sum of DT-LTI systems (tabular and graphical methods), Unit impulse response and unit step response of LTI systems. The Sampling theorem and its implications- Spectra of sampled signals. Reconstruction: Aliasing and its effects, Nyquist rate and Nyquist interval

UNIT III FOURIER ANALYSIS FOR PERIODIC AND APERIODIC SIGNALS 9 hours

Fourier series representation of a continuous time periodic signal: Trigonometric and Complex exponential and their relation. Continuous Time Fourier Transform (CTFT), magnitude and phase response, properties of CTFT, Fourier series representation of a discrete time periodic signal: Discrete Fourier series (DFS), Th Discrete-Time Fourier Transform (DTFT) and its properties.

UNIT IV ANALYSIS OF CONTINUOUS TIME SIGNAL AND SYSTEMS USING LAPLACE TRANSFORM 9 hours

The Laplace Transform of continuous time signals and systems, relation between Laplace and Fourier transform, region of convergence, poles and zeros of system. Laplace transform of some common signals, properties of Laplace transform, properties of region of convergence. Inverse Laplace transform, Laplace domain analysis of continuous time LTI system.

UNIT V ANALYSIS OF DISCRETE TIME SIGNAL AND SYSTEMS USING Z TRANSFORM 9 hours

The z-Transform of discrete time signals and systems, region of convergence, z-transform of some common sequences, properties of Z transform, properties of region of convergence. Inverse z-

transform: distinct pole and repeated-pole system. Z - domain analysis for discrete-time systems, system function analysis of discrete-time LTI.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Understand the fundamentals and classifications of signals & systems.
CO2: Analyse the LTI systems using convolution and concept of sampling.
CO3: Represent periodic and aperiodic signals in the frequency domain using Fourier transforms.
CO4: Analyse the continuous time system behaviour using the Laplace Transform.
CO5: Analyse the discrete time system behaviour using the z-Transform.

Text Books:

1. Alan V Oppenheim, Alan S Willsky and S Hamid Nawab, "Signals and Systems", PHI Learning Private Limited, 2nd edition, 2010
2. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International ISE edition, 1999.

Reference Books:

1. Haykin. S and Barry Van Veen, "Signals and Systems", John Wiley and Sons, 2nd edition, 2012.
2. Lathi, B. P, "Signal Processing and Linear Systems", Oxford University Press, 1998.
3. Hsu.H.P and Rakesh Ranjan, "Signals and Systems- Schaums's Outlines", Tata McGraw Hill, 2nd edition, 2010.
4. Samir S. Soliman and Mandyam Dhati Srinath, "Continuous and Discrete Signals and Systems", Prentice-Hall International, 2nd edition, 2011.
5. Luis F. Chaparro, "Signals and Systems Using MATLAB", Academic Press-An Imprint of Elsevier, 1st edition, 2011.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDECE102 COMMUNICATION SYSTEMS

L	T	P	C
3	0	0	3

Course Objectives:

1. Study the fundamental concepts of communication theory.
2. Analyze various analog continuous wave modulation and pulse modulation techniques.
3. Evaluate the performance of analog communication systems in the presence of noise.
4. Study different baseband and bandpass digital modulation techniques.
5. Study the performance of digital receivers

UNIT I NOISES ANALYSIS 9 hours

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.

UNIT II ANALOG MODULATION 9 hours

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Frequency Division Multiplexing. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

UNIT III DIGITAL KEYING TECHNIQUES 9 hours

Pulse modulation, Sampling process. PAM, PPM, PWM and Pulse code modulation (PCM), Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers. Differential pulse code modulation and Adaptive PCM. Delta modulation.

UNIT IV SHIFT KEYING TECHNIQUES 9 hours

Baseband Pulse Transmission- Matched Filter – Error rate- Inter-Symbol Interference and Nyquist criterion. Pass band Digital Modulation Schemes-Passband Transmission Model- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Minimum Shift Keying.

UNIT V SIGNALS CONDITIONING 9 hours

Linear Block Codes- Convolutional codes- Linear equalization and Decision Feedback techniques for band-limited channels- Adaptive Equalization- Synchronization and Carrier Recovery for Digital modulation.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Analyze the analog continuous wave modulation techniques in time and frequency domain.
CO2: Evaluate the performance of continuous wave modulation systems in the presence of noise.
CO3: Study of various analog and digital pulsed modulation techniques.
CO4: Understand of various digital baseband and bandpass modulation techniques.
CO5: Study of improvement in the performance of digital communication system using channel coding and equalization technique.

Text Books:

1. Simon Haykin and Michale Moher, "An Introduction to Analog and Digital
2. Communications", 2nd Edition, John Wiley and Sons, 2007.
3. B. P. Lathi and Zhi Ding, "Modern Analog and Digital Communication Systems", 4th Edition, John Wiley and Sons, 2004

Reference Books:

1. H. P. Hsu, "Theory and Problems of Analog and Digital Communications", 3rd Edition, Schaum's Outline, 2009.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Barry J. R., Lee E. A. and Messerschmitt D. G., "Digital Communication", Kluwer Academic Publishers, 2004.
5. Proakis J.G., "Digital Communications", 4th Edition, McGraw Hill, 2000.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDECE201 COMMUNICATION SYSTEMS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

To understand the basics analog and digital modulation technique and get the real time exposure of communication system with detailed analysis of analog and digital communication techniques.

List of Experiments:

1. **1.** Amplitude Modulation and demodulation.
2. **2.** DSB-SC modulation and demodulation.
3. **3.** SSB-SC modulation and demodulation.
4. **4.** Frequency Modulation and demodulation.
5. **5.** Pre-emphasis and De-emphasis.
6. **6.** Phase modulation and demodulation.
7. **7.** Study and simulation of signals in the presence of noise.
8. **8.** Sampling and Reconstruction.
9. **9.** Pulse Amplitude Modulation and Time Division Multiplexing.
10. **10.** Pulse Code Modulation & demodulation and Differential PCM modulation & demodulation.
11. **11.** Quadrature Phase Shift Keying and Quadrature Amplitude Modulation.
12. **12.** Line Coding, Performance of Unipolar and Bipolar systems.
13. **13.** FSK, PSK and DPSK schemes.

Course Outcomes:

At the end of this course, the students will be able to

CO1: Understand the fundamental concepts of analog communication systems.
CO2: Evaluate the performance of communication systems in the presence of noise
CO3: Implement the various the pulse modulation schemes for digital communication
CO4: Demonstrate the various digital modulation technique
CO5: Examine the performance of coding in digital system

Text Books:

1. **1.** Simon Haykin**,** ***Title:*** Communication Systems (5th Edition)**,** ***Publisher:*** Wiley**.**

2. B. P. Lathi, Zhi Ding**,** ***Title:*** Modern Digital and Analog Communication Systems (4th Edition)**,** ***Publisher:*** Oxford University Press**.**
3. John G. Proakis, Masoud Salehi**,** ***Title:*** Fundamentals of Communication Systems (2nd Edition)**,** ***Publisher:*** Pearson Education**.**

Reference Books:

1. Harvey Lehpamer**,** ***Title:*** Introduction to Communication Systems (3rd Edition)**,** ***Publisher:*** McGraw-Hill Education**.**
2. Taub and Schilling**,** ***Title:*** Principles of Communication Systems (3rd Edition)**,** ***Publisher:*** McGraw-Hill Education**.**
3. Kennedy and Davis**,** ***Title:*** Electronic Communication Systems (4th Edition)**,** ***Publisher:*** McGraw-Hill Education**.**

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

Minor

23MDECE103 DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

Course Objectives:

1. (a) Understand basics of discrete time signals & systems and their classification
   (b) Get familiar with difference equation representation of discrete time LTI system
   (c) Study convolution & correlation and its properties and apply the same for finding response as well as analysis of discrete time LTI system.
2. Get acquainted with mathematical tools such as DTFT, DFT, FFT, z-transform and use them for the analysis of discrete time signals and LTI systems in transform domain
3. (a) Design various types of ADCs, DACs so as to process continuous signals using DSP system.
   (b) Realize FIR and IIR systems using direct, cascade and parallel forms.
4. Design IIR filter and FIR filter.
5. Acquire knowledge about real time implementation of various digital signal processing algorithms in DSP hardware

UNIT I INTRODUCTION **9 hours**

Discrete time Signal and System: Basic of discrete signal and system, comparison of analog and digital system, conversion of analog-to-digital (ADC) and digital-to-analog system (DAC), classification of discrete-time signals, and system, Analysis of discrete-time system: analysis of LTI System, difference equation analysis of LTI System, Convolution and Correlation of discrete time signal.

UNIT II DISCRETE TIME SIGNAL ANALYSIS IN TRANSFORM DOMAIN **9 hours**

Time-Domain and Frequency domain signal properties, the discrete time Fourier transform (DTFT), Discrete Fourier transform (DFT), fast Fourier transform (FFT), Z-transform, frequency domain analysis of discrete time signals and LTI systems, analysis of LTI system with Z-transform.

UNIT III DSP SYSTEM **9 hours**

Digital processing of Continuous time signals: Sampling of signals, sampling theorem, filtering process, ADC/DAC Conversion. LTI discrete-time System in Transform Domain: Types of transfer function, digital filters, all pass transfer function, inverse system. Implementation of DSP System: Structure for the realization of discrete-time systems, Structure for FIR and IIR, Representation of Numbers, Finite word length effects: Quantization of input signal, filter coefficient, Round-off effect in digital filters.

UNIT IV FILTER DESIGN **9 hours**

Basics of Analog Filter and Digital filters, Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Band-stop and High pass filters using Bilinear Transformation.

UNIT V DIGITAL SIGNAL PROCESSORS **9 hours**

Introduction to fixed point and floating-point DSP processors-Harvard architecture, pipelining, Multiplier-accumulator (MAC) unit, Architecture of TMS320C6713 floating point processor - Addressing modes, Instruction set, Applications.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Acquire basic knowledge about discrete time signals and systems and apply the same in analyzing LTI system in time domain.

CO2: Understand different types of mathematical tools such as DTFT, DFT, FFT, z-transform and use them in analyzing discrete time signals and LTI system in transform domain.

CO3: Design A/D & D/A conversion systems for digital processing of continuous time signal and implement various structures such as direct, cascade, parallel forms for realization of FIR, IIR systems.

CO4: Design Digital IIR and FIR filters to meet desired frequency response specification for low-pass, high-pass, band-pass and band-stop filtering application.

CO5: Ability to acquire knowledge on programmability Digital Signal Processor.

Text Books:

1. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Pearson, 4th Edition

2. S.K. Mitra, Digital Signal Processing: A computer based approach. TMH, 4th Edition

3. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 3rd Edition

Reference Books:

1. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

2. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.

3. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDECE104 OPTICAL COMMUNICATION

L	T	P	C
3	0	0	3

Course Objectives:

1. Enumerate the theoretical aspects of light transmission in optical fiber.
2. Understand optical sources, detectors and amplifiers.
3. Understand TDM and WDM systems.
4. Study the characteristics of optical fiber, sources and detectors.
5. Estimate optical link budget consisting of optical sources, fibers and detectors.

UNIT I OPTICAL FIBERS 9 hours

Ray Theory transmission. Optical Confinement, cutoff condition, single mode/multimode concept. Losses and Dispersion in optical fibers: Attenuation, Material Absorption Losses in Silica Glass Fibers, Linear Scattering Losses, Fiber Bend Loss, Non-Linear effects in optical fibers-SRS, SPM, SBS, FWM Dispersion, Chromatic dispersion, Intermodal dispersion, Overall fiber dispersion, Polarization. Chirped Gaussian pulses, Broadening of chirped Gaussian pulses, controlling the dispersion profile.

UNIT II OPTICAL SOURCES 9 hours

Light Emitting Diodes (LEDs): LED Structures, Light Source Materials, Quantum efficiency and LED Power, Modulation of LED. LASER Diodes- Laser Diode Modes, laser action, mode selection and Threshold Conditions, Some Injection laser structures-Gain guided lasers, index guided lasers, quantum well lasers, quantum dot lasers, Single frequency injection lasers-Short and coupled cavity lasers, distributed feedback lasers, vertical cavity surface emitting lasers, Injection laser characteristics, Threshold current dependence, Dynamic response, Frequency Chirp, noise, mode hopping, Reliability.

UNIT III PHOTO DETECTORS 9 hours

Physical principles of photo diodes, photo detector noise, detector response time, avalanche multiplication noise, structures for InGaAs APDs, temperature effect on avalanche gain, Receiver design, S/N estimation, Digital optical receivers, Digital receiver sensitivity, comparisons of photo detectors. Design issues, S/N and BER optimization, Practical receiver.

UNIT IV OPTICAL AMPLIFIERS 9 hours

Optical amplifiers-Semi-conductor optical amplifiers-performance characteristics, gain clamping, quantum dots, Fiber and waveguide amplifiers- Rare earth fiber amplifiers, Raman and Brillouin amplifiers, Wave guide amplifiers and fiber amplifiers, optical parametric amplifiers, wideband fiber amplifiers, Semi-conductor laser amplifiers- SLA, Design and applications of amplifiers.

UNIT V MULTIPLEXING CONCEPTS AND OPTICAL SYSTEMS 9 hours

WDM Concepts and components: Over-view, Passive optical couplers, Isolators & circulators, Fiber grating filters, dielectric thin film filters, and Phased array based devices, Diffraction gratings, Active optical components, tunable light sources. Time Division Multiplexing- Optical TDM techniques, Soliton communication- Solition generation, solution interaction, High capacity solution systems and jitter eduction, WDM solution system- Solition Multiplexing techniques, new trends in optical communication. Optical Systems: Point to point links, power penalties, and error control. Power penalty considerations and link budget analysis. Different topologies used in optical networks, optical LAN, WANS, SONET/SDH, WDM light wave
system- Channel spacing decision, multipliers, design issues.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Understand the structures of Optical fibers and its types.
CO2: Estimate attenuation and dispersion in optical fiber.
CO3: Describe various optical sources and detectors for communication applications.
CO4: Analyze the characteristics of optical fiber, sources and detectors, design as well as conduct experiments in software and hardware, analyze the results to provide valid conclusion.
CO5: Evaluate optical link budget consisting of optical sources, fibers and detectors.

Text Books:

1. Govind P Agrawal, Fiber -optic Communication systems, Willey Publication 4th Edition, 2010.
2. Gerdkeiser, Optical fiber communications, McGraw Hill International Edition, 5th Edition, 2013.
3. John M. Senior, Optical fiber communications, PHI, 4rd Edition, 2010.

Reference Books:

1. Max Ming-Kang Liu, Principles and Applications of Optical Communications, TMH, 2010.
2. S. C. Gupta, Text book on optical fiber communication and its applications PHI, 3rd Edition 2005.
3. Satish Kumar, Fundamentals of Optical Fiber communications, PHI, 2nd Edition, 2014.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDECE202 DIGITAL SIGNAL PROCESSING LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. To get familiar with various operations on discrete time signals and apply the same in implementing convolution and correlation of discrete time signals
2. To analyse spectrum of discrete time signal using DFT
3. To design digital IIR and FIR filters for low-pass and high-pass filtering
4. To analyse Multirate DSP system by implementing Interpolator and Decimator
5. To acquire knowledge about implementation of digital systems for noise filtering application

List of Experiments:

MATLAB based Experiments

1. Generation of Various signals and Sequences: Unit Impulse, Unit Step, Square, Saw Tooth, Triangular, Sinusoidal, Ramp, random signals.
2. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
3. Convolution (Linear and Circular) between Signals and Sequences.
4. Autocorrelation and Cross correlation between Signals and Sequences.
5. Spectrum analysis using DFT
6. IIR filter (LP/HP) Design using bi-linear transformation techniques
7. FIR filter (LP/HP) Design using window techniques
8. Analysis of Multi-rate DSP
9. Application od DSP: Noise Filtering

DSP Processor based Experiments

1. Study of DSP Processor and its architecture
2. Generation of Various signals and Sequences: Unit Impulse, Unit Step, Square, Saw Tooth, Triangular, Sinusoidal, Ramp, random signals.
3. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
4. Linear and Circular Convolution
5. Auto-correlation and Cross-correlation
6. FFT Implementation
7. FIR Filter design using Window Techniques (Rectangular, Triangular and Kaiser)
8. IIR Filter design

Course Outcomes:

At the end of this course, the students will be able to

CO1: Implement addition, multiplication, scaling, shifting, folding operations on discrete time signals and apply the same for computing convolution and correlation of discrete time signals in MATLAB and then using DSP processor

CO2: Analyse magnitude and phase spectrum of discrete time signal using DFT in MATLAB and implement FFT algorithm for the same using DSP processor

CO3: Design Digital IIR and FIR filters in MATLAB by using Bilinear transformation and Windowing technique respectively and Implementation of the same through DSP processor

CO4: Implement Interpolator and Decimator for the analysis of Multirate DSP system in MATLAB.

CO5: Design digital filter in MATLAB to suppress noise and extract the required information from the noisy signal

Text Books:

1. John G. Proakis, Dimitris G. Manolakis**,** ***Title:*** Digital Signal Processing: Principles, Algorithms, and Applications (4th Edition)**,*****Publisher:*** Pearson Education**.**
2. Alan V. Oppenheim, Ronald W. Schafer**,** ***Title:*** Discrete-Time Signal Processing (3rd Edition)**,** ***Publisher:*** Pearson Education**.**
3. Sanjit K. Mitra**,** ***Title:*** Digital Signal Processing: A Computer-Based Approach (4th Edition)**,** ***Publisher:*** McGraw-Hill Education**.**

Reference Books:

1. P. Ramesh Babu**,** ***Title:*** Digital Signal Processing**,** ***Publisher:*** Scitech Publications**.**
2. S. Salivahanan, A. Vallavaraj, C. Gnanapriya**,** ***Title:*** Digital Signal Processing (2nd Edition)**,** ***Publisher:*** McGraw-Hill Education**.**
3. Rulph Chassaing, Donald Reay**,** ***Title:*** Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK (2nd Edition)**,** ***Publisher:*** Wiley**.**

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

Minor in Electronics and Communication Engineering

Stream Name: Embedded Systems

(Applicable to CE, EEE, ME, CSE, CST, CSE (AI), CSE (DS), CSE (CS) , CSE (AI and ML) and CSE (Networks)

Minor

23MDECE106 MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS

L	T	P	C
3	0	0	3

Course Objectives:

The main objectives of the course is to

1. To understand the architecture and applications of the ARM Cortex-Mx processor.
2. To comprehend the types, priority, and behaviour of exceptions and interrupts.
3. To study the architectural and advanced features of the LPC 17xx microcontroller.
4. To understand the architecture and features of programmable DSP processors.
5. To explore the architecture and programming considerations of the TMS320C62x, TMS320C64x, and TMS320C67x processors.

UNIT I ARM CORTEX-MX PROCESSOR 9 hours

Applications, Programming model – Registers, Operation - modes, Exceptions and Interrupts, Reset Sequence, Instruction Set (ARM and Thumb), Unified Assembler Language, Memory Maps, Memory Access Attributes, Permissions, Bit-Band Operations, Unaligned and Exclusive Transfers. Pipeline, Bus Interfaces.

UNIT II EXCEPTIONS AND INTERRUPTS 9 hours

Exceptions, Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor and Pendable Service Call, Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency.

UNIT III LPC 17XX MICROCONTROLLER 9 hours

Internal memory, GPIOs, Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT.

UNIT IV PROGRAMMABLE DSP (P-DSP) PROCESSORS 9 hours

: Harvard architecture, Multi port memory, architectural structure of P-DSP- MAC unit, Barrel shifters, Introduction to TI DSP processor family

UNIT V VLIW ARCHITECTURE AND TMS320C6000 9 hours

VLIW architecture and TMS320C6000 series, architecture study, data paths, cross paths, Introduction to Instruction level architecture of C6000 family, Assembly Instructions memory addressing, for arithmetic, logical operations.

TMS320C55x – Architecture overview, Addressing modes, Instruction set, Programming considerations, system issues.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Explain the architecture, applications, and programming model of the ARM Cortex-Mx processor
CO2: Explain and configure different types of exceptions and interrupts.
CO3: Describe the architecture and peripheral interfaces of the LPC 17xx microcontroller and its advance features.
CO4: Explain the architecture and key features of programmable DSP processors.
CO5: Describe the architecture, instruction set, and programming considerations of various TI DSP processors.

Text Books:

1. N. Senthil Kumar and M Saravanan, "Microprocessors and Microcontrollers" 2nd Edition, Oxford university press, 2016.

2. Venkatramani B. and Bhaskar M. "Digital Signal Processors: Architecture, Programming and Applications", TMH, 2nd Edition.
3. TMS Manual on TMS320C62XX, TMS320C64XX and TMS320C67XX.

Reference Books:

1. Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing and Optimizing", Morgan Kaufman Publication.

2. Technical references and user manuals on www.arm.com, NXP Semiconductor www.nxp.com and Texas Instruments www.ti.com

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDECE107 PROGRAMMING LANGUAGES FOR EMBEDDED SOFTWARE

L	T	P	C
3	0	0	3

Course Objectives:

The main objectives of the course is to

1. To introduce students to various programming languages like C, C++, Java script, PERL, etc.
2. To distinguish between Procedural and OOP language, Introduce features of OOPs etc.
3. To demonstrate the development of some typical applications using different Programming languages.

UNIT I EMBEDDED 'C' PROGRAMMING 9 hours

Bitwise operations, Dynamic memory allocation, OS services, linked stack and queue, Sparse matrices, Binary tree, Interrupt handling in C, Code optimization issues, Writing LCD drives, LED drivers, Drivers for serial port communication, Embedded Software Development Cycle and Methods (Waterfall, Agile).

UNIT II OBJECT ORIENTED PROGRAMMING 9 hours

Introduction to procedural, modular, object oriented and generic programming techniques, Limitations of procedural programming, objects, classes, data members, methods, data encapsulation, data Abstraction and information hiding, inheritance, polymorphism.

UNIT III CPP PROGRAMMING 9 hours

'cin', 'cout', formatting and I/O manipulators, new and delete operators, Defining a class, data members and methods, 'this' pointer, constructors, destructors, friend function, dynamic memory allocation.

UNIT IV OVERLOADING AND INHERITANCE 9 hours

Need of operator overloading, overloading the assignment, overloading using friends, type conversions, single inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance,multiple inheritance.

Templates: Function template and class template, member function templates and template arguments

UNIT V EXCEPTION HANDLING 9 hours

Syntax for exception handling code: try-catch-throw, Multiple Exceptions. **Scripting Languages**: Overview of Scripting Languages – PERL, CGI, VB Script, Java Script. PERL: Operators, Statements Pattern Matching etc. Data Structures, Modules, Objects, Tied Variables, Inter process Communication Threads, Compilation & Line Interfacing.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Introduce students to various programming languages like C, C++, Java script, PERL, etc.
CO2: Distinguish between Procedural and OOP language, Introduce features of OOPs etc.
CO3: Demonstrate the development of some typical applications using different Programming languages.
CO4: Analyze the trade-offs between various embedded programming languages and platforms.
CO5: Integrate hardware and software to design complete embedded system projects.

Text Books:

1. Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition, 2008
2. Robert Sedgewick, "Algorithms in C++", Addison Wesley Publishing Company, 1999.

Reference Books:

1. Randal L. Schwartz, "Learning Perl", O'Reilly Publications, 6th Edition 2011.
2. Michael Berman, "Data structures via C++", Oxford University Press, 2002

Online Learning Resources

1. https://nptel.ac.in/courses/106/103/106103068/

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDECE203 MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS LABORATORY

L	T	P	C
0	**0**	**3**	**1.5**

Course Objectives:

The main objectives of the course is to

1. To write the ARM 'C' programming for applications
2. To understand the interfacing of various modules with ARM 7/ ARM Cortex-M3
3. To develop assembly and C Programming for DSP processors

List of Experiments:

Part A) Experiments to be carried out on Cortex-Mx development boards and using GNU tool-chain

1. Blink an LED with software delay, delay generated using the SysTick timer.
2. System clock real time alteration using the PLL modules.
3. Control intensity of an LED using PWM implemented in software and hardware.
4. Control an LED using switch by polling method, by interrupt method and flash the LED once every five switch presses.
5. UART Echo Test.
6. Take analog readings on rotation of rotary potentiometer connected to an ADC channel.
7. Temperature indication on an RGB LED.
8. Mimic light intensity sensed by the light sensor by varying the blinking rate of an LED.
9. Evaluate the various sleep modes by putting core in sleep and deep sleep modes.
10. System reset using watchdog timer in case something goes wrong.
11. Sample sound using a microphone and display sound levels on LEDs.

Part B) Experiments to be carried out on DSP C6713 evaluation kits and using Code Composer Studio (CCS)

12. To develop an assembly code and C code to compute Euclidian distance between any two points
13. To develop assembly code and study the impact of parallel, serial and mixed execution
14. To develop assembly and C code for implementation of convolution operation
15. To design and implement filters in C to enhance the features of given input sequence/signal

Software Requirements:
Keil for ARM, Code Composer Studio

Hardware Requirements:
ARM Cortex Mx Development Boards, TI TMS C6713 evaluation kit

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Install, configure and utilize tool sets for developing applications based on ARM processor core.
CO2: Design and developtheARM7 based embedded systems for various applications.
CO3: Develop application programs on ARM and DSP development boards both in assembly and C
CO4: Design and implement the digital filters on DSP6713 processor.
CO5: Analyze the hardware and software interaction and integration.

Text Books:

1. Muhammad Ali Mazidi, Rolin D. McKinlay, Janice Gillispie Mazidi**,** ***Title:*** The 8051 Microcontroller and Embedded Systems: Using Assembly and C (2nd Edition)**,** ***Publisher:*** Pearson Education**.**
2. Kenneth J. Ayala**,** ***Title:*** The 8051 Microcontroller (3rd Edition)**,** ***Publisher:*** Cengage Learning**.**
3. Raj Kamal**,** ***Title:*** Microcontrollers: Architecture, Programming, Interfacing and System Design (2nd Edition)**,** ***Publisher:*** Pearson Education**.**

Reference Books:

1. B. Venkataramani, M. Bhaskar**,** ***Title:*** Digital Signal Processors: Architecture, Programming and Applications (2nd Edition)**,** ***Publisher:*** McGraw-Hill Education**.**
2. Avtar Singh, S. Srinivasan**,** ***Title:*** Digital Signal Processing: Implementations Using DSP Microprocessors with Examples from TMS320C54xx (1st Edition)**,** ***Publisher:*** Cengage Learning**.**
3. Rulph Chassaing, Donald Reay**,** ***Title:*** Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK (2nd Edition)**,** ***Publisher:*** Wiley**.**

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

Minor

23MDECE108 REAL TIME OPERATING SYSTEMS

L	T	P	C
3	0	0	3

Course Objectives:

The main objectives of the course is to

1. Understand the introduction of real-time embedded systems
2. Know the different types of policies.
3. Understand the Multi-resource Services techniques.
4. Learn the Embedded System Components.
5. Know the embedded system design based on availability and reliability.

UNIT I INTRODUCTION TO REAL-TIME EMBEDDED SYSTEMS 9 hours

Brief history of Real Time Systems, A brief history of Embedded Systems. Resource Analysis, RealTime Service Utility, Scheduling Classes, The Cyclic Executive, Scheduler Concepts, Preemptive Fixed Priority Scheduling Policies, Real-Time OS, Thread Safe Reentrant Functions.

UNIT II RTOS POLICIES 9 hours

Preemptive Fixed-Priority Policy, Feasibility, Rate Monotonic least upper bound, Necessary and Sufficient feasibility, Deadline – Monotonic Policy, Dynamic priority policies.

I/O Resources: Worst-case Execution time, Intermediate I/O, Execution efficiency, I/O Architecture. Memory: Physical hierarchy, Capacity and allocation, Shared Memory, ECC Memory, Flash file systems.

UNIT III MULTI-RESOURCE SERVICES 9 hours

Blocking, Deadlock and livestock, Critical sections to protect shared resources, priority inversion. Soft Real-Time Services: Missed Deadlines, QoS, Alternatives to rate monotonic policy, mixed hard and soft real-time services.

UNIT IV EMBEDDED SYSTEM COMPONENTS 9 hours

Firmware components, RTOS system software mechanisms, Software application components. Debugging Components- Exceptions assert, Checking return codes, Single-step debugging, kernel scheduler traces, Test access ports, Trace ports, Power-On self-test and diagnostics, External test equipment, Application-level debugging. Basic concepts of drill-down tuning, hardware – supported profiling and tracing, Building performance monitoring into software, Path length, Efficiency, and Call frequency, Fundamental optimizations.

UNIT V HIGH AVAILABILITY AND RELIABILITY DESIGN 9 hours

Reliability and Availability, Similarities and differences, Reliability, Reliable software, Available software, Design tradeoffs, Hierarchical applications for Fail-safe design. Design of RTOS – PIC microcontroller.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Introduce real-time embedded systems

CO2: Describe the different types of policies.

CO3: Demonstrate the Multi-resource Services techniques.

CO4: Explain the Embedded System Components.

CO5: Explain the embedded system design based on availability and reliability

Text Books:

1. C.M. Krishna and G.Shin, Real Time Systems, McGraw-Hill International Edition, 2017.

2. Jean J Labrosse, Embedded Systems Building Blocks Complete and Ready-to-use Modules in C, CMP books, 2/e, 1999. (reprint 2011)

Reference Books:

1. Jean J Labrosse, Micro C/OS-II, The Real Time Kernel, CMP Books, 2011.

2. Sam Siewert, V, Real-Time Embedded Components and Systems: With Linux and RTOS (Engineering), 2015.

3. Tanenbaum, Modern Operating Systems, 4th edition, Pearson Edition, 2015.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor

23MDECE109 SoC ARCHITECTURE

L	T	P	C
3	0	0	3

Course Objectives:

The main objectives of the course is to

1. To understand the basics related to SoC architecture and different approaches related to SoC Design.
2. To select an appropriate robust processor for SoC Design
3. To select an appropriate memory for SoC Design.
4. To realize real time case studies

UNIT I INTRODUCTION TO THE SYSTEM APPROACH 9 hours

System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory &Addressing. System level interconnection, An approach for SoC Design, System Architecture and Complexity

UNIT II PROCESSORS 9 hours

Introduction, Processor Selection for SoC, Basic concepts in Processor Architecture, Basic concepts in Processor Microarchitecture, Basic elements in Instruction handling.

Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instruction extensions, VLIW Processors, Superscalar Processors

UNIT III MEMORY DESIGN FOR SoC 9 hours

Overview: SoC external memory, SoC Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Other Types of Cache, Split – I, and D – Caches, Multilevel Caches, SoC Memory System, Models of Simple Processor – memory interaction.

UNIT IV INTERCONNECT, CUSTOMIZATION AND CONFIGURABILITY 9 hours

Interconnect Architectures, Bus: Basic Architectures, SoC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time.

SoC Customization: An overview, Customizing Instruction Processor, Reconfigurable Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on
Reconfigurable Parallelism.

UNIT V APPLICATION STUDIES / CASE STUDIES 9 hours

SoC Design approach; AES-algorithms, Design and evaluation; Image compression–JPEG compression.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand the basics related to SoC architecture and different approaches related to SoC Design.
CO2: Select an appropriated robust processor for SoC Design
CO3: Select an appropriate memory for SoC Design.
CO4: Design SoC
CO5: Realize real time case studies

Text Books:

1. Computer System Design System-on-Chip - Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
2. ARM System on Chip Architecture – Steve Furber, 2ndEdition, 2000, Addison Wesley Professional.

Reference Books:

1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer.

2. System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination

Minor

23MDECE204 QNX BASED REAL TIME OS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

The main objectives of the course is to

1. Understand the architecture and core concepts of the QNX RTOS and Learn to develop and debug applications using the QNX Momentics IDE. (L2)
2. Apply the knowledge of process and thread management, including synchronization techniques. (L3)
3. Construct inter-process communication (IPC) methods and their applications in QNX. (L3)
4. Understand hardware programming concepts, including interrupt handling and memory access. (L2)
5. Develop to build and configure QNX boot/OS images for embedded systems. (L6)

List of Experiments:

1. Study of QNX Micro Kernal Operating System and QNX Momentics IDE
2. Installation of QNX Momentics IDE 8.0, and Installation of QNX Operating System in Raspberry Pi 4
3. Write a program for “Hello World” and using QNX Momentics IDE, execute on x86 and ARMx64 architecture.
4. Write a program that creates multiple child processes using fork() and print different messages in parent and child process. Terminate the parent after 5 seconds and print the pid from the child.
5. Implement a multi-threaded application using POSIX threads (pthread_create). Each thread should process a different part of an array and the main thread should wait for all threads to complete using pthread_join.
6. Write a program to create a process with 4 threads that update the portin of array of size 1000 bytes by updating 250 bytes each. Make the main thread to join on the 4 threads and print the completion. Use mutex to prevent data corruption while each thread is updating the array.
7. Implementing a thread-safe bounded buffer (also known as a circular queue) that is shared between multiple producer threads and multiple consumer threads. The buffer has a fixed size (N slots). Producers add items to the buffer, and consumers remove items from the buffer.
8. Write a program to create a basic Client and Server model to send / receive data. If MsgReply() was removed from server what happens?, if the server’s MsgReceive() returns a failure, should the program exit?
9. Write a program to create a pulse and send from a process to another by keeping pid and cid in the pulse. Verify the exchange of messages and delivery of pulses
10. Write a program to create a pulse and send from a process to another by use name_attach(), and

name_attach() creates a channel with several channel flags turned on, your server should expect to receive kernel pulses on a disconnect pulse, release the scoid by calling ConnectDetach()

11. Write a program to creates shared memory objects and handles, reads and updates the shared memory, finally release message and disconnect pulse with server client model.
12. Write a Program to Simple standard interrupt handling - Interrupt 1, works only on VM ware virtual machine
13. Write a program to a timer function, it will wake up 5 seconds from the time it runs and then every 1500 milliseconds after that it will wake up by receiving a pulse.
14. Implement two processes that communicate via shared memory using shm_open and mmap. One process writes data, and the other reads and displays it.
15. Create a new virtual machine image with a larger boot disk from Momentics IDE and VSCode and build the image directory on the target (x86_64 virtualized)
16. Create the Boot image using QNX BSP

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Describe the QNX OS architecture and its microkernel-based design and Develop and debug QNX-based applications using appropriate tools.
CO2: Apply process/thread management and synchronization techniques in QNX.
CO3: Implement inter-process communication methods for real-time systems.
CO4: Configure and build QNX boot/OS images for specific hardware platforms.
CO5: Develop strong knowledge on the POSIX standards that help in System Application Development

Text Books:

1. Raj Kamal***,Title:*** Embedded Systems: Architecture, Programming and Design (3rd Edition)***, Publisher:*** McGraw-Hill Education***. (Includes discussion on RTOS concepts and QNX as a case study.)***
2. Jane W. S. Liu***, Title:*** Real-Time Systems***, Publisher:*** Pearson Education***. (Covers theoretical foundations relevant to QNX RTOS-based development.)***
3. K. C. Wang***, Title:*** Embedded and Real-Time Operating Systems (1st Edition)***, Publisher:*** Springer***. (Includes chapters on microkernel OS and practical real-time programming principles applicable to QNX.)***

Reference Books:

1. Phillip A. Laplante***, Title:*** Real-Time Systems Design and Analysis (4th Edition)***, Publisher:*** Wiley***. (Comprehensive coverage of real-time OS concepts with relevance to QNX-based labs.)***
2. Robert Oshana***, Title:*** DSP Software Development Techniques for Embedded and Real-Time Systems***, Publisher:*** Newnes/Elsevier***. (Includes practical design approaches for real-time systems using RTOS, suitable for QNX environments.)***

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

Minor in Quantum Computing

(Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

Minors

23MDINS101 INTRODUCTION TO QUANTUM COMPUTING

	L	T	P	C
Pre-requisite: None	**3**	**0**	**0**	**3**

Course Description:

This course introduces the basics of quantum mechanics as applied to computing. Students learn about qubits, quantum gates, circuits, and key algorithms like Grover's and Shor's. Concepts such as superposition, entanglement, and quantum communication are explored. Practical exposure is given through programming on platforms like IBM Qiskit.

Course Objectives:

1. Understand quantum mechanics principles in computing.
2. Explore qubits, quantum gates, and circuits.
3. Analyze the advantages of quantum algorithms.
4. Study entanglement, superposition, and interference.
5. Investigate real-world applications and platforms.

UNIT I QUBITS AND QUANTUM FOUNDATIONS 9 hours

Classical Bits vs Qubits, Postulates of Quantum Mechanics, Superposition and Probability Amplitudes, Dirac Notation (Bra-Ket), Bloch Sphere Representation, Measurement in Quantum Systems, Quantum State Collapse.

UNIT II QUANTUM GATES AND CIRCUITS 9 hours

Quantum Logic Gates: Pauli-X, Y, Z; Hadamard (H); Phase (S, T), Controlled Gates: CNOT, Toffoli, Unitary and Reversible Operations, Quantum Circuit Representation, Building Basic Quantum Circuits, Quantum Parallelism and Interference, No-Cloning Theorem and Quantum Gate Simulation.

UNIT III QUANTUM ALGORITHMS 9 hours

Need for Quantum Algorithms, Deutsch and Deutsch-Jozsa Algorithm, Grover's Search Algorithm (Quadratic Speed-up), Shor's Factoring Algorithm (Exponential Speed-up), Simon's Algorithm (Overview), Complexity Comparison: Classical vs Quantum.

UNIT IV ENTANGLEMENT AND QUANTUM COMMUNICATION 9 hours

Quantum Entanglement and Bell States, Quantum Teleportation Protocol, Superdense Coding, Quantum Key Distribution: BB84, E91 Protocols, Decoherence and Quantum Noise, Quantum Error Correction Codes (Bit Flip, Phase Flip, Shor Code).

UNIT V QUANTUM PLATFORMS AND APPLICATIONS 9 hours

Overview of Quantum Programming Platforms: IBM Qiskit, Microsoft Q#, Google Cirq, Quantum Circuit Simulation using Qiskit, Executing Code on Real Quantum Hardware (IBM Q). Quantum Applications in:Cryptography, Machine Learning, Optimization, Chemistry, Building and Testing a Sample Quantum Program.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Explain concepts of quantum mechanics
CO2: Illustrate quantum gates/circuits
CO3: Analyze algorithms (e.g., Shor, Grover)
CO4: Evaluate communication protocols
CO5: Develop quantum programs on IBM Q

Text Books:

1. **Michael A. Nielsen & Isaac L. Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition.
2. **David McMahon** – *Quantum Computing Explained*, Wiley.
3. **Bernhardt, Chris** – *Quantum Computing for Everyone*, MIT Press.

Reference Books:

1. **Mermin, N. David** – *Quantum Computer Science: An Introduction*, Cambridge University Press.
2. **William H. Press et al.** – *Numerical Recipes in C: The Art of Scientific Computing* (for simulation background)
3. **Rieffel&Polak** – *Quantum Computing: A Gentle Introduction*, MIT Press.
4. **Mermin, N. David** – *Quantum Computer Science: An Introduction*, Cambridge University Press.
5. **William H. Press et al.** – *Numerical Recipes in C: The Art of Scientific Computing* (for simulation background)
6. **Rieffel&Polak** – *Quantum Computing: A Gentle Introduction*, MIT Press.

Online Courses & Resources:
IBM Qiskit: IBM Qiskit Textbook:Hands-on, beginner-friendly curriculum for quantum programming
Coursera:*Quantum Mechanics for Scientists and Engineers* by Stanford (Leonard Susskind)

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minors

23MDINS102 MATHEMATICAL FOUNDATIONS FOR QUANTUM COMPUTING

	L	T	P	C
Pre-requisite: None	**3**	**0**	**0**	**3**

Course Description:

This course covers the mathematical tools required for quantum computing. It focuses on linear algebra, complex vector spaces, eigenvalues, and probability theory in quantum systems. Students gain skills to model quantum states and analyze measurements. These foundations prepare them for understanding quantum algorithms.

Course Objectives:

1. Cover linear algebra & complex vector spaces.
2. Model quantum states mathematically.
3. Apply probability theory to measurements.
4. Study eigenvalues and transformations.
5. Prepare for algorithm analysis with rigor.

UNIT I FOUNDATIONS OF COMPLEX VECTOR SPACES 9 hours

Complex Numbers: Polar form, Euler's formula, Vectors in $\mathbb{C}^n$, Inner Product Spaces, Dirac Notation (Bra-Ket), Hilbert Space: Definitions and Properties, Orthogonality and Completeness, Norms, Metrics, and Distance in Complex Spaces.

UNIT II MATRIX ALGEBRA AND OPERATORS 9 hours

Matrix Multiplication and Linear Transformations, Special Matrices: Identity, Diagonal, Unitary, Tensor Products of Matrices and Vectors, Kronecker Product Applications, Unitary and Invertible Operators, Quantum Gates as Linear Operators.

UNIT III EIGEN CONCEPTS AND QUANTUM OBSERVABLES 9 hours

Eigenvalues and Eigenvectors, Hermitian Operators and Spectral Theorem, Quantum Observables and Expectation Values, Commutators and Compatibility, Measurement Operators and Matrix Diagonalization, Applications in Quantum Gate Analysis.

UNIT IV QUANTUM MEASUREMENT & PROBABILITY 9 hours

Basics of Probability Theory in Quantum Systems, Born's Rule and Measurement Probabilities, Projection Postulate, Density Matrix Formalism, Mixed States and Pure States, Trace, Partial Trace, and Operator Sums.

UNIT V ADVANCED STRUCTURES IN QUANTUM MATH 9 hours

Group Theory Basics: Symmetry, Permutations, Pauli Group, Clifford Group, and their roles, Fourier Transform in Quantum Context, Gram-Schmidt Orthogonalization, Lie Groups and Lie Algebras, Use of Lie Algebra in Hamiltonian Formulation.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Explain concepts of quantum mechanics
CO2: Illustrate quantum gates/circuits
CO3: Analyze algorithms (e.g., Shor, Grover)
CO4: Evaluate communication protocols
CO5: Develop quantum programs on IBM Q

Text Books:

1. **Nielsen & Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press
2. **Brian C. Hall** – *Quantum Theory for Mathematicians*, Springer
3. **T.S. Blyth & E.F. Robertson** – *Basic Linear Algebra*, Springer

Reference Books:

1. **Roman S.** – *Advanced Linear Algebra*, Springer
2. **Axler, Sheldon** – *Linear Algebra Done Right*, Springer
3. **Shankar, R.** – *Principles of Quantum Mechanics*, Springer
4. **W. Greiner** – *Quantum Mechanics: An Introduction*, Springer

Online Courses & Resources:
MIT OpenCourseWare:*Linear Algebra (Gilbert Strang):*Link
edX:*Mathematics for Quantum Computing* by TUDelft:Link
Khan Academy:*Linear Algebra, Probability & Statistics:*Link
Quantum Country:*Spaced Repetition & Essays on Quantum Math:*Link

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minors

23MDINS201 QUANTUM PROGRAMMING AND SIMULATION LABORATORY

L	T	P	C
0	0	3	1.5

Prerequisties: None

Course Description:

This lab provides hands-on experience with quantum algorithms. Students implement and simulate algorithms such as Deutsch-Jozsa, Grover's search, Shor's algorithm, and teleportation. Both simulation and real hardware platforms are used. The focus is on practical understanding and experimentation.

Course Objectives:

1. To train students in programming quantum circuits using Qiskit, Q#, and related tools.
2. To explore advanced quantum simulations for teleportation, QFT, and hybrid models.
3. To develop practical skills in debugging and optimizing quantum programs.
4. To expose learners to both simulated environments and real quantum devices.
5. To motivate students through project-based learning in quantum applications.

List of Experiments:

1. State Vector Simulation (Qiskit)
2. Bell State Implementation
3. Deutsch-Jozsa Circuit
4. Grover's Search in Qiskit
5. QFT Circuit in Python
6. Shor Algorithm Simulation
7. Quantum Teleportation in Code
8. VQE (Hybrid Circuit)
9. QAOA Simulation
10. Quantum Random Number Generator
11. Comparison: Real vs Simulated Runs
12. Mini-Project: Quantum Password Cracker

Course Outcomes:

CO1: Ability to program and simulate quantum algorithms effectively.
CO2: Proficiency in using platforms like IBM Qiskit and Microsoft Q# for experimentation.
CO3: Understanding of differences between simulated and real hardware execution.
CO4: Skills to implement hybrid quantum-classical solutions such as VQE and QAOA.
CO5: Experience in developing a mini-project showcasing applied quantum computing.

Reference Books:

1. Michael Nielsen & Isaac Chuang – *Quantum Computation and Quantum Information*
2. Eric R. Johnston et al. – *Programming Quantum Computers*
3. David McMahon – *Quantum Computing Explained*
4. Gilbert Strang – *Introduction to Linear Algebra*
5. Sarah Kaiser & Chris Granade – *Learn Quantum Computing with Python and Q#*

Online Learning Resources/Virtual Labs:
IBM Qiskit Textbook: https://qiskit.org/learn
Microsoft Q# Documentation: https://learn.microsoft.com/en-us/azure/quantum/
Coursera: *Introduction to Quantum Computing*
edX: *Quantum Computing Fundamentals, Quantum Algorithms*

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination.

Minors

23MDINS103 QUANTUM ALGORITHMS

	L	T	P	C
Pre-requisite: None	**3**	**0**	**0**	**3**

Course Description:

This course explores the design and analysis of algorithms in the quantum domain. Students study key algorithms like Deutsch, Grover's search, and Shor's factoring, along with Fourier-based methods. The course highlights the speed-up of quantum methods over classical ones. Implementation on real frameworks like Qiskit is emphasized.

Course Objectives:

1. Understand algorithm design principles in the quantum domain.
2. Use mathematical tools such as linear algebra and probability in algorithm analysis.
3. Implement quantum algorithms and compare them with classical equivalents.
4. Study key applications in cryptography, database search, and optimization.

UNIT I MATHEMATICAL TOOLS FOR QUANTUM ALGORITHMS 9 hours

Review of Complex Numbers & Linear Algebra for Quantum Computing, Inner Product Spaces, Hilbert Spaces, Dirac Notation and Interpretations, Quantum State Vectors and Superposition, Overview of Quantum Gates and Operators, Building Block Concepts for Algorithmic Design.

UNIT II SEARCH AND ORACLE-BASED ALGORITHMS 9 hours

Deutsch's Algorithm: Problem and Solution Strategy, **Simon's Algorithm**: Period-finding and Speed-up Over Classical, **Grover's Search Algorithm**: Amplitude Amplification, Oracle Construction in Grover's Algorithm, Circuit Analysis and Complexity Comparison, Limitations and Applications in Database Search.

UNIT III EIGEN CONCEPTS AND QUANTUM OBSERVABLES 9 hours

Eigenvalues and Eigenvectors, Hermitian Operators and Spectral Theorem, Quantum Observables and Expectation Values, Commutators and Compatibility, Measurement Operators and Matrix Diagonalization, Applications in Quantum Gate Analysis.

UNIT IV FOURIER-BASED & CRYPTOGRAPHIC ALGORITHMS 9 hours

Quantum Fourier Transform (QFT): Theory and Circuit, **Phase Estimation Algorithm**: Foundations and Usage, **Shor's Algorithm**: Integer Factorization and Discrete Logarithms, Modular Arithmetic and Period Finding, Cryptographic Implications of Quantum Algorithms, Efficiency Analysis vs Classical RSA Factorization.

UNIT V ADVANCED & HYBRID QUANTUM ALGORITHMS 9 hours

Variational Quantum Eigensolver (VQE), Quantum Approximate Optimization Algorithm (QAOA), Quantum Machine Learning (QML): Classification & Clustering, Hybrid Quantum-Classical Models, IBM Qiskit&Cirq for Implementation, Building Custom Quantum Algorithms for NISQ Devices.

Course Outcomes:

CO1: Understand quantum algorithm building blocks

CO2: Analyze well-known quantum algorithms

CO3: Apply quantum algorithms to application domains

CO4: Evaluate efficiency and complexity of algorithms
CO5: Create and simulate quantum algorithms

Text Books:

1. **Michael A. Nielsen & Isaac L. Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press
2. **Cristopher Moore & Stephan Mertens** – *The Nature of Computation*, Oxford University Press
3. **Eleanor G. Rieffel& Wolfgang Polak** – *Quantum Computing: A Gentle Introduction*, MIT Press

Reference Books:

1. **Gideon Amir** – *Quantum Algorithms via Linear Algebra*, MIT Press
2. **S. Jordan** – *Quantum Algorithm Zoo*, [Online repository]
3. **T. G. Wong** – *Quantum Algorithm Design Techniques*
4. **Roland, Cerf** – *Quantum Search Algorithms*, Springer

Online Courses & Resources:

edX (MIT)	*Quantum Algorithms for Cybersecurity*	Link
Coursera	*Quantum Computing* by University of London	Link
Qiskit Textbook	*Algorithms & Quantum Machine Learning Modules*	Link
Braket (AWS)	*Quantum Computing Developer Tools & Tutorials*	Link

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minors

23MDINS104 QUANTUM INFORMATION AND COMMUNICATION

	L	T	P	C
Pre-requisite:	**3**	**0**	**0**	**3**

Course Description:

This course introduces quantum information theory and its role in communication. Topics include entropy, fidelity, quantum teleportation, and quantum key distribution. Students analyze security protocols and the challenges of building quantum networks. Practical tools like Qiskit and NetSquid are used for simulation.

Course Objectives:

1. Understand the principles of quantum information theory.
2. Explore quantum entropy, fidelity, and mutual information.
3. Study quantum communication protocols and networks.
4. Analyze quantum key distribution and cryptographic security.
5. Implement protocols like teleportation and superdense coding.

UNIT I QUANTUM INFORMATION BASICS 9 hours

Classical vs Quantum Information, Density matrices and mixed states, Quantum entropy and Shannon entropy, Von Neumann entropy, Quantum data compression.

UNIT II QUANTUM COMMUNICATION PROTOCOLS 9 hours

Quantum teleportation, Superdense coding, Quantum repeaters and communication channels, No-cloning theorem, Quantum channel capacity.

UNIT III FIDELITY, DISTANCE & INFORMATION THEORY 9 hours

Fidelity and trace distance, Quantum mutual information, Holevo bound, Information trade-offs in communication, Channel noise and error modeling.

UNIT IV QUANTUM CRYPTOGRAPHY 9 hours

Principles of quantum cryptography, BB84 and B92 key distribution protocols, Eavesdropping and security analysis, Quantum bit commitment, Post-quantum cryptography relevance.

UNIT V APPLICATIONS & TOOLS 9 hours

Quantum internet: architecture and challenges, Networked quantum systems, Simulation using Qiskit, NetSquid, QuTiP, IBM Q Network and cloud-based setups, Practical implementation of QKD in simulation.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand quantum information concepts

CO2: Apply quantum communication protocols

CO3: Analyze fidelity, entropy, and data transfer limits

CO4: Evaluate quantum cryptographic techniques

CO5: Create and simulate quantum communication models

Text Books:

1. **Michael A. Nielsen & Isaac L. Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press
2. Mark M. Wilde – *Quantum Information Theory*, Cambridge University Press
3. John Watrous – *The Theory of Quantum Information*, Cambridge University Press

Reference Books:

1. Peter W. Shor – *Foundations of Quantum Computing* (Lecture notes)
2. Charles H. Bennett & Gilles Brassard – *Original Papers on QKD (BB84)*
3. Stephanie Wehner – *Quantum Communication Networks*, arXiv

Online Courses & Resources:

Coursera	*Quantum Cryptography* by University of Geneva	Coursera Link
edX	*Quantum Information Science I* (Harvard/MIT)	edX Course
Qiskit	*Quantum Information Applications in Qiskit Textbook*	Qiskit Info
QuTech	*Quantum Internet Tutorials & Tools*	QuTech

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minors

23MDINS202 QUANTUM ALGORITHMS LABORATORY

L	T	P	C
0	0	3	1.5

Prerequisties: None

Course Descriptions: This lab provides hands-on experience with quantum algorithms. Students implement and simulate algorithms such as Deutsch-Jozsa, Grover's search, Shor's algorithm, and teleportation. Both simulation and real hardware platforms are used. The focus is on practical understanding and experimentation.

Course Objectives:

1. To provide hands-on practice in implementing quantum algorithms.
2. To understand the working of algorithms like Grover's, Shor's, and Deutsch-Jozsa.
3. To strengthen the link between theoretical knowledge and practical applications.
4. To familiarize students with quantum simulators and real hardware platforms.
5. To encourage problem-solving through quantum circuit design.

List of Experiments

1. Deutsch Algorithm
2. Deutsch-Jozsa
3. Grover's Algorithm
4. QFT Visualization
5. Shor's Algorithm
6. QRNG Implementation
7. Bell State Entanglement
8. Bernstein-Vazirani Algorithm
9. Quantum Teleportation
10. Phase Estimation
11. Circuit Simulation
12. Mini-Project: RSA Key Breaking

Course Outcomes:

CO1: Ability to design and implement basic quantum algorithms.
CO2: Skill to simulate and test quantum circuits using software tools.
CO3: Competence in analyzing the performance of algorithms on quantum platforms.
CO4: Capability to compare classical vs quantum approaches for given problems.
CO5: Practical experience in applying algorithms to real-world inspired use cases.

Reference Books:

1. Michael A. Nielsen & Isaac L. Chuang – *Quantum Computation and Quantum Information*, Cambridge University Press.
2. Eleanor G. Rieffel & Wolfgang Polak – *Quantum Computing: A Gentle Introduction*, MIT Press.
3. David McMahon – *Quantum Computing Explained*, Wiley.

Online Learning Resources/Virtual Labs:

IBM Qiskit Textbook – https://qiskit.org/learn
Coursera – *Introduction to Quantum Computing* (University of Toronto / University of London).
edX – *Quantum Computing Fundamentals and Quantum Algorithms* (MIT / Delft).

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination.

Minors

23MDINS105 QUANTUM MACHINE LEARNING (QML)

	L	T	P	C
Pre-requisite: Nil	**3**	**0**	**0**	**3**

Course Description:

This course blends quantum computing with machine learning. Students learn quantum data encoding, supervised and unsupervised quantum algorithms, and hybrid models. Case studies such as quantum-enhanced fraud detection and NLP are included. Practical implementation is done using Qiskit and PennyLane.

Course Objectives:

1. Introduce the fundamentals of quantum-enhanced machine learning.
2. Understand quantum data encoding and kernel methods.
3. Explore quantum algorithms for supervised and unsupervised learning.
4. Analyze hybrid quantum-classical architectures.
5. Implement QML models using frameworks like Qiskit and PennyLane.

UNIT I INTRODUCTION TO QML **9 hours**

Need for QML: Why quantum for ML?,Classical vs quantum machine learning, Quantum states as information carriers, Data encoding: amplitude, angle, basis encoding, Introduction to quantum feature space.

UNIT II QML ALGORITHMS – SUPERVISED LEARNING **9 hours**

Quantum classifiers (quantum SVMs, qNN), Quantum perceptron, Variational quantum classifiers (VQC), Quantum kernels, Cost functions in quantum models.

UNIT III QML ALGORITHMS – UNSUPERVISED LEARNING **9 hours**

Quantum k-means and clustering, Quantum PCA, Quantum generative models (QGANs), Dimensionality reduction and similarity metrics, Performance analysis and limitations.

UNIT IV HYBRID MODELS & OPTIMIZATION **9 hours**

Variational Quantum Circuits (VQCs), Hybrid quantum-classical training loops, Barren plateaus and optimization issues, Quantum gradient descent and parameter shift rule, Comparative study of classical and QML models.

UNIT V QML TOOLS AND CASE STUDIES **9 hours**

Implementing QML with Qiskit Machine Learning, PennyLane and TensorFlow Quantum integration, Case studies: quantum-enhanced fraud detection, NLP, Quantum datasets and benchmark models, Project: design a small QML application.

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Understand foundations of quantum machine learning

CO2: Apply QML algorithms to datasets

CO3: Analyze quantum kernels, data encoding, and models

CO4; Evaluate hybrid quantum-classical models

CO5: Create and simulate QML models using frameworks

Text Books:

1. Maria Schuld, Francesco Petruccione – *Machine Learning with Quantum Computers*, Springer
2. Peter Wittek – *Quantum Machine Learning: What Quantum Computing Means to Data Mining*, Academic Press

Reference Books:

1. Jacob Biamonte – *Quantum Machine Learning*, Nature, 2017
2. Seth Lloyd – *Quantum algorithms for supervised/unsupervised learning* (Research papers)
3. VojtěchHavlíček – *Supervised Learning with Quantum-Enhanced Feature Spaces*, Nature, 2019

Online Courses & Resources:

edX	*Quantum Machine Learning* by UTS	edX Course
Qiskit	*Qiskit Machine Learning Module*	Qiskit ML
Xanadu	*QML with PennyLane (Free online textbook)*	PennyLane QML Book
Coursera	*Quantum Machine Learning* by University of Toronto	Coursera

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination.

Minor in Quantum Technology

(Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

Minor

23MDINS106 FOUNDATIONS OF QUANTUM TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course introduces the fundamental principles of quantum mechanics and their application in quantum information science. It covers the mathematical foundations, including linear algebra and complex vector spaces, to describe quantum states and operators. Key topics include superposition, measurement, entanglement, and quantum dynamics, along with the probabilistic nature of quantum systems. The course also explores practical aspects of quantum technologies, such as qubits, quantum logic gates, decoherence, and basic quantum circuit modeling using simulation tools. By the end, students will gain both theoretical understanding and foundational skills for working with quantum systems and emerging quantum technologies.

Course Objectives:

1. Introduce the fundamental quantum mechanics concepts essential for quantum technologies.
2. Build strong mathematical foundations for quantum state modeling.
3. Develop understanding of superposition, entanglement, and measurement.
4. Explain the physical principles behind quantum devices.
5. Prepare students for advanced studies in quantum computation, communication, sensing, and materials.

UNIT I: QUANTUM MECHANICS FOUNDATIONS **9 hours**

Classical vs Quantum systems, Wave-particle duality, Schrödinger equation (Time-dependent and Time-independent), Postulates of Quantum Mechanics, Quantum states and state vectors, Complex Hilbert spaces, Dirac notation (Bra-Ket notation), Probabilistic interpretation of quantum mechanics.

UNIT II: LINEAR ALGEBRA FOR QUANTUM SYSTEMS **9 hours**

Complex vector spaces and inner products, Orthonormal basis and orthogonality, Linear operators and transformations, Unitary operators and Hermitian operators, Tensor products for multi-qubit systems, Eigenvalues and Eigenvectors, Commutators and anti-commutators, Representing quantum states with matrices.

UNIT III: SUPERPOSITION, MEASUREMENT, AND ENTANGLEMENT 9 hours

Principle of superposition, Measurement postulate, Probability amplitudes and Born rule, State collapse upon measurement, Entanglement and Bell states, EPR paradox and non-locality, Density matrices and mixed states, Quantum decoherence.

UNIT IV: OPERATORS AND QUANTUM DYNAMICS 9 hours

Time evolution operators, Hamiltonian and energy eigenstates, Quantum harmonic oscillator (brief overview), Unitary evolution and Schrödinger equation solutions, Quantum tunnelling, Adiabatic theorem basics, Operator algebra in quantum systems, Expectation values and observables.

UNIT V: QUANTUM TECHNOLOGIES BUILDING BLOCKS 9 hours

Basic qubit systems (spin-1/2, photon polarization, superconducting qubits), Two-level quantum systems modelling, Bloch sphere representation, Quantum logic gates fundamentals, Multi-qubit systems: controlled operations, Introduction to decoherence and quantum error correction, Quantum technologies: hardware platforms overview, Basic quantum circuit modeling using simulators (Qiskit or Q# demo examples).

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Understand postulates of quantum mechanics for quantum technologies

CO2: Apply linear algebra and Dirac notation to quantum state analysis

CO3: Analyze superposition, entanglement, and measurement processes

CO4: Evaluate quantum systems through operators and probability amplitudes

CO5: Create mathematical models for simple quantum systems

Textbooks:

1□. Michael A. Nielsen & Isaac L. Chuang – Quantum Computation and Quantum Information

2□. N. David Mermin – Quantum Computer Science: An Introduction

3□. David McMahon – Quantum Computing Explained (Wiley)

Reference Books

1□. Griffiths, D. – Introduction to Quantum Mechanics

2□. Sakurai, J.J. – Modern Quantum Mechanics

3□. ohnWatrous – The Theory of Quantum Information

4□. V.K. Krishnan – Linear Algebra and its Applications to Quantum Computing

Online Courses & Resources

Platform	**Course Title**
MIT OpenCourseWare	Quantum Physics I, II (MIT OCW 8.04 & 8.05)
edX (Berkeley)	Quantum Mechanics and Quantum Computation

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Minor

23MDINS107 SOLID STATE PHYSICS FOR QUANTUM TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course provides a comprehensive understanding of the fundamental materials science and physics concepts essential for quantum technologies. It covers crystal structures, electronic properties, and semiconductor physics relevant to quantum devices, including quantum wells, dots, and superconductors. Students will explore quantum confinement in low-dimensional systems, lattice vibrations, phonon interactions, and their impact on qubit performance. The course also examines advanced materials for quantum technologies, such as topological insulators, NV centers, and photonic crystals, along with fabrication challenges and design strategies for achieving long coherence times.

Course Objectives:

1. Understand fundamental solid-state physics principles relevant to quantum technologies.
2. Study the electronic properties of materials used in quantum hardware.
3. Explore quantum confinement and nanostructures for qubit implementation.
4. Analyze crystal structures, band theory, and defects influencing quantum devices.
5. Build foundations for material selection and engineering for quantum systems.

UNIT I: CRYSTAL STRUCTURE AND ELECTRONIC PROPERTIES 9 hours

Crystal lattices and unit cells, Bravais lattices, Miller indices, Reciprocal lattice and Brillouin zones, Atomic bonding in solids (covalent, ionic, metallic, van der Waals), X-ray diffraction and crystal structure determination, Electronic structure of solids, Free electron theory, Energy bands: metals, semiconductors, and insulators.

UNIT II: SEMICONDUCTOR PHYSICS FOR QUANTUM DEVICES 9 hours

Intrinsic and extrinsic semiconductors, Charge carriers: electrons, holes, effective mass, Carrier concentration and Fermi level, p-n junctions and semiconductor heterostructures, Quantum wells and quantum dots as qubits, Superconductors and Josephson junctions, Semiconductor fabrication basics, Materials for quantum hardware: Si, GaAs, diamond NV centers, topological insulators.

UNIT III: QUANTUM CONFINEMENT AND LOW-DIMENSIONAL SYSTEMS 9 hours

Quantum size effects: nanowires, nanotubes, 2D materials, Quantum dots: discrete energy levels, Quantum Hall effect, Topological quantum materials, Spintronics and spin qubits, Quantum confinement in superconducting qubits, Heterostructure-based quantum devices, Valleytronics and emerging 2D materials (MoS_2 , graphene).

UNIT IV: LATTICE VIBRATIONS AND PHONON INTERACTIONS 9 hours

Lattice vibrations and phonons, Heat capacity and thermal conductivity of solids, Electron-phonon interaction, Decoherence in solid-state qubits due to phonons, Magnetic impurities and Kondo effect, Defects and dislocations in crystals, Dopants and quantum impurity systems, Nuclear spin environments and coherence times.

UNIT V: MATERIALS FOR QUANTUM TECHNOLOGIES 9 hours

Material engineering for superconducting qubits, NV centers in diamond for quantum sensing, Topological materials for robust qubits, Photonic crystal materials for optical qubits, Hybrid quantum systems: coupling different materials, Fabrication challenges and material purity, Advances in quantum materials research, Designing material systems for long coherence time.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Understand crystal structures and band theory

CO2: Apply knowledge of semiconductors, insulators, and conductors in quantum materials

CO3: Analyze quantum confinement effects and low-dimensional systems

CO4: Evaluate defects, phonons, and interactions in solid-state systems

CO5: Create models for quantum device material systems

Textbooks:

1. Charles Kittel – Introduction to Solid State Physics

2. Michael A. Nielsen & Isaac Chuang – Quantum Computation and Quantum Information

3. Simon L. Altmann – Band Theory of Solids

Reference Books

1□. Ashcroft &Mermin – Solid State Physics

2□. Yu & Cardona – Fundamentals of Semiconductors: Physics and Materials Properties

3□. David Awschalom – Semiconductor Spintronics and Quantum Computation

4□. Dieter Vollhardt – Introduction to the Theory of Many-Body Systems

Online Courses & Resources

Platform	**Course Title**
MIT OpenCourseWare	Solid State Physics (MIT 8.231)
edX	Quantum Materials and Devices (U. Tokyo)
Coursera	Quantum Materials (ÉcolePolytechnique)

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Minor

23MDINS203 QUANTUM DEVICES AND MATERIALS LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: Nil

Course Objectives:

1. Simulate quantum devices and materials behavior.
2. Explore quantum optics and solid-state quantum systems.
3. Model quantum dots, superconductors, and photonic devices.
4. Perform quantum simulation of condensed matter systems.
5. Build foundational skills for quantum hardware understanding.

List of Experiments (12 Experiments)

1. Simulation of Single-Qubit Optical Devices
2. Modeling Quantum Dots and Energy Level Transitions
3. Simulation of Two-Level Atom and Rabi Oscillations
4. Quantum Harmonic Oscillator: Energy Levels Visualization
5. Spin-1/2 Systems and Magnetic Resonance Simulation
6. Superconducting Qubits Circuit Simulation
7. Josephson Junction Modeling for Quantum Circuits
8. Quantum Photonic Interferometer Simulation
9. Simulation of NV Centers in Diamond for Quantum Sensing
10. Solid-State Quantum Materials Simulation (Band Structures)
11. Modeling Quantum Light-Matter Interactions (Jaynes-Cummings Model)

Platforms & Tools:

1. QuTiP (Quantum Toolbox in Python)
2. Qiskit Nature / Qiskit Metal
3. MATLAB Simulink
4. COMSOL Multiphysics (for materials simulation)
5. Silvaco TCAD (for device-level modeling)

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination.

Minor

23MDINS108 INTRODUCTION TO QUANTUM COMMUNICATION

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course provides a comprehensive introduction to quantum communication principles, technologies, and protocols. It covers the fundamental differences between classical and quantum communication, including quantum entanglement, qubits, and quantum information security. Key topics include Quantum Key Distribution (QKD) protocols, quantum teleportation, and entanglement distribution techniques for secure and long-distance communication. Students will explore quantum networks, quantum internet architecture, and advanced quantum communication applications such as quantum secure direct communication, quantum secret sharing, and post-quantum cryptography. The course also discusses practical implementation challenges, hybrid quantum-classical models, and emerging trends shaping the future of quantum communication.

Course Objectives:

1. Introduce fundamental principles of quantum communication.
2. Study quantum key distribution (QKD) protocols.
3. Analyze quantum teleportation, entanglement swapping, and quantum repeaters.
4. Evaluate quantum security principles and their advantages.
5. Prepare students for designing secure communication protocols for future quantum networks.

UNIT I: INTRODUCTION TO QUANTUM COMMUNICATION 9 hours

Classical communication vs quantum communication, No-cloning theorem and quantum information security, Qubits and qubit transmission channels, Quantum entanglement fundamentals, EPR paradox and Bell's inequalities, Quantum states and measurement, Role of superposition and measurement collapse, Overview of quantum internet and its architecture.

UNIT II: QUANTUM KEY DISTRIBUTION (QKD) PROTOCOLS 9 hours

Classical cryptography limitations, BB84 protocol, B92 protocol, E91 entanglement-based protocol, Decoy-state QKD, Device-independent QKD, Practical implementation challenges in QKD, Experimental QKD systems (fiber, free-space, satellites).

UNIT III: QUANTUM TELEPORTATION AND ENTANGLEMENT DISTRIBUTION **9 hours**

Quantum teleportation protocol, Entanglement swapping, Quantum repeaters for long-distance communication, Error sources in quantum teleportation, Resource requirements for teleportation, Entanglement purification techniques, Bell state measurements, Applications of teleportation in distributed quantum computing.

UNIT IV: QUANTUM NETWORKS AND QUANTUM INTERNET **9 hours**

Architecture of quantum networks, Quantum routers and switching, Quantum memories and storage nodes, Distributed entanglement generation and management, Multiparty quantum communication Blind quantum computing, Performance metrics for quantum networks (fidelity, key rate), Challenges in large-scale quantum network deployment.

UNIT V: ADVANCED QUANTUM COMMUNICATION PROTOCOLS AND APPLICATIONS **9 hours**

Quantum secure direct communication, Quantum digital signatures, Position-based quantum cryptography, Quantum secret sharing, Post-quantum cryptography overview, Quantum cloud communication protocols, Building hybrid quantum-classical communication models, Future directions in quantum communication technology.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Understand quantum communication concepts

CO2: Apply quantum entanglement to communication protocols

CO3: Analyze QKD protocols and teleportation mechanisms

CO4: Evaluate security of quantum communication

CO5: Design quantum communication networks and protocols

Textbooks:

1. M. Nielsen & I. Chuang – Quantum Computation and Quantum Information

2. Mark M. Wilde – Quantum Information Theory

3. Scarani – Quantum Cryptography: A Primer

Reference Books

1. VedranDunjko – Introduction to Quantum Communication and Cryptography

2. Norbert Lütkenhaus – Practical Security in Quantum Key Distribution

3. David McMahon – Quantum Computing Explained

4. Bouwmeester et al. – The Physics of Quantum Information

Online Courses & Resources

Platform	Course Title
edX	Quantum Cryptography (ETH Zurich)
Coursera	Quantum Communication (Delft University of Technology)
MIT	OpenCourseWare Quantum Information Science (MIT 6.443)
YouTube	Quantum Internet & Quantum Networking Tutorials
IBM Qiskit	Qiskit tutorials on quantum teleportation and QKD

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Minor

23MDINS109 INTRODUCTION TO QUANTUM SENSING

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course provides a comprehensive introduction to the principles and technologies of quantum sensing and metrology, highlighting how quantum phenomena such as superposition, entanglement, and squeezing enable precision measurements beyond classical limits. Students will explore fundamental concepts like the Standard Quantum Limit, Heisenberg limit, and quantum phase estimation, along with key measurement techniques including quantum interferometry, atomic clocks, magnetometry, and quantum imaging. The course also covers noise sources, decoherence, and error mitigation strategies, and examines cutting-edge applications in navigation, medical imaging, environmental monitoring, and space-based sensing. By the end, learners will gain both theoretical understanding and practical insight into the design and operation of advanced quantum sensor systems.

Course Objectives:

1. Introduce the principles of quantum sensing and metrology.
2. Explain how quantum superposition and entanglement enhance measurement sensitivity.
3. Study applications of quantum sensors across multiple domains.
4. Analyze noise, decoherence, and quantum limits on measurement.
5. Prepare students to design and analyze quantum-enhanced sensors.

UNIT I: INTRODUCTION TO QUANTUM SENSING AND METROLOGY 9 hours

Classical vs quantum sensing, Precision limits: Standard Quantum Limit (SQL), Quantum metrology fundamentals, Heisenberg limit, Quantum phase estimation for precision measurements, Quantum non-demolition measurements, Quantum error correction in sensing, Importance of coherence and entanglement in sensors.

UNIT II: QUANTUM MEASUREMENT PRINCIPLES **9 hours**

Superposition and interference in measurement, Quantum Fisher information, Squeezed states for noise reduction, Photon counting and single-photon detectors, Spin-based measurements (NV centers, trapped ions), Ramsey interferometry, Quantum state tomography, Applications of quantum-enhanced interferometry.

UNIT III: QUANTUM SENSOR TECHNOLOGIES **9 hours**

Atomic clocks (optical & microwave), Gravimeters and accelerometers, Magnetometers (SQUIDs, NV centers), Quantum gyroscopes, Quantum imaging & super-resolution microscopy, Quantum lidar and radar, Force and electric field sensing, Photonic quantum sensing systems.

UNIT IV: DECOHERENCE, NOISE, AND ERROR MITIGATION IN QUANTUM SENSING **9 hours**

Sources of decoherence in quantum sensors, Thermal noise and quantum noise sources, Quantum back-action, Squeezing and noise reduction techniques, Dynamical decoupling techniques, Noise spectroscopy for sensor calibration, Robust error mitigation protocols, Evaluating sensitivity vs noise tradeoffs.

UNIT V: ADVANCED APPLICATIONS AND FUTURE QUANTUM SENSING SYSTEMS **9 hours**

Quantum sensing for biological and medical imaging, Navigation and positioning without GPS, Quantum-enhanced gravitational wave detection (LIGO), Quantum-enhanced environmental monitoring, Sensors for national defense and security, Space-based quantum sensors, Integrated quantum photonic sensing platforms, Design of hybrid quantum-classical sensor systems.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Understand the basic principles of quantum sensing

CO2: Apply quantum superposition and entanglement to sensing

CO3: Analyze quantum sensor architectures

CO4: Evaluate sensitivity and error limits in quantum measurements

CO5: Design quantum sensing systems for real-world applications

Textbooks:

1□. Christian L. Degen, F. Reinhard, P. Cappellaro – Quantum Sensing

2□. Giovannetti, Lloyd &Maccone – Advances in Quantum Metrology

3□. David Budker& Derek F. Jackson Kimball – Optical Magnetometry

Reference Books

1□. Kurt Jacobs – Quantum Measurement Theory and its Applications

2□. Helmut Rauch – Neutron Interferometry

3□. M. O. Scully & M. S. Zubairy – Quantum Optics (Chapters on Metrology)

4□. VlatkoVedral – Introduction to Quantum Information Science

Online Courses & Resources

Platform	**Course Title**
edX	Quantum Sensing & Metrology (LMU Munich)
Coursera	Quantum Optics and Sensing (University of Colorado Boulder)
MIT OpenCourseWare	Quantum Measurement and Sensing (MIT)
YouTube	Quantum Sensing Lectures
IBM Qiskit	Tutorials on Quantum Phase Estimation

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Minor

23MDINS204 QUANTUM COMMUNICATION AND SENSING LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: Nil

Course Objectives:

1. Simulate and analyze quantum communication protocols.
2. Implement quantum key distribution (QKD) and teleportation.
3. Perform quantum sensing simulations for precision measurements.
4. Evaluate sensor performance with noise and decoherence.
5. Gain hands-on experience with quantum simulation tools.

List of Experiments (12 Experiments)

1. Simulation of Qubits and Bloch Sphere Visualization
2. Implementation of BB84 Quantum Key Distribution Protocol
3. Simulation of B92 and E91 QKD Protocols
4. Quantum Entanglement Generation and Bell Inequality Testing
5. Quantum Teleportation Protocol using Qiskit/Cirq
6. Simulation of Quantum Repeaters and Entanglement Swapping
7. Noise and DecoherenceModeling in Quantum Communication Channels
8. Ramsey Interferometry Simulation for Quantum Sensing
9. Implementation of NV CenterMagnetometry Simulation
10. Quantum Gravimeter and Accelerometer Simulation
11. Quantum Phase Estimation for High-Precision Metrology

Platforms & Tools:

1. IBM Qiskit
2. Google Cirq
3. RigettiPyQuil
4. Quantum Inspire
5. MATLAB / Python with quantum libraries

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination.

Minor

23MDINS110 QUANTUM OPTICS PREREQUISITES FOR QUANTUM TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite: Nil

Course Description:

This course introduces the fundamental principles and applications of quantum optics and photonics. It covers the classical and quantum description of light, electromagnetic field quantization, and light–matter interactions. Topics include coherence theory, quantum noise, and advanced phenomena such as photon antibunching, squeezing, and cavity-QED. The course also explores emerging quantum photonics technologies, including single-photon sources, entangled photon generation, quantum key distribution, and quantum metrology, preparing students for research and experimentation in modern quantum optics.

Course Objectives:

1. Introduce fundamentals of light-matter interaction relevant for quantum technologies.
2. Explain the quantization of electromagnetic fields.
3. Study the role of photons as quantum information carriers.
4. Explore coherent states, squeezed states, and single-photon sources.
5. Prepare for quantum sensing, communication, and photonic quantum computing applications.

UNIT I: CLASSICAL AND QUANTUM DESCRIPTION OF LIGHT 9 hours

Review of electromagnetic waves, Maxwell‘s equations for light propagation, Plane waves, polarization, Poynting vector, Classical interference, diffraction, coherence, Blackbody radiation & Planck's hypothesis, Photoelectric effect, Photons as quantized light energy, Introduction to quantum theory of radiation.

UNIT II: QUANTIZATION OF ELECTROMAGNETIC FIELD 9 hours

Harmonic oscillator quantization, Field quantization in free space, Photon number (Fock) states, Coherent states and classical-quantum correspondence, Vacuum fluctuations and zero-point energy, Single-mode vs multi-mode quantization, Spontaneous and stimulated emission, Quantum field operators and commutation relations.

UNIT III: LIGHT-MATTER INTERACTION **9 hours**

Two-level atom model, Absorption, stimulated emission, spontaneous emission, Einstein coefficients, Rabi oscillations, Jaynes-Cummings model, Resonant and non-resonant interaction, Cavity Quantum Electrodynamics (Cavity-QED), Atom-photon entanglement.

UNIT IV: QUANTUM COHERENCE AND QUANTUM NOISE **9 hours**

Classical vs quantum coherence, First- and second-order coherence functions, Photon antibunching, Hanbury Brown and Twiss experiment, Quantum squeezing of light, Phase-sensitive amplification, Quantum noise, shot noise, and standard quantum limit, Quantum nondemolition measurements.

UNIT V: QUANTUM PHOTONICS APPLICATIONS **9 hours**

Single-photon sources (quantum dots, NV centers, SPDC), Entangled photon pair generation, Photonic qubits and linear optical quantum computing, Quantum key distribution with photons, Photonic integrated circuits, Quantum sensors based on squeezed light, Quantum metrology using entangled photons, Designing experiments for quantum optics labs.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Understand quantum nature of light

CO2: Apply Maxwell‘s equations to optical fields

CO3: Analyze interaction of photons with matter

CO4: Evaluate coherence, squeezing, and quantum noise

CO5: Create models for photonic quantum systems

Textbooks:

1 Mark Fox – Quantum Optics: An Introduction

2. Rodney Loudon – The Quantum Theory of Light

3. M. O. Scully & M. S. Zubairy – Quantum Optics

Reference Books

1□. Stephen Barnett – Quantum Information

2□. Peter Meystre – Elements of Quantum Optics

3□. Michel Le Bellac – Quantum Physics

4□. D. F. Walls & G. J. Milburn – Quantum Optics

Online Courses & Resources

Platform	Course Title
MIT OpenCourseWare	Quantum Optics (MIT 8.421)
edX	Principles of Photonics (EPFL)
Coursera	Quantum Optics 1 & 2 (U. Rochester)
YouTube	Quantum Optics Lectures (Various universities)

Mode of Evaluation: Assignments, Mid Term Tests, End Semester Examination

Honors in Electronics and Communication Engineering

Honors

23HDECE101 ANALOG IC DESIGN

L	T	P	C
3	0	0	3

Course Objectives:

1. To explore MOSFET characteristics, biasing techniques and current mirrors for analog circuit design.
2. To design and analyze single-stage amplifiers and their performance with feedback and cascode configurations.
3. To analyze the design and performance of differential amplifiers in analog circuits.
4. To examine the characteristics and compensation techniques of operational amplifiers.
5. To understand the design principles of bandgap reference circuits.

UNIT I REVIEW OF MOSFET DEVICE CHARACTERISTICS 9 hours

Second order effects, MOS small signal Model, Capacitances, body bias effect, Current biasing, voltage biasing, Technology biasing, Relative comparison and limitations. Basic building blocks and basic cells-Switches, active resistors, Current sources and sinks, Current mirrors: Basic current mirror, cascode current mirror, low voltage current mirror, Wilson and Widlar current mirrors, voltage and current references, Mismatch in accuracies, Design solutions to minimize mismatch in accuracies.

UNIT II SINGLE STAGE AMPLIFIER: 9 hours

Analytical justification of operating region suitable for amplification/switching, Design of CS amplifier with different loads, Limitations of diode connected load, Improving output impedance of CS amplifier through feedback ,small signal analyses of common gate and common drain topologies and their frequency response with parasitic affects, significance of cascode, design of cascode amplifier and with ideal current source load and practical cascode load, Limitations of cascode, folded cascode amplifier and design with parasitics.

UNIT III DIFFERENTIAL AMPLIFIER 9 hours

Significance of differential signaling, Limitations of quasi differential amplifier, Design of differential amplifier with current source load and diode connected load and small signal analyses, errors due to mismatch, replication principle, qualitative analysis, common mode response, gilbert cell, Common centroid layout.

UNIT IV OPERATIONAL AMPLIFIER 9 hours

Characterization, two stage Op-amp, small signal analysis, Miller compensation, effect of RHP zero on stability, Lead compensation, constant gmbiasing, design of biasing circuit independent of process and temperature variations.

UNIT V BAND GAP REFERENCE 9 hours

General considerations, Supply independent biasing, temperature independent references, negative-TC voltage, positive TC voltage, Bandgap reference, PTAT generation, curvature correction, Design of BGR under low voltage conditions.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Understand the MOSFET characteristics, biasing techniques and current mirrors for analog circuit design.

CO2: Design and analyze single-stage amplifiers and their performance with feedback and cascode configurations.

CO3: Analyze the design and performance of differential amplifiers in analog circuits.

CO4: Learn the characteristics and compensation techniques of operational amplifiers.

CO5: Understand the design principles of bandgap reference circuits.

Text Books:

1. Behzad Razavi, Design of Analog CMOS Integrated Circuit, McGraw Hill Education, 2017, 2nd Edition.

2. Paul J. Hurst, Paul R. Gray, Robert G Meyer and Stephen H. Lewis, Analysis and Design of Analog Integrated Circuits, Wiley, 2024, 6thEdition.

3. Mohammed Ismail and Terri Fiez, Analog VLSI: Signal and Information Processing, McGraw Hill, 1994.

Reference Books:

1. Randall L. Geiger, Phillip E. Allen and Noel R. Strader, VLSI Design Techniques for Analog and Digital Circuits, Tata McGraw-Hill Education, 1989.

2. David Johns, Tony Chan Carusone and Kenneth Martin, Analog Integrated Circuit Design, Wiley, 2011, 2nd Edition.

3. Paul G. A. Jespers and Boris Murmann, Systematic Design of Analog CMOS Circuits, Cambridge University Press, 2017.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination

Honors

23HDECE102 DIGITAL IC DESIGN

L	T	P	C
3	0	0	3

Course Objectives:

1. To understand MOSFET and CMOS inverter operation along with constraints.
2. To explore CMOS design techniques for combinational and sequential logic circuits.
3. To gain knowledge on the timing issues in digital circuits.
4. To design and analyze various arithmetic building blocks.
5. To learn about the design and functionality of semiconductor memories.

UNIT I MOS INVERTERS 9 hours

Structure and Operation of MOS Transistor (MOSFET), MOSFET Current Voltage Characteristics, MOSFET Scaling and Small-Geometry Effect, MOSFET Capacitances, CMOS Inverter- Static and switching characteristics, Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitic, Power Consumption in CMOS Gates.

UNIT II DESIGNING COMBINATIONAL & SEQUENTIAL LOGIC GATES IN CMOS 9 hours

Static CMOS design- ratioed logic, pass transistor logic, transmission gate logic, Dynamic CMOS Design, Static Latches and Registers, Dynamic Latches and Registers, Alternative Register Styles, Nonbistable Sequential Circuits, Logic Style for Pipelined Structures.

UNIT III TIMING ISSUES IN DIGITAL CIRCUITS 9 hours

Introduction, Synchronous Timing basics, Clock Skew and Jitter, Clock distribution techniques, Clock Generation and Synchronization.

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS 9 hours

Introduction, The Adder: Circuit and Logic Design, Multipliers: Shifters, Power Considerations in Data path Structures.

UNIT V DESIGNING MEMORY 9 hours

Introduction, Semiconductor Memories - An Introduction, The Memory Core: RAM, ROM, Memory Peripheral Circuitry.

Course Outcomes:

At the end of the course, the students will be able to

CO1: To understand MOSFET and CMOS inverter operation along with constraints.
CO2: To explore CMOS design techniques for combinational and sequential logic circuits.
CO3: To gain knowledge on the timing issues in digital circuits.
CO4: To design and analyze various arithmetic building blocks.
CO5: To learn about the design and functionality of semiconductor memories.

Text Books:

1. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, Pearson, 2003, 2ndEdition.
2. John P. Uyemura, CMOS Logic Circuit Design, Springer, 2001.
3. John P. Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 2002.

Reference Books:

1. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits, McGraw-Hill, 2003, 3rdEdition.
2. Charles Hawkins, Jaume Segura and Payman Zarkesh Ha, CMOS Integrated Digital Electronics: A First Course, IET, 2012

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination

Honors

23HDECE201 ANALOG AND DIGITAL IC DESIGN LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. To gain proficiency in designing and analyzing MOSFET-based analog circuits, including amplifiers and current mirrors.
2. To explore the implementation of feedback topologies and differential amplifiers to enhance circuit performance.
3. To enhance proficiency in simulating and optimizing two-stage operational amplifiers from schematic to post-layout.
4. To acquire proficiency in designing and simulating CMOS inverters and logic Gates using EDA tools.
5. To explore various architectures for arithmetic circuits such as adders, shift registers, and multipliers.

List of Experiments:
Any five experiments from each group (All circuit still post layout)

Analog IC Design Lab

1. Lambda calculation for PMOS & NMOS, Transconductance plots,
2. Single transistor amplifier with different loads,
3. CS amplifier with source degeneration,
4. Cascode amplifier.
5. Basic current sink, Cascode current sink.
6. Basic current source, Cascode current source.
7. Basic current mirror, Wilson current mirror,
8. Cascode current mirror,
9. Feedback topologies,
10. CMOS differential amplifier with current mirror load.
11. Two stage Operational amplifier.

Digital IC Design Lab

1. Design and Simulation of CMOS Inverter to study the transfer Characteristics by varying the design constraints using EDA Tools
2. Design and Simulation of logic gates using various logic styles and compare the performance

Design the following building blocks employing various architectures and develop HDL models:

3. 32-bit Parallel adder using 8-bit adder module,

4. 32-bit Shift register using 8-bit Shift register module

5. Combinational and sequential multipliers: 8 x 8 multiplier,

6. Combinational and sequential multipliers: 16 X 16 multipliers

7. Perform the functional simulation, Static Timing Analysis and post synthesis timing verification

RTL to GDS-II: Design any System as a case Study

Course Outcomes:

At the end of this course, the students will be able to

CO1: Construct and evaluate single-stage and multi-stage amplifiers with various loads and feedback techniques.
CO2: Apply the principles of current sources, sinks, and mirrors for effective circuit biasing.
CO3: Implement and refine CMOS differential and two-stage operational amplifiers through post-layout simulations.
CO4: Construct and analyze CMOS inverters and logic gates with different design constraints and logic styles.
CO5: Implement and compare parallel adders, shift registers, and multipliers for performance optimization.

Text Books:

1. Behzad Razavi**,** ***Title:*** Design of Analog CMOS Integrated Circuits**,** ***Publisher:*** McGraw-Hill Education**.**
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic**,** ***Title:*** Digital Integrated Circuits: A Design Perspective (2nd Edition)**,** ***Publisher:*** Pearson Education**.**

Reference Books:

1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer**,** ***Title:*** Analysis and Design of Analog Integrated Circuits (5th Edition)**,** ***Publisher:*** Wiley**.**
2. D. A. Johns, K. Martin**,** ***Title:*** Analog Integrated Circuit Design**,** ***Publisher:*** Wiley India**.**
3. Neil H.E. Weste, David Money Harris**,** ***Title:*** CMOS VLSI Design: A Circuits and Systems Perspective (5th Edition)**,** ***Publisher:*** Pearson**.**
4. David A. Hodges, Horace G. Jackson, Resve A. Saleh**,** ***Title:*** Analysis and Design of Digital Integrated Circuits: In Deep Submicron Technology (3rd Edition)**,** ***Publisher:*** McGraw-Hill Education**.**

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination

Honors

23HDECE103 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

Course Objectives:

1. Understand the discrete random signal processing.
2. Study the spectrum estimation.
3. Understand the linear estimation and prediction.
4. Know the designing of adaptive filter.
5. Study the multi-rate signal processing.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9 hours

Discrete Random Processes- Ensemble averages, stationary processes, Autocorrelation and Autocovariance matrices. Parseval's Theorem, Wiener-Khintchine Relation- Power Spectral Density Periodogram, Spectral Factorization, Filtering random processes. Low Pass Filtering of White Noise. Parameter estimation: Bias and consistency.

UNIT II SPECTRUM ESTIMATION 9 hours

Estimation of spectra from finite duration signals, Non-Parametric Methods-Correlation Method, Periodogram Estimator, Performance Analysis of Estimators -Unbiased, Consistent Estimators Modified periodogram, Bartlett and Welch methods, Blackman –Tukey method. Parametric Methods - AR, MA, ARMA model based spectral estimation. Parameter Estimation -Yule-Walker equations, solutions using Durbin's algorithm.

UNIT III LINEAR ESTIMATION AND PREDICTION 9 hours

Linear prediction- Forward and backward predictions, Solutions of the Normal equations- Levinson Durbin algorithms. Least mean squared error criterion -Wiener filter for filtering and prediction, FIR Wiener filter and Wiener IIR filters, Discrete Kalman filter.

UNIT IV ADAPTIVE FILTERS 9 hours

FIR adaptive filters -adaptive filter based on steepest descent method-Widrow-Hoff LMS adaptive algorithm, Normalized LMS. Adaptive channel equalization-Adaptive echo cancellation-Adaptive noise cancellation- Adaptive recursive filters (IIR). RLS adaptive filters-Exponentially weighted RLS-sliding window RLS.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 9 hours

Mathematical description of change of sampling rate - Interpolation and Decimation, Decimation by an integer factor - Interpolation by an integer factor, Sampling rate conversion by a rational factor, Filter implementation for sampling rate conversion- Direct form FIR structures, Polyphase filter structures, time-variant structures. Multistage implementation of multirate system. Application to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Recognise the discrete random signal processing.
CO2: Demonstrate different spectrum estimation techniques.
CO3: Realize the linear estimation and prediction.
CO4: Design the adaptive filter.
CO5: Analyse the multi-rate signal processing.

Text Books:

1. Monson H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, Inc., Singapore, 2002.

Reference Books:

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Pearson Education, 2002.

2. John G. Proakis et.al., Algorithms for Statistical Signal Processing, Pearson Education, 2002.

3. Dimitris G. Manolakis et.al., Statistical and adaptive signal Processing, McGraw Hill, Newyork,2000.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination

Honors

23HDECE104 CAD FOR VLSI

L	T	P	C
3	0	0	3

Course Objectives:

1. Learn VLSI Design methodologies.
2. Understand layout, placement and partitioning.
3. Understand floor planning and routing along with algorithm.
4. Learn different types of modelling techniques.
5. Understand the concepts of high-level synthesis.

UNIT I INTRODUCTION TO VLSI DESIGN FLOW 9 hours

Introduction to VLSI Design methodologies, Basics of VLSI design automation tools, Algorithmic Graph Theory and Computational Complexity, Tractable and Intractable problems, General purpose methods for combinatorial optimization.

UNIT II LAYOUT, PLACEMENT AND PARTITIONING 9 hours

Layout Compaction, Design rules, Problem formulation, Algorithms for constraint graph compaction, Placement and partitioning, Circuit representation, Placement algorithms, Partitioning

UNIT III FLOOR PLANNING AND ROUTING 9 hours

Floor planning concepts, Shape functions and floorplan sizing, Types of local routing problems, Area routing, Channel routing, Global routing, Algorithms for global routing.

UNIT IV SIMULATION AND LOGIC SYNTHESIS 9 hours

Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation, Combinational Logic Synthesis, Binary Decision Diagrams, Two Level Logic Synthesis.

UNIT V HIGH LEVEL SYNTHESIS 9 hours

Hardware models for high level synthesis, internal representation, allocation, assignment and scheduling, scheduling algorithms, Assignment problem, High level transformations.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Outline floor planning and routing
CO2: Exemplify the significance VLSI Design flow.
CO3: Learn the entire process associated with layout, placement and partitioning.
CO4: Learn the different algorithms associated with routing and concepts of floor planning.
CO5: Implement different modelling techniques.

Text Books:

1. N. A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002
2. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.

Reference Books:

1. Sadiq M. Sait, Habib Youssef, "VLSI Physical Design automation: Theory and Practice", World Scientific 1999.
2. Steven M.Rubin, "Computer Aids for VLSI Design", Addison Wesley Publishing 1987.

Mode of Evaluation: Assignments, Mid Term Tests and End Semester Examination

Honors

23HDECE202 PHYSICAL DESIGN AUTOMATION LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

1. To implement and analyze graph algorithms used in physical design automation for VLSI.
2. To study and apply line sweep algorithms for solving computational geometry problems efficiently.
3. To explore partitioning algorithms for efficient circuit design, including group migration, simulated annealing, and metric allocation methods.
4. To analyze various floor planning algorithms for VLSI design, focusing on constraint based, hierarchical, and optimization techniques.
5. To study and apply routing algorithms for efficient pathfinding in VLSI design and network communication.

List of Experiments:

Any ten experiments are to be conducted (Minimum one from each group)

I. Graph algorithms

1. Graph search algorithms
   - Depth first search
   - Breadth first search
2. Spanning tree algorithm
   - Kruskal‘s algorithm
3. Shortest path algorithm
   - Dijkstra algorithm
   - Floyd-Warshall algorithm
4. Steiner tree algorithm

II. Computational geometry algorithm

1. Line sweep method
2. Extended line sweep method

III. Partitioning algorithms

1. Group migration algorithms
   6. Kernighan –Lin algorithm
   7. Extensions of Kernighan-Lin algorithm
   8. Fiduccias –Mattheyses algorithm
   9. Goldberg and Burstein algorithm
2. Simulated annealing and evolution algorithms
   10. Simulated annealing algorithm
   11. Simulated evolution algorithm
3. Metric allocation method

IV. Floor planning algorithms

1. Constraint based methods

2. Integer programming based methods
3. Rectangular dualization based methods
4. Hierarchical tree based methods
5. Simulated evolution algorithms
6. Time driven Floorplanning algorithms

V. Routing algorithms
1. Two terminal algorithms
   12. Maze routing algorithms
      o Lee‘s algorithm
      o Soukup‘s algorithm
   13. Hadlock algorithm
   14. Line-Probe algorithm
   15. Shortest path based algorithm
2. Multi terminal algorithm
   16. Stenier tree based algorithm
      o SMST algorithm
      o Z-RST algorithm

Course Outcomes:

At the end of this course, the students will be able to

CO1: Apply graph-based algorithms to solve problems like spanning trees, shortest paths, and Steiner trees in VLSI design.
CO2: Implement and analyze line sweep and extended line sweep methods for geometric problem-solving.
CO3: Apply partitioning techniques to optimize circuit design using algorithms like Kernighan-Lin, simulated annealing, and metric allocation.
CO4: Utilize floor planning algorithms to optimize area, performance, and layout efficiency in VLSI design.
CO5: Implement and analyze two-terminal and multi-terminal routing algorithms for optimal interconnection in circuits and networks.

Text Books:

1. Naveed A. Sherwani**,** ***Title:*** Algorithms for VLSI Physical Design Automation (3rd Edition)**,** ***Publisher:*** Springer**.**
2. Sadiq M. Sait, Habib Youssef**,** ***Title:*** VLSI Physical Design Automation: Theory and Practice**,** ***Publisher:*** World Scientific Publishing**.**
3. Charles J. Alpert, Dinesh P. Mehta, Sachin S. Sapatnekar**,** ***Title:*** Handbook of Algorithms for Physical Design Automation**,** ***Publisher:*** CRC Press**.**

Reference Books:

1. Andrew B. Kahng, Jens Lienig, Igor L. Markov, Jin Hu**,** ***Title:*** VLSI Physical Design: From Graph Partitioning to Timing Closure**,** ***Publisher:*** Springer**.**
2. Majid Sarrafzadeh, C. K. Wong**,** ***Title:*** An Introduction to VLSI Physical Design**,** ***Publisher:*** McGraw-Hill Education**.**
3. Naveed A. Sherwani**,** ***Title:*** Algorithms for VLSI Physical Design Automation (3rd Edition)**,** ***Publisher:*** Springer**.**

Mode of Evaluation: Continuous Internal Evaluation, Model Test and End Semester Examination