MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE

MADANAPALLE

(UGC-AUTONOMOUS)

www.mits.ac.in

Estd 1998

DEPARTMENT OF ELECTRICAL AND ELECTRONICS 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 ELECTRICAL AND ELECTRONICS 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 become a Department recognized for its ability to provide quality education to the students and make them excel in the domain of electrical & electronics engineering, with research proficiency and ethics, to meet the challenges from society.
Mission	➢ To impart quality education and advancements in program of studies for producing engineers with scientific temperament and moral values in the field of electrical & electronics engineering ➢ To create and develop research culture with deep sense of commitment, so as to enable the industries to adopt the research outputs ➢ To enhance the technical dexterity, so as to find the suitable solutions in their respective domain, for welfare of the society

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Programme Educational Objectives of the B. Tech Electrical & Electronics Engineering are: The graduates will

PEO1: Acquire a successful career in electrical industries, allied fields and entrepreneurship with profound knowledge in core engineering.

PEO2: Pursue higher education and involve in research activities to gain in-depth knowledge in electrical and electronics engineering.

PEO3: Exhibit intellectual skills, ethics and pursue life-long learning to cater the societal needs.

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 specialisation 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)

The Electrical and Electronics Engineering Graduates will be able to

PSO 1: Facilitate technical solutions for different power issues to maintain the stability and reliability of Power Systems.

PSO 2: Control the various power electronics converters, electrical machines / drives used in industry.

PSO 3: Understand various computational tools / methods for the design and analysis of various electrical systems.

MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE, MADANAPALLE

B. Tech Four Year Curriculum Structure

Branch: ELECTRICAL AND ELECTRONICS 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	BSC	23MAT101	Linear Algebra and Calculus	3	0	0	3	3
2	BSC	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	BSC	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	HSMC	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	HSMC	23ENG101	Communicative English	2	0	0	2	2
2	BSC	23MAT102	Differential Equations and Vector Calculus	3	0	0	3	3
3	BSC	23CHE102	Chemistry	3	0	0	3	3
4	ESC	23CME101	Basic Civil and Mechanical Engineering	3	0	0	3	3
5	PCC	23EEE102	Electrical Circuits Analysis - I	3	0	0	3	3
6	HSMC	23ENG201	Communicative English Laboratory	0	0	2	2	1
7	BSC	23CHE202	Chemistry Laboratory	0	0	2	2	1
8	ESC	23ME201	Engineering Workshop	0	0	3	3	1.5
9	PCC	23EEE202	Electrical Circuits Laboratory	0	0	3	3	1.5
10	HSMC	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	BS	23MAT104	Complex Variables and Transforms	3	0	0	3	3
3	ES	23EEE103	Electromagnetic Field Theory	2	1	0	3	3
4	PC	23EEE104	Electrical Circuit Analysis - II	2	1	0	3	3
5	PC	23EEE105	DC Machines and Transformers	3	0	0	3	3
6	PC	23EEE203	Electrical Circuit Analysis and Simulation Laboratory	0	0	3	3	1.5
7	PC	23EEE204	DC Machines and Transformers Laboratory	0	0	3	3	1.5
8	SEC		**Skill Enhancement Course – I** *(Refer ANNEXURE - VI)*	1	0	2	3	2
9	Audit Course	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	ES		**Design Thinking and Innovation Related Courses** *(Refer ANNEXURE - II)*	1	0	2	3	2
3	PC	23EEE106	Analog Circuits	2	1	0	3	3
4	PC	23EEE107	Power Systems I	3	0	0	3	3
5	PC	23EEE108	Induction and Synchronous Machines	3	0	0	3	3
6	PC	23EEE109	Control Systems	2	1	0	3	3
7	PC	23EEE205	Induction and Synchronous Machines Laboratory	0	0	3	3	1.5
8	PC	23EEE206	Control Systems Laboratory	0	0	3	3	1.5
9	SEC		**Skill Enhancement Course – II** *(Refer ANNEXURE - VI)*	1	0	2	3	2
Total				**14**	**2**	**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	23EEE110	Power Electronics	3	0	0	3	3
2	PCC	23EEE111	Digital Circuits	2	1	0	3	3
3	PCC	23EEE112	Power Systems II	3	0	0	3	3
4	ESC	23PHY102	Introduction to Quantum Technologies and Applications	3	0	0	3	3
5	PE		**Professional Elective - I** *(Annexure - IV)*	3	0	0	3	3
6	OE		**Open Elective - I** *(Annexure - III)*	3	0	0	3	3
7	PCC	23EEE207	Power Electronics Laboratory	0	0	3	3	1.5
8	PCC	23EEE208	Analog and Digital Circuits 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	23EEE701	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	23EEE113	Electrical Measurements and Instrumentation	3	0	0	3	3
2	PCC	23EEE114	Microprocessors and Microcontrollers	3	0	0	3	3
3	PCC	23EEE115	Power System Analysis	2	1	0	3	3
4	PE		**Professional Elective - II** *(Annexure - IV)*	3	0	0	3	3
5	PE		**Professional Elective-III** *(Annexure - IV)*	3	0	0	3	3
6	OE		**Open Elective – II** *(Annexure - III)*	3	0	0	3	3
7	PCC	23EEE209	Electrical Measurements and Instrumentation Laboratory	0	0	3	3	1.5
8	PCC	23EEE210	Microprocessors and Microcontrollers 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	23EEE901	Workshop*	0	0	0	0	0
Total				**20**	**1**	**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	23EEE116	Power System Operation and Control	3	0	0	3	3
2	Management Course		**Management Course- II** *(Annexure – V)*	2	0	0	2	2
3	PE		**Professional Elective – IV** *(Annexure - IV)*	3	0	0	3	3
4	PE		**Professional Elective – V** (*Annexure - IV)*	3	0	0	3	3
5	OE		**Open Elective – III** *(Annexure - III)*	3	0	0	3	3
6	OE		**Open Elective – IV** *(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	23EEE702	Summer Internship II	0	0	0	2	2
Total				**20**	**0**	**2**	**24**	**21**

IV Year II Semester

S. No.	Category	Course Code	Course Title	Hours Per Week				Credits
				L	T	P	Total	
1	PROJ	23EEE703	Project Work and Internship	0	0	24	24	12
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	23ECE301	Bio-Medical Electronics	ECE
15	23ECE302	VLSI Design	ECE
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	23ECE3M01	Microprocessors and Interfacing	ECE
13	23ECE3M02	Microprocessors and Microcontrollers	ECE
14	23CSE3M01	Privacy and Security in Online Social Media	CSE
15	23CSE3M02	Computer Networks and Internet Protocol	CSE
16	23CSE3M03	Introduction to Soft Computing	CSE
17	23CSE3M04	Human Computer Interaction (in Hindi)	CSE
18	23MD3M01	Research Methodology	Multidisciplinary
19	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	23ECE3M03	System Design Through Verilog	ECE
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	23MD3M03	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	23ECE303	Embedded Systems	ECE
10	20ECE304	DSP Architecture	ECE
11	20ECE305	Community Radio Technology	ECE
12	20CSE302	Software Project Management	CSE
13	23CSD302	Cloud Computing	CSE (DS)
14	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.	23EEE4M01	Computer Architecture and Organization
2.	23EEE4M02	Computer Architecture
3.	23EEE4M03	Microsensors and Nanosensors
4.	23EEE4M04	Electronic Systems Design: Hands-on Circuits and PCB Design with CAD Software
5.	23EEE4M05	Electronic Modules for Industrial Applications using Op-Amps
6.	23EEE4M06	Electronic Systems for Cancer Diagnosis
7.	23EEE4M07	Signals and Systems
8.	23EEE4M08	Electrical Safety and Risk Management (SWAYAM)
9.	23EEE4M09	Utilization of Electrical Energy (SWAYAM)
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.	23EEE401	AI and ML for Electrical Engineering
2.	23EEE402	Programmable Logic Controllers
3.	23EEE403	Electric Drives
Any advanced courses can be appended in future.		

Professional Elective – III		
Sl. No.	**Course Code**	**Course Title**
1.	23EEE404	Communication Systems
2.	23EEE405	Switchgear and Protection
3.	23EEE406	Renewable and Distributed Energy Technologies
Any advanced courses can be appended in future.		

Professional Elective – IV		
Sl. No.	**Course Code**	**Course Title**
1.	23EEE407	Modern Control Theory
2.	23EEE408	HVDC and FACTS
3.	23EEE409	Electrical Distribution System
Any advanced courses can be appended in future.		

Professional Elective –V		
Sl. No.	**Course Code**	**Course Title**
1	23EEE410	Hybrid Electric Vehicles
2	23EEE411	Switched Mode Power Conversion
3	23EEE412	Digital Signal Processing
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.	23CSE610	Data Structures
Any Courses in Communication Skills can be appended in future.		

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

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

Skill Enhancement Course – IV		
Sl. No.	**Course Code**	**Course Title**
1.	23EEE601	Applications of Soft Computing Tools in Electrical Engineering
Any Courses can be appended in future.		

Skill Enhancement Course – V		
Sl. No.	**Course Code**	**Course Title**
1.	23EEE602	Power Systems and Simulation
Any Courses can be appended in future.		

ANNEXURE - VII

Minors in Electrical and Electronics Engineering

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

Stream Name: Microgrid Technology

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	23MDEEE101	Futuristic Power Systems	3	0	0	3	3
2	Professional Core Course	23MDEEE102	Power Electronic Converters for Energy Sources	3	0	0	3	3
3	Professional Core Course	23MDEEE201	Microgrid Power Electronics Interface Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23MDEEE103	Microgrid Power and Control Architecture	3	0	0	3	3
5	Professional Core Course	23MDEEE104	Microgrid System Design	3	0	0	3	3
6	Professional Core Course	23MDEEE202	Modeling and Simulation of Microgrid Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23MDEEE105	Analysis in Microgrid Technology	3	0	0	3	3
			Total	**10**	**5**	**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 Electrical Vehicle

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	23HDEEE101	E Mobility	3	0	0	3	3
2	Professional Core Course	23HDEEE102	Battery Management Systems	3	0	0	3	3
3	Professional Core Course	23HDEEE201	Battery Management Systems and Motor Control Laboratory	0	0	3	3	1.5
III Year II Semester								
4	Professional Core Course	23HDEEE103	Special Machines for Electric Vehicles	3	0	0	3	3
5	Professional Core Course	23HDEEE104	Grid Interface of Electric Vehicles	3	0	0	3	3
6	Professional Core Course	23HDEEE202	EV Simulation and Modeling Laboratory	0	0	3	3	1.5
IV Year I Semester								
7	Professional Core Course	23HDEEE105	EV charging Technologies	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, 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:

- Provide hands-on experience in programming fundamentals, algorithm design, and basic problem-solving techniques.
- Enable students to implement control structures for program flow control in practical scenarios.
- Reinforce understanding of arrays, memory models, and string manipulation through practical exercises
- Provide hands-on practice with functions, function calls, and parameter manipulation using pointers.
- 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.
v)

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:

- To familiarize engineering chemistry and its applications
- To train the students on the principles and applications of electrochemistry and polymers
- 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

23EEE102 ELECTRICAL CIRCUIT ANALYSIS - I

L	T	P	C
3	0	0	3

Course Objectives:

To develop an understanding of the fundamental laws, elements of electrical circuits and to apply circuit analysis to DC and AC circuits.

UNIT I INTRODUCTION TO ELECTRICAL CIRCUITS 9 hours

Basic Concepts of passive elements of R, L, C and their V-I relations, Sources (dependent and independent), Kirchoff's laws, Network reduction techniques (series, parallel, series - parallel, star-to-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis to DC networks with dependent and independent voltage and current sources, node and mesh analysis.

UNIT II MAGNETIC CIRCUITS 9 hours

Basic definition of MMF, flux and reluctance, analogy between electrical and magnetic circuits, Faraday's laws of electromagnetic induction – concept of self and mutual inductance, Dot convention – coefficient of coupling and composite magnetic circuit, analysis of series and parallel magnetic circuits.

UNIT III SINGLE PHASE CIRCUITS 9 hours

Characteristics of periodic functions, Average value, R.M.S. value, form factor, representation of a sine function, concept of phasor, phasor diagrams, node and mesh analysis. Steady state analysis of R, L and C circuits to sinusoidal excitations-response of pure resistance, inductance, capacitance, series RL circuit, series RC circuit, series RLC circuit, parallel RL circuit, parallel RC circuit.

UNIT IV RESONANCE AND LOCUS DIAGRAMS 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 NETWORK THEOREMS (DC & AC EXCITATIONS) 9 hours

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem and compensation theorem

Course Outcomes:

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

CO1: Investigate various electrical networks in presence of active and passive elements.

CO2: Analyze magnetic circuit with various dot conventions.

CO3: Calculate the parameters of R, L, C network with sinusoidal excitation.

CO4: Infer the concept of resonance and coupled circuit.

CO5: Solve Electrical networks by applying principles of network theorems.

Text Books:

1. Engineering Circuits Analysis, Jack Kemmerly, William Hayt and Steven Durbin, TataMc Graw Hill Education, 2005, sixth edition.
2. Network Analysis, M. E. Van Valkenburg, Pearson Education, 2019, Revised ThirdEdition

Reference Books:

1. Fundamentals of Electrical Circuits, Charles K. Alexander and Mathew N.O. Sadiku,Mc Graw Hill Education (India), 2013, Fifth Edition
2. Electric Circuits (Schaum's outline Series), Mahmood Nahvi, Joseph Edminister, and K. Rao, Mc Graw Hill Education, 2017, Fifth Edition.
3. Electric Circuits, David A. Bell, Oxford University Press, 2009, Seventh Edition.
4. Introductory Circuit Analysis, Robert L Boylestad, Pearson Publications, 2023,Fourteenth Edition.
5. Circuit Theory: Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., 2018, Seventh Revised Edition.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ee81/preview
2. https://nptel.ac.in/courses/108104139
3. https://nptel.ac.in/courses/108106172
4. https://nptel.ac.in/courses/117106108

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:

- Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- Introduce the preliminary concepts of surveying.
- Acquire preliminary knowledge on Transportation and its importance in nation's economy.
- Get familiarized with the importance of quality, conveyance and storage of water.
- 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

23CHE202 CHEMISTRY LABORATORY

L	T	P	C
0	0	2	1

Course Objectives:

- 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

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

23EEE202 ELECTRICAL CIRCUITS LABORATORY

L	T	P	C
0	0	3	1.5

Course Objectives:

To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics. It also gives practical exposure to the usage of different circuits with different conditions.

List of Experiments:

1. Verification of Kirchhoff's circuit laws.
2. Verification of node and mesh analysis.
3. Verification of network reduction techniques.
4. Determination of cold and hot resistance of an electric lamp
5. Determination of Parameters of a choke coil.
6. Determination of self, mutual inductances, and coefficient of coupling
7. Series and parallel resonance
8. Locus diagrams of R-L (L Variable) and R-C (C Variable) series circuits
9. Verification of Superposition theorem
10. Verification of Thevenin's and Norton's Theorems
11. Verification of Maximum power transfer theorem
12. Verification of Compensation theorem
13. Verification of Reciprocity and Millman's Theorems

Note: Any 10 of the above experiments are to be conducted

Course Outcomes:

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

CO1: Analyse different circuit characteristics with the help of fundamental laws and various configurations

CO2: Understand the concepts of network theorems, node and mesh networks, series and parallel resonance and Locus diagrams.

CO3: Determine self, mutual inductances and coefficient of coupling values, parameters of choke coil.

CO4: Create locus diagrams of RL, RC series circuits and examine series and parallel resonance.

CO5: Apply various theorems to compare practical results obtained with theoretical calculations.

Reference Books:

1. Engineering Circuits Analysis, Jack Kemmerly, William Hayt and Steven Durbin, TataMc Graw Hill Education, 2005, sixth edition.

2. Network Analysis, M. E. Van Valkenburg, Pearson Education, 2019, Revised ThirdEdition

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

23MAT104 COMPLEX VARIABLE AND TRANSFORMS

L	T	P	C
3	0	0	3

Course Prerequisite: 23MAT101 & 23MAT102

Course Description:

The course is to introduce the Complex functions and their analyticity, complex integration, Taylor and Laurent series expansions and Calculus of Residues. Transform Techniques is one of the important topics in the study of Electrical and Electronics Engineering because of its widespread applications. The course covers the applications of Laplace Transforms, Fourier series and Transforms, and Z-Transforms relevant to communication engineering.

Course Objectives:

This course enables students to

1. Analyse the functions of Complex variables and their analyticity.
2. Familiarize the knowledge complex integration, Laurent series and Calculus of residues.
3. ApplyLaplacetransformandinverseLaplacetransformtosolveordinarydifferentialequations.
4. Apply Fourier series and Fourier transform to solve sine and cosine transforms.
5. Introduce the concept of Z-transforms and its applications.

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

UNIT II COMPLEX VARIABLE – INTEGRATION 9 hours

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

UNIT III LAPLACE TRANSFORMS 9 hours

Introduction - Applications to Differential Equations - Derivatives and Integrals of Laplace transforms, Convolutions-Integral Equation - Unit step and Impulse functions.

UNIT IV FOURIER SERIES AND FOURIER TRANSFORMS 9 hours

The Fourier coefficients - Even and Odd functions - Cosine and Sine Series - Extension to Arbitrary intervals

Introduction – Fourier transforms and its properties, Fourier sine and cosine transforms, Convolution theorem.

UNIT V Z - TRANSFORMS 9 hours

Introduction to Z-transform, Linearity property - Damping rule - Shifting rule - Initial and final value theorems, Inverse Z- transforms, convolution theorem - Evaluation of Inverse transforms -application to solve difference equations

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: Apply Laplace transforms in solving ordinary differential equations relevant to the representations of communication systems.

CO4: Apply Fourier transforms and Inverse Fourier transforms for solving boundary value problems in the field of communications.

CO5: Apply Z-Transforms and Inverse Z- transforms for solving difference equations in communication system analysis.

Text Books:

1. George F. Simmons, "Differential Equations with Applications and Historical Notes", McGraw Hill Education (India) Private Limited, second Edition, 2014.

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

Reference Books:

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

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

3. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.

4. Nita H. Shah and Monika K. Naik, Integral Transforms and Applications, Volume 13 in the series De Gruyter Series on the Applications of Mathematics in Engineering and Information Sciences,2022

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

B. Tech II Year I Semester

23EEE103 ELECTROMAGNETIC FIELD THEORY

		L	T	P	C
Pre-requisite	23EEE101, 23PHY101	**2**	**1**	**0**	**3**

Course Objectives:

1. To recall the basic knowledge of vector calculus and to understand the concept of electrostatics.
2. To study the behavior of electric field in the boundary of different mediums.
3. To learn the concept of magnetostatics, magnetic flux density, scalar and vector potential and their applications,
4. To evaluate the self and mutual inductance of various configurations.
5. To interpret Maxwell's equations and to understand the concept of Faraday's laws and induced emf.

UNIT I VECTOR ANALYSIS AND ELECTROSTATICS 9 hours

Vector Algebra: Scalars and Vectors, Unit vector, Vector addition and subtraction, Position and distance vectors, Vector multiplication, Components of a vector.

Coordinate Systems: Rectangular, Cylindrical and Spherical coordinate systems.

Vector Calculus: Differential length, Area and Volume. Del operator, Gradient of a scalar, Divergence of a vector and Divergence theorem (definition only). Curl of a vector and Stoke's theorem (definition only), Laplacian of a scalar

Electrostatics:

Coulomb's law and Electric field intensity (EFI) – EFI due to Continuous charge distributions (line and surface charge), Electric flux density, Gauss's law (Maxwell's first equation, $\nabla.\vec{D} = \rho_v$), Applications of Gauss's law, Electric Potential, Work done in moving a point charge in an electrostatic field (second Maxwell's equation for static electric fields, $\nabla \times \vec{E} = 0$), Potential gradient, Laplace's and Poison's equations.

UNIT II CONDUCTORS – DIELECTRICS AND CAPACITANCE 9 hours

Behaviour of conductor in Electric field, Electric dipole and dipole moment – Potential and EFI due to an electric dipole, Torque on an Electric dipole placed in an electric field, Current density-conduction and convection current densities, Ohm's law in point form, Behaviour of conductors in an electric field, Polarization, dielectric constant and strength, Continuity equation and relaxation time, Boundary conditions between conductor to dielectric, dielectric to dielectric and conductor to free space, Capacitance of parallel plate, coaxial and spherical capacitors, Energy stored and density in a static electric field, Coupled and decoupled capacitors.

UNIT III MAGNETOSTATICS, AMPERE'S LAW AND FORCE IN MAGNETIC FIELDS 9 hours

Biot-Savart's law and its applications viz. Straight current carrying filament, circular, square, rectangle and solenoid current carrying wire – Magnetic flux density and Maxwell's second Equation ($\nabla.\vec{B} = 0$), Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid, toroidal current carrying conductor, point form of Ampere's circuital law, Maxwell's third equation ($\nabla \times \vec{H} = \vec{J}$).

Magnetic force, moving charges in a magnetic field – Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic

field, force between two straight long and parallel current carrying conductors, Magnetic dipole, Magnetic torque, and moment.

UNIT IV SELF AND MUTUAL INDUCTANCE 9 hours

Self and mutual inductance – determination of self-inductance of a solenoid, toroid, coaxial cable and mutual inductance between a straight long wire and a square loop wire in the same plane – Energy stored and energy density in a magnetic field.

UNIT V TIME VARYING FIELDS 9 hours

Faraday's laws of electromagnetic induction, Maxwell's fourth equation $\left(\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}\right)$, integral and point forms of Maxwell's equations, statically and dynamically induced EMF, Displacement current, Modification of Maxwell's equations for time varying fields, Poynting theorem and Poynting vector.

Course Outcomes:

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

CO1: Remember the concepts of vector algebra, vector calculus, various fundamental laws, self and mutual inductance

CO2:Understand the concepts of electrostatics, conductors, dielectrics, capacitance, magneto statics, magnetic fields, time varying fields, self and mutual inductances.

CO3:Apply vector calculus, Coulomb's law, Gauss's law, Ohm's law in point form, Biot-Savart's law, Ampere's circuital law, Maxwell's third equation, self and mutual inductances, Faraday's laws, Maxwell's fourth equation, Poynting theorem to solve various numerical problems.

CO4:Analyze vector calculus, electrostatic fields, behavior of conductor in electric filed, Biot-Savart's law and its applications.

CO5:Analyze magnetic force, moving charges in a magnetic field, self-inductance of different cables, mutual inductance between different wires and time varying fields.

Text Books:

1. "Elements of Electromagnetics" by Matthew N O Sadiku, Oxford Publications, 7th edition, 2018.
2. "Engineering Electromagnetics" by William H. Hayt & John. A. Buck Mc. Graw-Hill, 7th Editon.2006.

Reference Books:

1. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt. Ltd, 2nd edition.
2. "Electromagnetic Field Theory" by Yaduvir Singh, Pearson India, 1st edition, 2011.
3. "Fundamentals of Engineering Electromagnetics" by Sunil Bhooshan, Oxford University Press, 2012.
4. Schaum's Outline of Electromagnetics by Joseph A. Edminister, Mahamood Navi, 4th Edition,2014.

Web Resources:

1. https://archive.nptel.ac.in/courses/108/106/108106073/
2. https://nptel.ac.in/courses/117103065

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

B. Tech II Year I Semester

23EEE104 ELECTRICAL CIRCUIT ANALYSIS - II

		L	T	P	C
Pre-requisite	23EEE101, 23EEE102	**2**	**1**	**0**	**3**

Course Objectives:

1. To gain knowledge about three phase circuits
2. To know the transient and steady-state response of electrical circuits
3. To calculate the various two port network parameters and to know interconnections.
4. To understand the application of Fourier series in network analysis.
5. To learn design of passive filters.

UNIT I ANALYSIS OF THREE PHASE BALANCED AND UNBALANCED CIRCUITS — 9 hours

Analysis of three phase balanced circuits:

Phase sequence, star and delta connection of sources and loads, relation between line and phase quantities, analysis of balanced three phase circuits, measurement of active and reactive power.

Analysis of three phase unbalanced circuits:

Loop method, Star-Delta transformation technique, two-wattmeter method for measurement of three phase power.

UNIT II LAPLACE TRANSFORMS AND TRANSIENT ANALYSIS — 9 hours

Laplace transforms – Definition and Laplace transforms of standard functions– Shifting theorem – Transforms of derivatives and integrals, Inverse Laplace transforms and applications.

Transient Analysis: Transient response of R-L, R-C and R-L-C circuits (Series and parallel combinations) for D.C. and sinusoidal excitations – Initial conditions - Solution using differential equation approach and Laplace transform approach.

UNIT III NETWORK PARAMETERS — 9 hours

Impedance parameters, Admittance parameters, Hybrid parameters, Transmission (ABCD) parameters, conversion of Parameters from one form to other, Conditions for Reciprocity and Symmetry, Interconnection of Two Port networks in Series, Parallel and Cascaded configurations-problems.

UNIT IV ANALYSIS OF ELECTRIC CIRCUITS WITH PERIODIC EXCITATION — 9 hours

Fourier series and evaluation of Fourier coefficients, Trigonometric and complex Fourier series for periodic waveforms, Application to Electrical Systems – Effective value and average value of non-sinusoidal periodic waveforms, power factor, effect of harmonics

UNIT V FILTERS — 9 hours

Classification of filters-Low pass, High pass, Band pass and Band Elimination filters, Constant-k filters -Low pass and High Pass, Design of Filters.

Course Outcomes:

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

CO1: Remember the concepts of Laplace transforms, formulation of various circuit topologies (R, L and C components) and basic filters

CO2: Understand three phase balanced and unbalanced circuits, different circuit configurations and it's mathematical modeling, network parameters and various filters

CO3: Apply Laplace transforms to solve various electrical network topologies and filter design concepts

CO4: Analyze three phase circuits, transient response of various network topologies, electric circuits with periodic excitations and filter characteristics

CO5: Design suitable electrical circuits and various filters for different applications

Text Books:

1. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, 8th Edition McGraw-Hill, 2013
2. Fundamentals of Electric Circuits, Charles K. Alexander, Mathew N. O. Sadiku, 3rd Edition, Tata McGraw-Hill, 2019

Reference Books:

1. Network Analysis, M. E. Van Valkenburg, 3rd Edition, PHI, 2019.
2. Network Theory, N. C. Jagan and C. Lakshminarayana, 1st Edition, B. S. Publications, 2012.
3. Circuits and Networks Analysis and Synthesis, A. Sudhakar, Shyam Mohan S. Palli, 5th Edition, Tata McGraw-Hill, 2017.
4. Engineering Network Analysis and Filter Design (Including Synthesis of One Port Networks)- Durgesh C. Kulshreshtha Gopal G. Bhise, Prem R. Chadha ,Umesh Publications 2012.
5. Circuit Theory: Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., 2018, 7th Revised Edition.

Web Resources:

1. https://archive.nptel.ac.in/courses/117/106/117106108/
2. https://archive.nptel.ac.in/courses/108/105/108105159/

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

B. Tech II Year I Semester

23EEE105 DC MACHINES AND TRANSFORMERS

		L	T	P	C
Pre-requisite	23EEE101	**3**	**0**	**0**	**3**

Course Objectives:

1. To familiarize with the constructional details, principle of operation, prediction of performance, the methods of testing of dc generator.
2. To study the starting methods, speed control and testing of DC Machines
3. To acquaint with the constructional details, the principle of operation and performance of single phase transformers
4. To impart knowledge on various tests conducted on transformers
5. To learn different vector groups of three phase transformers

UNIT I DC GENERATORS 9 hours

Construction and principle of operation of DC machines – EMF equation for generator – Excitation techniques– characteristics of DC generators –applications of DC Generators, Back-emf and torque equations of DC motor – Armature reaction and commutation, Applications.

UNIT II STARTING, SPEED CONTROL AND TESTING OF DC MACHINES: 9 hours

Characteristics of DC motors – losses and efficiency – applications of DC motors. Necessity of a starter – starting by 3-point and 4-point starters – speed control by armature voltage and field current control – testing of DC machines – brake test, Swinburne's test –Hopkinson's test–Field Test.

UNIT III SINGLE-PHASE TRANSFORMERS 9 hours

Introduction to single-phase Transformers (Construction and principle of operation) – emf equation – operation on no-load and on load –lagging, leading and unity power factors loads –phasor diagrams– equivalent circuit – regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – all day efficiency, Applications. Transformer Design – Area product approach

UNIT IV TESTING OF TRANSFORMERS 9 hours

Open Circuit and Short Circuit tests – Sumpner's test – separation of losses— Parallel operation with equal and unequal voltage ratios – auto transformer – equivalent circuit – comparison with two winding transformers.

UNIT V THREE-PHASE TRANSFORMERS 9 hours

Polyphase connections- Y/Y, Y/Δ, Δ/Y, Δ/Δ, open Δ and Vector groups – third harmonics in phase voltages – Parallel operation– three winding transformers- transients in switching – off load and on load tap changers – Scott connection.

Course Outcomes:

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

CO1: Understand the process of voltage build-up in DC generators and characteristics.

CO2: Understand the process of torque production, starting and speed control of DC motors and illustrate their characteristics.

CO3: Obtain the equivalent circuit of single-phase transformer, auto transformer and determine its efficiency & regulation.

CO4: Apply various testing methods for transformers and speed control of DC motors

CO5: Analyze various configurations of three-phase transformers

Text Books:

1. Electric Machinery by Fitzgerald, A.E.,Kingsley, Jr.,C.,& Umans, S. D, 7th edition, McGraw-Hill Education, 2014.
2. Performance and analysis of AC machines by M.G. Say, CBS, 2002.

Reference Books:

1. Electrical Machines by D. P.Kothari, I .J .Nagarth, McGraw Hill Publications, 5th edition
2. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2011.
3. Generalized Theory of Electrical Machines by Dr. P S Bimbhra, 7th Edition, Khanna Publishers, 2021.
4. Theory & Performance of Electrical Machines by J.B.Gupta, S.K.Kataria & Sons,2007.
5. Electrical Machinery by Dr. P S Bimbhra, 7th edition, Khanna Publishers, New Delhi,1995.

Web Resources:

1. nptel.ac.in/courses/108/105/108105112
2. nptel.ac.in/courses/108/105/108105155

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

B. Tech II Year I Semester

23EEE203 ELECTRICAL CIRCUIT ANALYSIS AND SIMULATION LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite 23EEE201, 23EEE202

Course Objectives:

1. To measure active and reactive Power for Star and Delta Connected Balanced and Unbalanced Loads.
2. To determine the various two port network parameters
3. To verify circuit laws and methods of analysis in simulation tools.
4. To simulate circuit theorems using simulation tools.
5. To study Resonance and Transient response in electric circuits

List of Experiments:

Any 10 of the following experiments are to be conducted:

1. Measurement of Active Power and Reactive Power for balanced loads.
2. Measurement of Active Power and Reactive Power for unbalanced loads.
3. Determination of Z and Y parameters.
4. Determination of ABCD and hybrid parameters
5. Verification of Kirchhoff's current law and voltage law using simulation tools.
6. Verification of mesh and nodal analysis using simulation tools.
7. Verification of super position and maximum power transfer theorems using simulation tools.
8. Verification of Reciprocity and Compensation theorems using simulation tools.
9. Verification of Thevenin's and Norton's theorems using simulation tools.
10. Verification of series and parallel resonance using simulation tools.
11. Simulation and analysis of transient response of RL, RC and RLC circuits.
12. Verification of self-inductance and mutual inductance by using simulation tools.

Course Outcomes:

CO1: Understand the power calculations in three phase circuits.
CO2: Analyze the time response of given network.
CO3: Determination of two port network parameters.
CO4: Simulate and analyze electrical circuits using software tools
CO5: Apply various theorems to solve different electrical networks using simulation tools

Reference Books:

1. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.

2. Sudhakar and Shyammohan S Palli, "Network Analysis", Tata McGraw- Hill publications, 2007.

3. Abhijit Chakrabarti, "Circuit Theory: Analysis and Synthesis", Dhanpat Rai & Co., 2014.

4. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.

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

B. Tech II Year I Semester

23EEE204 DC MACHINES AND TRANSFORMERS LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite **23EEE201**

Course Objectives:

1. To conduct various tests on transformers.
2. To analyse the Open circuit and load. Characteristics of DC separately excited shunt generator.
3. To conduct and analyse the load test on DC shunt, series and compound motors.
4. To examine the self-excitation in DC generators.
5. To Pre-determine and determine the efficiency of different DC machines.

List of Experiments:

Any 10 of the following experiments are to be conducted:

1. Speed control of DC shunt motor by Field Current and Armature Voltage Control.
2. Brake test on DC shunt motor- Determination of performance curves.
3. Swinburne's test - Predetermination of efficiencies as DC Generator and Motor.
4. Hopkinson's test on DC shunt Machines.
5. Load test on DC compound generator-Determination of characteristics.
6. Load test on DC shunt generator-Determination of characteristics.
7. Fields test on DC series machines-Determination of efficiency.
8. Brake test on DC compound motor-Determination of performance curves.
9. OC & SC tests on single phase transformer.
10. Sumpner's test on single phase transformer.
11. Scott connection of transformers.
12. Parallel operation of Single-phase Transformers.
13. Separation of core losses of a single-phase transformer.

Course Outcomes:

CO1: Demonstrate starting and speed control methods of DC Machines.
CO2: Apply theoretical concepts to determine the performance characteristics of DC Machines.
CO3: Analyze the parallel operation of single phase transformers
CO4: Determine the performance parameters of single-phase transformer.
CO5: Analyze the performance analysis of transformers using various tests.

References:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
3. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. https://ems-iitr.vlabs.ac.in/List%20of%20experiments.html

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 **7 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 **7 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 **7 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 **7 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

23EEE106 ANALOG CIRCUITS

	L	T	P	C
Pre-requisite: 23EEE101, 23EEE102	**2**	1	**0**	**3**

Course Objectives:

1. To understand the basic concepts of semiconductor diode and BJT
2. To study the small signal modelling of BJT and Feedback Amplifiers.
3. To gain knowledge about the working of oscillator circuits and operational amplifiers.
4. To learn the applications of operational amplifiers.
5. To learn the concepts of Timers, ADC & DAC and its applications.

UNIT I DIODE AND BJT CIRCUITS 9 hours

Diode clipping and clamping circuits: Diode clippers, clipping at two independent levels, Transfer characteristics of clippers, clamping circuit operation.

DC biasing of BJTs: Load lines, Operating Point, Bias Stability, Collector-to-Base Bias, Self-Bias, Stabilization against Variations in V_{BE} and β for the Self-Bias Circuit, Bias Compensation, Thermal Runaway, Thermal Stability.

UNIT II SMALL SIGNAL MODELLING AND FEEDBACK AMPLIFIERS 9 hours

Small Signals Modeling of BJT: Analysis of a Transistor Amplifier Circuit using h-parameters, Simplified CE Hybrid Model, Analysis of CE, CC, CB Configuration using Approximate Model, Frequency Response of CE and CC amplifiers.

Feedback Amplifiers: Classification of Amplifiers, the Feedback Concept, General Characteristics of Negative-Feedback Amplifiers, Effect of Negative Feedback upon Output and Input Resistances, Voltage-Series Feedback, Current-Series Feedback, Current-Shunt Feedback, Voltage-Shunt Feedback.

UNIT III OSCILLATORS AND OPERATIONAL AMPLIFIERS 9 hours

Oscillator Circuits: Barkhausen Criterion of oscillation, Oscillator operation, R-C phase shift oscillator, Wien bridge Oscillator, Crystal Oscillator.

Operational Amplifiers: Introduction, Basic information of Op-Amp, Ideal Operational Amplifier, Block Diagram Representation of Typical Op-Amp, OP-Amps Characteristics: Introduction, DC and AC characteristics, 741 op-amp & its features.

UNIT IV OP-AMP APPLICATIONS AND SIGNAL GENERATORS 9 hours

OP-AMPS Applications: Introduction, Basic Op-Amp Applications, Instrumentation Amplifier, AC Amplifier, V to I and I to V Converter, Sample and Hold Circuit, Log and Antilog Amplifier, Multiplier and Divider, Differentiator, integrator.

Comparators and Waveform Generators: Introduction, Comparator, Square Wave Generator, Monostable Multivibrator, Triangular Wave Generator, Sine Wave Generators.

UNIT V TIMERS, D/A & A/D CONVERTERS 9 hours

Timers and Phase Locked Loop: Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger, PLL block schematic, principles and description of individual blocks, 565 PLL, Applications of VCO (566).

Digital To Analog And Analog To Digital Converters: Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A-D Converters – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

Course Outcomes:

At the end of this course students will demonstrate the ability to
CO1: Understand the concepts of diode circuits and biasing of BJT
CO2: Analyse small signal modelling of BJT and Feedback Amplifiers
CO3: Study the Oscillator circuits and OP-AMP characteristics
CO4: Understand the applications of OP-AMPs and Signal Generators
CO5: Analyze various circuit characteristics by using timers, Phase locked loops and ADC & DAC

Text Books:

1. Electronic Devices and Circuits- J. Millman, C.Halkias, Tata Mc-Graw Hill, 2nd Edition, 2010.
2. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition, 2003.

Reference Books:

1. Electronic Devices and Circuit Theory – Robert L.Boylestad and Lowis Nashelsky, Pearson Edition, 2021.
2. Electronic Devices and Circuits–G.K. Mithal, Khanna Publisher, 23rd Edition, 2017.
3. Electronic Devices and Circuits – David Bell, Oxford, 5th Edition, 2008.
4. Electronic Principles–Malvino, Albert Paul, and David J. Bates, McGraw-Hill/Higher Education, 2007.
5. Operational Amplifiers and Linear Integrated Circuits – Gayakwad R.A, Prentice Hall India, 2002.
6. Operational Amplifiers and Linear Integrated Circuits –Sanjay Sharma, Kataria & Sons, 2nd Edition, 2010.
7. Design of Analog CMOS Integrated Circuits - Behzad Razavi

Web Resources:

1. https://nptel.ac.in/courses/122106025
2. https://nptel.ac.in/courses/108102112

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

B. Tech II Year II Semester

23EEE107 POWER SYSTEMS I

		L	T	P	C
Pre-requisite	23EEE101	**3**	**0**	**0**	**3**

Course Objectives:

1. To impart knowledge about Hydro and Thermal Power Plants
2. To study about layouts and working of Nuclear Power Plants
3. To learn the operations of various substations
4. To understand various types of distribution systems and underground cables
5. To Analyze various economic aspects related to power generation and distribution

UNIT I POWER GENERATION STATIONS 9 hours

Power System evolution–Load curve -Load factor, diversity factor, Load curve (brief description only) - Numerical Problems.

Generation-conventional (block schematic details, special features, environmental and ethical factors, advantages, disadvantages) -hydro, thermal, nuclear –renewable energy(block schematic details, special features, environmental factors, regulations, advantages, disadvantages) –solar and wind –Design of a rooftop/ground mounted solar farm (concepts only) – Energy storage systems as alternative energy sources- grid storage systems- bulk power grids –smart grids – micro grids.

UNIT II POWER TRANSMISSION SYSTEM 9 hours

Electrical Model: Line parameters -resistance- inductance and capacitance (Derivation of three phase double circuit) - Transmission line modelling-classifications -short line, medium line, long line-transmission line as two port network-parameters- derivation and calculations

UNIT III SUBSTATIONS 9 hours

Air Insulated Substations – indoor & outdoor substations, substations layouts of 33/11 kV showing the location of all the substation equipment. Bus bar arrangements in the sub-stations: simple arrangements like single bus bar, sectionalized single bus bar, double bus bar with one and two circuit breakers, main and transfer bus bar system with relevant diagrams.

Gas Insulated Substations (GIS) – advantages of gas insulated substations, constructional aspects of GIS, comparison of air insulated substations and gas insulated substations.

UNIT IV DISTRIBUTION SYSTEMS AND UNDERGROUND CABLES 9 hours

Distribution Systems: Classification of Distribution systems, A.C Distribution, Overhead versus Underground system, Connection schemes of Distribution system, Requirements of Distribution system, Design considerations in Distribution system.

Underground Cables: Types of cables, construction, types of insulating materials, calculation of insulation resistance, stress in insulation and power factor of cable. Capacitance of single and 3-Core belted Cables. Grading of cables: capacitance grading and intersheath grading.

UNIT V ECONOMIC ASPECTS & TARIFF 9 hours

Economic Aspects – load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity factor and plant use factor, base and peak load plants.

Tariff Methods– Costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a tariff method, tariff methods: simple rate, flat rate, block-rate, two-part, three–part, and power factor tariff methods, Time of Day (ToD) tariff and Time of Use (ToU) tariff.

Course Outcomes:

At the end of this course students will demonstrate the ability to
CO1:Understand the working of Conventional and Renewable Energy Power Plants
CO2:Understand the Modelling of Transmission line system
CO3:Study the operations of various substations
CO4: Understand various types of distribution systems and underground cables
CO5:Analyze various economic aspects related to power generation and distribution

Text Books:

1. S. N. Singh, Electric Power Generation, Transmission and Distribution, PHI Learning Pvt Ltd, New Delhi, 2nd Edition, 2010
2. J. B. Gupta, Transmission and Distribution of Electrical Power, S. K. Kataria and sons,10th Edition, 2012

Reference Books:

1. I. J. Nagarath & D.P. Kothari, Power System Engineering, McGraw-Hill Education, 3rd Edition, 2019.
2. C. L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International Publishers, 6th Edition, 2018.
3. V. K. Mehta and Rohit Mehta, Principles of Power System, S. Chand, 4th Edition, 2005.
4. Turan Gonen, Electric Power Distribution System Engineering, McGraw-Hill, 1985.
5. Handbook of switchgear, BHEL, McGraw-Hill Education, 2007.

Web Resources:

1. https://nptel.ac.in/courses/108102047

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

B. Tech II Year II Semester

23EEE108 INDUCTION AND SYNCHRONOUS MACHINES

		L	T	P	C
Pre-requisite	23EEE101, 23EEE102, 23EEE105	**3**	**0**	**0**	**3**

Course Objectives:

1. To deal with the basic concepts of polyphase induction motors.
2. To emphasize the performance analysis of polyphase induction motors.
3. To understand operation, construction and types of single phase motors and their applications in house hold appliances and control systems.
4. To deal with the detailed analysis of Synchronous generators and concept of parallel operation
5. To study the operation and analysis of Synchronous motors.

UNIT I 3-PHASE INDUCTION MOTORS 9 hours

Construction of Squirrel cage and Slipring induction motors– production of rotating magnetic field – principle of operation – rotor emf and rotor frequency – rotor current and power factor at standstill and during running conditions– rotor power input, rotor copper loss and mechanical power developed and their inter-relationship –equivalent circuit – phasor diagram, Applications.

UNIT II PERFORMANCE OF 3-PHASE INDUCTION MOTORS 9 hours

Torque equation – expressions for maximum torque and starting torque – torque-slip characteristics – double cage and deep bar rotors – No load, Brake test and Blocked rotor tests – circle diagram for predetermination of performance- methods of starting –starting current and torque calculations - speed control of induction motor with V/f control method, rotor resistance control and rotor emf injection technique –crawling and cogging – induction generator operation.

UNIT III SINGLE PHASE MOTORS 9 hours

Single phase induction motors – constructional features – double revolving field theory, Cross field theory – equivalent circuit- starting methods: capacitor start capacitor run, capacitor start induction run, split phase & shaded pole, AC series motor, Applications.

UNIT IV SYNCHRONOUS GENERATOR 9 hours

Constructional features of non-salient and salient pole type alternators- armature windings – distributed and concentrated windings – distribution & pitch factors – E.M.F equation – armature reaction – voltage regulation by synchronous impedance method – MMF method and Potier triangle method – two reaction analysis of salient pole machines - methods of synchronization- Slip test – Parallel operation of alternators.

UNIT V SYNCHRONOUS MOTOR 9 hours

Synchronous motor principle and theory of operation – Effect of excitation on current and power factor– synchronous condenser –expression for power developed –hunting and its suppression – methods of starting, Applications.

Course Outcomes:

At the end of this course students will demonstrate the ability to
CO1: Understand the basic concepts of polyphase induction motors
CO2: Perform the analysis of polyphase induction motors
CO3: Understand operation, construction and types of single phase motors and applications
CO4: Evaluate the regulation of Synchronous generator
CO5: Perform the analysis of Synchronous motors

Text Books:

1. Electrical Machinery, Dr. P.S. Bhimbra, Khanna Publishing, 2021, First Edition.

2. Performance and analysis of AC machines by M.G. Say, CBS, 2002.

Reference Books:

1. Electrical machines, D.P. Kothari and I.J. Nagrath, McGraw Hill Education, 2017, Fifth Edition.

2. Theory & Performance of Electrical Machines by J.B.Gupta, S.K.Kataria & Sons,2007.

3. Electric Machinery, A.E.Fitzgerald, Charles kingsley, Stephen D.Umans, McGraw-Hill, 2020, Seventh edition.

Web Resources:

1. https://nptel.ac.in/courses/108/105/108105131
2. https://nptel.ac.in/courses/108106072

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

B. Tech II Year II Semester

23EEE109 CONTROL SYSTEMS

	L	T	P	C
Pre-requisite: 23 EEE101, 23MAT102, 23MAT104	**2**	**1**	**0**	**3**

Course Objectives:

1. To understand the applications of control system and use of transfer function models for the analysis of physical systems.
2. To provide adequate knowledge in the time response of second order system and steady state analysis.
3. To understand the stability of a system by root locus technique.
4. To understand the stability of a system by analysis of frequency response and design of compensators.
5. To obtain the knowledge about design of controllers and state variable analysis.

UNIT I CONTROL SYSTEMS CONCEPTS 9 hours

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. Principle of operation of DC and AC Servo motor, Transfer function of DC servo motor - AC servo motor, Synchros.

UNIT II TIME RESPONSE ANALYSIS 9 hours

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, P, PI, PID Controllers.

UNIT III STABILITY ANALYSIS IN TIME DOMAIN 9 hours

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 FREQUENCY RESPONSE ANALYSIS 9 hours

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 – Lag, Lead, Lag-Lead Compensator design in frequency Domain.

UNIT V STATE SPACE ANALYSIS OF CONTINUOUS SYSTEMS 9 hours

Concepts of state, state variables and state model, state models - 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:

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

CO1: Analyse the modeling of the physical systems and develop the transfer function by block diagram and signal flow graph techniques.

CO2: Analyse the time response of a second order system and study of effect of controllers on time response

CO3: Analyse the stability of a system in time domain by RH criterion and Root Locus.

CO4: Analyse the stability of a system in frequency domain by suitable techniques and design of compensators.

CO5: Design the controllers and analyze state space model of a system.

Text Books:

1. Modern Control Engineering by Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 5th edition, 2010.

2. Control Systems Engineering by I. J. Nagrath and M. Gopal, New Age International (P) Limited Publishers, 5th edition, 2007.

Reference Books:

1. Control Systems Principles & Design by M.Gopal, 4th Edition, Mc Graw Hill Education, 2012.

2. Automatic Control Systems by B. C. Kuo and Farid Golnaraghi, John wiley and sons, 8th edition, 2003.

3. Feedback and Control Systems, Joseph J Distefano III, Allen R Stubberud & Ivan J Williams, 2nd Edition, Schaum's outlines, Mc Graw Hill Education, 2013.

4. Control System Design by Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado, Pearson, 2000.

5. Feedback Control of Dynamic Systems by Gene F. Franklin, J.D. Powell and Abbas Emami-Naeini, 6th Edition, Pearson, 2010.

Web Resources:

1. https://nptel.ac.in/courses/108102043.

2. https://nptel.ac.in/courses/108106098.

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

B. Tech II Year II Semester

23EEE205 INDUCTION AND SYNCHRONOUS MACHINES LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite 23EEE101, 23EEE204

Course Objectives:

1. To conduct various tests on Single phase induction motor.
2. To deal with the detailed analysis of polyphase induction motors & Synchronous generators and motors.
3. To introduce the concept of regulation and its calculations.
4. To Pre-determine and determine the efficiency of alternator.
5. To introduce the concept of Synchronization of synchronous generators.

List of Experiments:

Any 10 experiments of the following are required to be conducted

1. Brake test on three phase Induction Motor.
2. Circle diagram of three phase induction motor.
3. Speed control of three phase induction motor by V/f method.
4. Equivalent circuit of single-phase induction motor.
5. Power factor improvement of single-phase induction motor by using capacitors.
6. Load test on single phase induction motor.
7. Regulation of a three -phase alternator by synchronous impedance & MMF methods.
8. Regulation of three-phase alternator by Potier triangle method.
9. V and Inverted V curves of a three-phase synchronous motor.
10. Determination of X_d, X_q & Regulation of a salient pole synchronous generator.
11. Determination of efficiency of three phase alternator by loading with three phase induction motor.
12. Parallel operation of three-phase alternator under no-load and load conditions.
13. Determination of efficiency of a single-phase AC series Motor by conducting Brake test.

Course Outcomes:

CO1: Analyze various performance characteristics of 3-phase and 1-phase induction motors
CO2: Evaluate the performance of 3-phase Induction Motor by obtaining the circle diagram and equivalent circuit of 3-phase Induction Motor and single phase induction motor
CO3: Adapt the power factor improvement methods for single phase Induction Motor
CO4: Pre-determine the regulation of 3-phase alternator
CO5: Determine the synchronous machine reactance of 3-phase alternator

References:

1. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. Theory & Performance of Electrical Machines by J.B.Gupta, S.K.Kataria & Sons,2007.
5. https://em-coep.vlabs.ac.in/List%20of%20experiments.html

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

B. Tech II Year II Semester

23EEE206 CONTROL SYSTEMS LABORATORY

L	T	P	C
0	0	3	1.5

Pre-requisite: 23EEE101

Course Objectives:

1. To obtain the Transfer Function of separately excited D.C. Machine.
2. To study the effect of feedback on a Servo Motor, Synchros and to determine the characteristics
3. To learn the effect of controllers on Second Order Systems and placement of compensators.
4. To understand and validate the characteristics of a DC Motor using MATLAB/ SIMULINK.
5. To carryout stability analysis of LTI systems, Compensator and State feedback Controller design using MATLAB / SIMULINK.

List of Experiments:

Any 10 of the Following Experiments are to be conducted.

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor.
4. Effect of feedback on DC servo motor
5. Transfer function of DC Machine
6. Effect of P, PD, PI, PID Controller on a second order system
7. Lag and lead compensation – Magnitude and phase plot
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor
11. Linear system analysis (Time domain analysis, Error analysis) using MATLAB.
12. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using MATLAB
13. State space model for classical transfer function using MATLAB – Verification.

Course Outcomes:

CO1: Understand how to use feedback control system to determine transfer function of DC servo motor and any other given circuit with R, L and C components
CO2: Model the systems and able to design the controllers and compensators.
CO3: Get the knowledge about the effect of poles and zeros location on transient and steady state behavior of second order systems and implement through software tools.
CO4: Determine the performance and time domain specifications of first and second order systems.
CO5: Understand the stability analysis.

References:

1. M Gopal, “Control Systems: Principals and Design”, McGraw Hill Education, 4th Edition 2012.
2. I J Nagrath and M Gopal, “Control Systems Engineering”, New Age International, 2009
3. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 5th edition, 2010
4. B C Kuo, “Advanced Control Systems”, wiley Publishers, 9th Edition 2010

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

III Year I Semester

B. Tech III Year I Semester

23EEE110 POWER ELECTRONICS

	L	T	P	C
Pre-requisite: 23EEE101, 23EEE106	**3**	**0**	**0**	**3**

Course Objectives:

1. To introduce the fundamental characteristics and gate drive requirements of power semiconductor devices such as diodes, thyristors, MOSFETs, IGBTs, and wide-bandgap devices (GaN, SiC).
2. To provide a comprehensive understanding of single-phase and three-phase rectifier circuits, analyzing their performance under various load and source conditions.
3. To impart knowledge on DC-DC converters including chopper circuits and to analyze their control strategies and steady-state performance.
4. To develop the ability to analyze voltage and current source inverters and their various control and commutation methods for efficient energy conversion.
5. To study the operation and performance of AC voltage controllers and cycloconverters under different load conditions using appropriate control strategies.

UNIT I POWER SWITCHING DEVICES: 9 hours

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET, IGBT and GTO. Introduction to Galium Nitride and Silicon Carbide Devices.

UNIT II RECTIFIERS: 9 hours

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape, power factor and effect of source inductance; Analysis of rectifiers with filter capacitance, Dual Converter -Numerical problems.

UNIT III DC-DC CONVERTERS: 9 hours

Elementary chopper with an active switch and diode, concepts of duty ratio, control strategies and average output voltage: Power circuit, analysis and waveforms at steady state, duty ratio control and average output voltage of Buck, Boost and Buck- Boost Converters. **Applications of DC-DC Converters**: **Buck converter**: Applications in voltage regulators for DC motor drives, electric vehicles. **Boost converter**: Used in battery-powered systems, solar PV systems. **Buck-Boost converter**: Utilized in portable electronics, uninterruptible power supplies (UPS).

UNIT IV INVERTERS: 9 hours

Single phase Voltage Source inverters – operating principle - steady state analysis, Simple forced commutation circuits for bridge inverters – Voltage control techniques for inverters and Pulse width modulation techniques, single phase current source inverter with ideal switches, basic series inverter, single phase parallel inverter – basic principle of operation only, Three phase bridge inverters (VSI) – 180 degree mode – 120 degree mode of operation - Numerical problems.

UNIT V AC VOLTAGE CONTROLLERS & CYCLO CONVERTERS: 9 hours

AC voltage controllers – Principle of phase control – Principle of integral cycle control - Single phase two SCRs in anti-parallel – With R and RL loads – modes of operation of Triac – Triac with R and RL loads – RMS load voltage, current and power factor - wave forms – Numerical problems. Cyclo converters - Midpoint and Bridge connections - Single phase to single phase step-up and step-down cyclo converters with Resistive and inductive load, Principle of operation, Waveforms, output voltage equation.

Course Outcomes:

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

CO1 Understand the I-V characteristics, switching behavior, and gate drive requirements of power semiconductor devices including GaN and SiC.

CO2 Analyze and design single-phase and three-phase rectifiers for different load conditions and assess the impact of source inductance and power factor.

CO3 Apply duty ratio control methods to evaluate the performance of DC-DC converters such as Buck, Boost, and Buck-Boost converters.

CO4 Analyze the operation of single-phase and three-phase inverters, and apply voltage control and PWM techniques under various load conditions.

CO5 Evaluate the performance of AC voltage controllers and cycloconverters with R and RL loads using different control strategies.

Text Books:

1. M. H. Rashid, ―Power Electronics: Circuits, Devices and Applications‖, 2nd edition, Prentice Hall of India, 1998.
2. P.S. Bimbhra, ―Power Electronics‖, 4th Edition, Khanna Publishers, 2010.
   M. D. Singh & K. B. Kanchandhani, ―Power Electronics‖, Tata Mc Graw Hill Publishing Company, 1998.

Reference Books:

1. Ned Mohan, ―Power Electronics‖, Wiley, 2011.
2. Robert W. Erickson and Dragan Maksimovic, ―Fundamentals of Power Electronics‖ 2nd Edition, Kluwer Academic Publishers, 2004.
3. Vedam Subramanyam, ―Power Electronics‖, New Age International (P) Limited, 1996.
4. V. R. Murthy, ―Power Electronics‖, 1st Edition, Oxford University Press, 2005.
5. P. C. Sen, ―Power Electronics‖, Tata Mc Graw-Hill Education, 1987.
6. J. M. D. Murphy ―Power Electronic Control of Alternating Current Motors‖.

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

B. Tech III Year I Semester

23EEE111 DIGITAL CIRCUITS

	L	T	P	C
Pre-requisite: 23EEE101, 23EEE106	**3**	**0**	**0**	**3**

Course Objectives:

1. To Learn Boolean algebra, logic simplification techniques, and combinational circuit design.
2. To analyze combinational circuits like adders, subtractors, and code converters.
3. To explore combinational logic circuits and their applications in digital design.
4. To understand sequential logic circuits, including latches, flip-flops, counters, and shift registers.
5. To gain knowledge about programmable logic devices and digital IC‘s.

UNIT I LOGIC SIMPLIFICATION AND COMBINATIONAL LOGIC DESIGN **9 hours**

Review of Boolean Algebra and De Morgan‘s Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex-NOR operations, Minimization of Switching Function.

UNIT II INTRODUCTION TO COMBINATIONAL DESIGN **9 hours**

Binary Adders, Subtractors, BCD adder and Binary multiplier, Arithmetic and Logical Unit, Code converters - Binary to Gray, Gray to Binary, BCD to Excess-3, BCD to Seven Segment display.

UNIT III COMBINATIONAL LOGIC DESIGN **9 hours**

Decoders, Encoders, Priority Encoder, Multiplexers, Demultiplexers, Comparators, Implementations of Logic Functions using Decoders and Multiplexers.

UNIT IV SEQUENTIAL LOGIC DESIGN **9 hours**

Latches, Flip-flops, S-R, D, T, JK and Master-Slave JK FF, Edge triggered FF, set up and hold times, Ripple counters, Synchronous counters, Shift registers.

UNIT V PROGRAMMABLE LOGIC DEVICES **9 hours**

ROM, Programmable Logic Devices (PLA and PAL). **Digital IC’s:** Decoder (74x138), Priority Encoder (74x148), multiplexer (74x151) and de-multiplexer (74x155), comparator (74x85).

Course Outcomes:

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

CO1: Learn Boolean algebra, logic simplification techniques, and combinational circuit design.

CO2: Analyze combinational circuits like adders, subtractors, and code converters.

CO3: Explore combinational logic circuits and their applications in digital design.

CO4: Understand sequential logic circuits, including latches, flip-flops, counters, and shift registers.

CO5: Gain knowledge about programmable logic devices and digital IC‘s.

Text Books:

1. Digital Design, M.Morris Mano & Michel D. Ciletti, 5th Edition, Pearson Education, 1999.

2. Switching theory and Finite Automata Theory, Zvi Kohavi and Nirah K.Jha, 2nd Edition, Tata McGraw Hill, 2005.

Reference Books:

1. Fundamentals of Logic Design, Charles H Roth,Jr., 5th Edition, Brooks/cole Cengage Learning, 2004.

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

B. Tech III Year I Semester

23EEE112 POWER SYSTEMS II

	L	T	P	C
Pre-requisite:	**3**	**0**	**0**	**3**

Course Objectives:

1. To study about line parameters and constants
2. To study the performance of transmission lines
3. To know about overhead line insulators, corona, sag and tension in transmission lines
4. To study about symmetrical components and different types of faults in power system.
5. To understand the concept of voltage control, compensation methods

UNIT I TRANSMISSION LINE PARAMETERS 9 hours

Types of Conductors - Calculation of Resistance for Solid Conductors, Bundle Conductors, Skin effect, Proximity effect, Concept of GMR & GMD- Transposition of Power lines- Calculation of inductance for single phase and three phase, Single and Double circuit lines, Symmetrical and asymmetrical conductor configurations with and without transposition. Calculation of Capacitance for 2 wire and 3 wire systems, effect of ground on Capacitance, Capacitance calculations for symmetrical and asymmetrical single and three phase, single and double circuit lines, Numerical Problems

UNIT II PERFORMANCE OF TRANSMISSION LINES 9 hours

Classification of Transmission Lines-Short, medium and long line and their models representation - Nominal-T, Nominal-π and A, B, C, D Constants for symmetrical networks, Numerical Problems and solutions for estimating regulation and efficiency of all types of lines. Ferranti effect and Charging Current

UNIT III OVERHEAD LINE INSULATORS 9 hours

Types of Insulators, String efficiency and Methods for improvement, – Voltage Distribution, Calculation of String efficiency, Capacitance Grading and Static Shielding., Numerical Problems.
Sag and Tension: Sag and Tension Calculations with equal and unequal heights of towers, Effect of wind and ice on weight of conductor, Stringing chart, Sag template and its applications Numerical Problems.
Corona: Corona- factors affecting corona, critical voltages and Power loss due to Corona. Radio Interference

UNIT IV SHORT CIRCUIT ANALYSIS 9 hours

Per-Unit System, Per-Unit equivalent reactance network of a three phase power system. Short circuit current and MVA calculations, fault levels, application of Series Reactors. Numerical problems
Symmetrical Components and Fault Analysis: Symmetrical component theory, symmetrical component transformation. Positive, negative and zero sequence components of voltages, currents and impedances Positive, negative and zero sequence networks LG, LL, LLG faults with and without fault impedance and LLL fault. Numerical Problems

UNIT V VOLTAGE CONTROL AND POWER FACTOR IMPROVEMENT **9 hours**

Methods of voltage control, shunt and series capacitors / Inductors, tap changing transformers, synchronous phase modifiers, power factor improvement methods. **Compensation in Power Systems:** Concepts of Load compensation Load ability characteristics of overhead lines – Uncompensated transmission line – Symmetrical line – Radial line with asynchronous load – Compensation of lines. Introduction to Power Electronic Compensation Devices: Overview and need for advanced compensation techniques in modern power systems. Role of FACTS (Flexible AC Transmission Systems) in grid stability and control. Key Devices and Applications: STATCOM (Static Synchronous Compensator): Principle, reactive power control, voltage regulation; UPFC (Unified Power Flow Controller): Control of voltage, impedance, and phase angle; SVC (Static VAR Compensator): Operation, comparison with mechanical compensators; TCSC (Thyristor-Controlled Series Capacitor): Series compensation and stability enhancement

Course Outcomes:

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

CO1. Analyze transmission line parameters such as resistance, inductance, and capacitance for various conductor configurations

CO2: Evaluate the performance of short, medium, and long transmission lines using ABCD parameters and determine efficiency and regulation

CO3: Calculate string efficiency, sag and tension, and assess the impact of corona and weather on overhead lines

CO4: Apply symmetrical component theory to perform short circuit analysis of power systems under various fault conditions

CO5: Recommend appropriate voltage control and power factor correction methods and assess compensation techniques in power systems

Text Books:

1. C.L. Wadhwa, ―Electrical Power Systems , New Age International Pub. Co, Third Edition, 2001.
2. . D.P. Kothari and I.J. Nagrath, ―Modern Power System Analysis‖, Tata Mc Graw Hill Pub. Co.,New Delhi, Fourth edition, 2011.
3. B.R.Gupta,―Power System Analysis and Design‖, S.ChandPublishing.1998.

Reference Books:

1. A. Chakrabarti, M.L. Soni, P.V. Gupta, U.S. Bhatnagar, ―A Text book on Power System Engineering, Dhanpat Rai Publishing Company (P) Ltd, 2008.
2. John J. Grainger & W.D. Stevenson, ―Power System Analysis‖, Mc Graw Hill International,1994.
3. Hadi Sadat, ―Power System Analysis‖, Tata Mc Graw Hill Pub. Co. 2002.
4. 4. W.D. Stevenson, ―Elements of Power system Analysis‖, McGraw Hill International Student Edition

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee17/preview

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

23EEE207 POWER ELECTRONICS LABORATORY

		L	T	P	C
Pre-requisite:	23EEE110	**0**	**0**	**3**	**1.5**

Course Objectives:

1. To study the static and switching characteristics of power semiconductor devices such as SCR, MOSFET, and IGBT.
2. To design and implement gate triggering and commutation circuits for power converters.
3. To analyze the operation of controlled rectifiers and AC voltage controllers with different load conditions.
4. To evaluate the performance of choppers and inverters for DC-DC and DC-AC power conversion.
5. To simulate and demonstrate the working of cycloconverters and dual converters under resistive and inductive loads.

CHOOSE ANY TEN FROM THE FOLLOWING LIST:

1. Study of Characteristics of SCR, MOSFET & IGBT.
2. Gate firing circuits for SCR‘s: (a) R triggering (b) R-C triggering.
3. Single Phase AC Voltage Controller with R and RL Loads.
4. Forced Commutation circuits (Class A, Class B, Class C, Class D & Class E).
5. DC Jones chopper with R and RL Loads.
6. Single Phase Parallel inverter with R and RL loads.
7. Single Phase Cyclo converter with R and RL loads.
8. Single Phase Half-controlled converter with R and RL load.
9. Single Phase Fully controlled converter with R and RL load.
10. Three Phase half-controlled bridge converter with R, RL-load.
11. Three Phase fully controlled bridge converter with R, RL-load.
12. Single Phase series inverter with R and RL loads.
13. Single Phase dual converter with RL loads.

Content Beyond Syllabus:

1. Design and Simulation of Buck, Boost and Buck-Boost Converters Using MATLAB.
2. Simulation of three phase voltage source inverter with the sine PWM technique.

Course Outcomes:

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

CO1: Analyze the Characteristics of Power Semiconductor Devices (SCR, MOSFET, IGBT) and their Role in Power Converters.

CO2: Design and Implement Gate Firing Circuits for SCR-based Power Converters.

CO3: Evaluate the Performance of Single-phase and Three-phase Power Converters with R and RL Loads.

CO4: Apply Different Commutation Techniques to Analyze Inverter for Efficient Power Control.

CO5: Apply Different Commutation Techniques to Analyze Chopper Circuits for Efficient Power Control.

Reference Books:

1. O.P. Arora, ―Power Electronics Laboratory: Theory, Practice and Organization (Narosa series in Power and Energy Systems)‖, Alpha Science International Ltd., 2007.

2. 2. M. H. Rashid, ―Simulation of Electric and Electronic circuits using PSPICE‖, M/s PHI Publications.

3. PSPICE A/D user‘s manual – Microsim, USA.

4. PSPICE reference guide – Microsim, USA. 5. MATLAB and its Tool Books user‘s manual and – Math works, USA.

Online Learning Resources/Virtual Labs:

http://vlabs.iitb.ac.in/vlabs-ev/labs/mit_bootcamp/power_electronics/labs/index.php

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

B. Tech III Year I Semester

23EEE208 ANALOG AND DIGITAL CIRCUITS LABORATORY

		L	T	P	C
Pre-requisite:	23EEE111	**0**	**0**	**3**	**1.5**

Course Objectives:

1. To study the characteristics and applications of semiconductor diodes and transistors.
2. To design and analyze rectifiers, amplifiers, and oscillator circuits.
3. To implement basic Op-Amp applications. and implement combinational and sequential logic circuits.
4. To utilize universal gates for logic circuit realization and clock generation.
5. To design and implement essential digital components like adders, multiplexers, flip-flops, encoders, and decoders.

ANALOG CIRCUITS List of Experiments: (Any 06 Experiments are to be conducted)

1. CB Characteristics
2. CE Characteristics
3. CE Amplifier
4. CC Amplifier
5. Clippers
6. Clampers
7. RC Phase shift oscillator
8. Astable multivibrator
9. Monostable multivibrator
10. Triangular wave generator.
11. A to D Converter
12. D to A Converter
13. Op-Amp Applications-Adder, subtractor, comparator

DIGITAL CIRCUITS List of Experiments: (Any 6 Experiments are to be conducted)

1. Realization of Boolean Expressions using Gates
2. Design and realization of logic gates using universal gates
3. Generation of a clock using NAND / NOR gates
4. Design a 4–bit Adder / Subtractor
5. Design and realization of a 4-bit Gray to Binary and Binary to Gray Converter

6. Design and realization of 8x1 MUX using 2x1 MUX
7. Design and realization of a 4-bit comparator
8. Design and realization of Flip-Flops.
9. Design and realization of Encoders
10. Design and realization of Decoders
11. Design and realization of a 4-bit ripple counter.

Course Outcomes:

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

1. Interpret the characteristics of diodes and transistors for circuit design. **L3**
2. Construct and evaluate rectifiers, amplifiers, and oscillator circuits**. L3**
3. Implement basic Op-Amp applications, combinational and sequential circuits using logic gates**. L4**
4. Design digital systems using universal gates, multiplexers, and comparators. **L4**
5. Develop and realize fundamental digital components such as adders, converters, flip-flops, encoders, and decoders. **L4**

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

B. Tech III Year II 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

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III Year II Semester

B. Tech III Year II Semester

23EEE113 ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

	L	T	P	C
Pre-requisite: 23EEE101, 23EEE102, 23EEE104	**3**	**0**	**0**	**3**

Course Objectives:

1. To study about the working principle of electrical measuring instruments.
2. To study the performance of instrumental transformers, power factor, frequency and energy meters,
3. To study the functioning of DC and AC bridges,
4. To study the basics of digital volt meters and transducers,
5. To understand the concept of sensors and data acquisition systems

UNIT I MEASURING INSTRUMENTS & DIGITAL METERS 9 hours

Fundamentals: True Value, Errors (Gross, Systematic, Random); Static Characteristic of Instruments (Accuracy, Precision, Sensitivity, Resolution & threshold); Error Analysis- Simple problems; Statistical treatment of data-Simple problems. **Indicating Instruments:** Three forces in Electromechanical indicating instrument (Deflecting, controlling & damping forces); Moving iron type (attraction and repulsion), PMMC, Electrodynamometer Type instruments: Torque equation (Expression only, no derivation), shape of scale – simple problems on torque equations; Measurement of voltage and current - Extension of Range of ammeter and voltmeter – problems on extension of range of ammeter and voltmeter. Digital Measurement Systems: Structure and working of digital voltmeters, ammeters, multimeters. Smart Meters: Basic structure, functionalities (real-time data logging, load profiling, communication protocols). Non-invasive Measurement: Clamp meters, Hall effect-based sensors

UNIT II MEASUREMENT OF POWER, POWER FACTOR AND ENERGY: 9 hours

Instrument transformers: Types, CT and PT – Ratio and phase angle errors; (Expression only, no derivation)

Measurement of power: Principle and Operation of Single-phase dynamometer wattmeter, expression (Expression only no derivation) for deflecting and control torques, errors and compensations. **Measurement of power factor:** Principle and operation of Single-phase Electrodynamometer Power factor meter.

Measurement of Frequency: Principle and Operation of single phase frequency meter- vibrating reed type, - ferro dynamic type meter.

Measurement of Energy: Principle and Operation of Single phase induction type energy meter, driving and braking torques (expression only no derivation), errors and compensations, testing by phantom loading.

Digital Power/Energy Meters: Working principles, advantages, role in energy management

Intelligent Electronic Devices (IEDs): Role in protection, metering, and control.

Phasor Measurement Units (PMUs): Synchrophasor concept, GPS synchronization, applications in WAMS.

UNIT III D.C & A.C BRIDGES 9 hours

Measurement of Resistance: Methods of measuring low, medium and high resistances –Sensitivity of Whetstone‘s bridge– Kelvin‘s double bridge for Measuring low resistance, Megger for measurement of high resistance.

Measurement of Inductance: - Maxwell‘s bridge, Anderson‘s bridge.

Measurement of Capacitance: De Sauty bridge. Wien‘s bridge–Scheringbridge–Numerical problems

UNIT IV DIGITAL VOLT METERS AND TRANSDUCERS 9 hours

Digital Voltmeters: Ramp type, Dual Slope integrating type, successive approximation, Potentiometric type DVMs.

Classification of transducers: Active/passive, analog/digital- Strain Gauge-gauge factor (Elementary treatment only)-applications of strain gauge, Q-Meter.

UNIT V TRANSDUCERS, SENSORS AND DATA ACQUISTION 9 hours

Definition of Transducers, Classification of Transducers, Advantages of Electrical Transducers, Characteristics and Choice of Transducers; Principle Operation of Resistor, Inductor and Capacitive Transducers; LVDT and its Applications, Strain Gauge and Its Principle of Operation, Gauge Factor, Thermistors, Thermocouples, Piezo Electric Transducers, Photo electric Transducers, Hall effect, Photo Diodes. Optocoupler.

Silicon based micro sensors: Pressure sensor, Gyro sensor, Accelerometer, Flow sensor, Proximity sensor, Temperature sensor, Humidity sensor. (Elementary treatment only)

Introduction to PLC and SCADA Systems: Data acquisition systems (DAS) and interfacing techniques

Course Outcomes:

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

CO1: Understand and analyze the principles, characteristics, and error handling in conventional and digital measuring instruments.

CO2: Apply modern measurement techniques using smart meters, PMUs, IEDs, and non-invasive sensors in industrial and smart grid environments.

CO3: Understand the principle and working of various DC and AC bridges for the measurement of Resistance, Inductance and Capacitance.

CO4: Understand the principle and working of different digital voltmeters and transducers.

CO5: Understand the working of various sensors and data acquisition systems.

Text Books:

1. Electrical & Electronic Measurement & Instruments by A.K. Sawhney Dhanpat Rai & Co. Publications, 2007.
2. Electrical Measurements and measuring Instruments–by E.W.Golding and F.C. Widdis, 5th Edition, Reem Publications, 2011.
3. Buckingham and Price, ―Electrical Measurements‖, Prentice – Hall

Reference Books:

1. Electronic Instrumentation by H.S.Kalsi,Tata Mcgrawhill, 3rd Edition, 2011.
2. Electrical Measurements: Fundamentals, Concepts, Applications–by Reissl and, M.U, New Age International (P) Limited, 2010.
3. Electrical & Electronic Measurement & Instrumentation by R.K.Rajput, 2nd Edition, S. Chand & Co., 2nd Edition, 2013.
4. Sensor Technology: Hand Book by JonS. Wilson, ELSEVIER publications,2005

Online Learning Resource:

1. https://onlinecourses.nptel.ac.in/noc22_ee112/preview

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

B. Tech III Year II Semester

23EEE114 MICROPROCESSORS AND MICROCONTROLLERS

	L	T	P	C
Pre-requisite: 23EEE101, 23EEE106	**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 MICROCONTROLLER **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 INTERFACING MICROCONTROLLER **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:

At the end of this course students will demonstrate the ability 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. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rdEdition,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 II Semester

23EEE115 POWER SYSTEM ANALYSIS

	L	T	P	C
Pre-requisite: 23EEE107, 23EEE112	**3**	**0**	**0**	**3**

Course Objectives:

1. The use of per unit values and graph theory concepts, solving a problem using computer.
2. Formation of Ybus and Zbus of a Power System network, power flow studies by various methods.
3. Different types of faults and power system analysis for symmetrical and also unsymmetrical faults.
4. Analysis of power system for steady state and transient stability and also methods to improve stability

UNIT I PER-UNIT SYSTEM AND YBUS FORMATION 9 hours

Per-Unit representation of Power system elements - Per-Unit equivalent reactance network of a three phase Power System - Graph Theory: Definitions, Bus Incidence Matrix, Y Bus formation by Direct and Singular Transformation Methods, Numerical Problems.

UNIT II FORMATION OF Z BUS 9 hours

Formation of ZBus: Partial network, Algorithm for the Modification of Z Bus Matrix for addition element for the following cases: Addition of element from a new bus to reference, Addition of element from a new bus to an old bus, Addition of element between an old bus to reference and Addition of element between two old busses - Modification of Z Bus for the changes in network

UNIT III POWER FLOW ANALYSIS 9 hours

Static load flow equations – Load flow solutions using Gauss Seidel Method: Algorithm and Flowchart. Acceleration Factor, Load flow Solution for Simple Power Systems (Max. 3-Buses): Newton Raphson Method in Polar Co-Ordinates Form: Load Flow Solution- Jacobian Elements, Algorithm and Flowchart. Decoupled and Fast Decoupled Methods.- Comparison of Different Methods

UNIT IV SHORT CIRCUIT STUDIES 9 hours

Short Circuit Current and MVA Calculations, Fault levels, Application of Series Reactors. Symmetrical Component Theory: Positive, Negative and Zero sequence components, Positive, Negative and Zero sequence Networks. Symmetrical Fault Analysis: LLLG faults with and without fault impedance, Unsymmetrical Fault Analysis: LG, LL and LLG faults with and without fault impedance, Numerical Problems.

UNIT V STABILITY ANALYSIS 9 hours

Elementary concepts of Steady State, Dynamic and Transient Stabilities. Derivation of Swing Equation, Power Angle Curve and Determination of Steady State Stability. Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation. Numerical methods for solution of swing equation - Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers. Wide-Area Monitoring, Protection, and Control (WAMPAC) Systems:

System-level stability improvement, Detection of oscillations and disturbances, Applications in early warning systems and post-fault analysis.

Course Outcomes:

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

CO1: Remember and understand the concepts of per unit values, Y Bus and Z bus formation, load flow studies, symmetrical and unsymmetrical fault calculations.

CO2: Apply the concepts of good algorithm for the given power system network and obtain the converged load flow solution and experiment some of these methods using modern tools and examine the results.

CO3: Analyse the symmetrical faults and unsymmetrical faults and done the fault calculations, analyse the stability of the system and improve the stability.

CO4: Demonstrate the use of these techniques through good communication skill.

CO5: Develop accurate algorithms for different networks and determine load flow studies and zero, positive and negative sequence impedances to find fault calculations.

Text Books:

1. Computer Methods in Power System Analysis by G.W.Stagg and A.H.El-Abiad, Mc Graw-Hill, 2006

2. Modern Power system Analysis by I.J.Nagrath&D.P.Kothari, Tata McGraw-Hill Publishing Company, 4th Edition, 2011.

Reference Books:

1. Power System Analysis by Grainger and Stevenson, McGraw Hill, 1994.

2. Power System Analysis by Hadi Saadat, McGraw Hill, 1998.

3. Power System Analysis and Design by B.R.Gupta, S. Chand & Company, 2005.

Online Learning Resource:

1. https://onlinecourses.nptel.ac.in/noc22_ee120/preview

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

B. Tech III Year II Semester

23EEE209 ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LABORATORY

	L	T	P	C
Pre-requisite: 23EEE113	**0**	**0**	**3**	**1.5**

Course Objectives:

1. Calibration of various electrical measuring instruments
2. Accurate determination of inductance and capacitance using AC Bridges
3. Measurement of resistance for different range of resistors using bridges
4. Performance of transducers and sensors

CHOOSE ANY TEN FROM THE FOLLOWING LIST:

1. Measurement of resistance using Wheatstone bridge and Kelvin‘s Double Bridge.
2. Measurement of inductance using Maxwell‘s bridge, Anderson bridge.
3. Measurement of capacitance using De-Sauty's bridge, Schering bridge.
4. Calibration of single phase energy meter using direct loading method.
5. Calibration of energy meter using Phantom load kit.
6. Measurement of Power using 3-Voltmeter and 3-Ammeter methods in a single phase Circuit.
7. Measurement to Real and Reactive Power in a three phase circuit.
8. Extension of range of given Ammeter and Voltmeter.
9. Measurement of displacement using LVDT.
10. Study of CRO: Measurement of voltage, current, frequency using lissajous patterns.
11. Measurement of different ranges of temperatures using i)RTD ii)Thermocouple
12. Measurement of strain with the help of strain gauge transducers

Course Outcomes:

At the end of the course students will be able to

CO1: Determine the unknown Resistance, Inductance and Capacitance using AC and DC bridges.-L3
CO2: Understand the calibration of single phase energy meter.-L2
CO3: Understand the measurement of power, power factor in a single phase circuit and real, reactive Power in a three phase circuit. -L2
CO4: Extend the range of Ammeter and Voltmeter. -L5
CO5: Understand the working of Transducers, Measure distance, temperature, current, voltage and humidity using sensors. -L2

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

B. Tech III Year II Semester

23EEE210 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

	L	T	P	C
Pre-requisite: 23EEE114	**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. Train their practical knowledge through laboratory experiments.
4. To understand and learn 8051 Microcontroller.
5. To acquire knowledge on microprocessors and microcontrollers, interfacing various peripherals, and configuring.

List of Experiments: (Any TEN of the experiments are to be conducted)

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 no_s.

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. Interfacing Stepper Motor with 8086

a) Write an ALP to 8086 processor to Interface a stepper motor and operate it in clockwise by choosing variable step-size.

b) Write an ALP to 8086 processor to Interface a stepper motor and operate it in Anti-clockwise by choosing variable step-size.

7. Interfacing ADC/DAC with 8086
a) Write an ALP to 8086 processor to Interface ADC.
b) Write an ALP to 8086 processor to Interface DAC and generate Square Wave/Triangular Wave/Step signal.

8. Communication between Two Microprocessors
a) Write an ALP to have Parallel communication between two microprocessors using 8255
b) Write an ALP to have Serial communication between two microprocessor kits using 8251.

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

10. Programs to Verify Timers/Counters of 8051
a) Write a program to create a delay of 25msec using Timer0 in mode 1 and blink all the Pins of P0.
b) Write a program to create a delay of 50 µsec using Timer1 in mode 0 and blink all the Pins of P2.
c) Write a program to create a delay of 75msec using counter0 in mode 2 and blink all the Pins of P1.
d) Write a program to create a delay of 80 µsec using counter1 in mode 1 and blink all the Pins of P3.

11. UART Operation in 8051
a) Write a program to transfer a character serially with a baud rate of 9600 using UART.
b) Write a program to transfer a character serially with a baud rate of 4800 using UART.
c) Write a program to transfer a character serially with a baud rate of 2400 using UART.

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.

Course Outcomes:
At the end of this course, the students will be able to
CO1: Formulate a program and implement algorithms using Assembly language.
CO2: Describe an Assembly language program for the 8086 Microprocessor.
CO3: Develop programs for different applications in the 8086 Microprocessor.
CO4: Interface peripheral devices with 8086 and 8051.
CO5: Use an Assembly/Embedded C programming approach for solving real-world problems.

Reference Books:
1. Kenneth.J.Ayala. The 8051 microcontroller, 3rd edition, Cengage learning,2010.
2. Advanced microprocessors and peripherals-A.K ray and K.M.Bhurchandani, TMH, 2nd edition2006.
3. The 8051 Microcontroller and Embedded Systems: Using Assembly and C by Muhammad AliMazidi, Janice Gillispie Mazidi, Second Edition.

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

B. Tech III Year I 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

Course Description:

The goal of this course is to expose the under graduate students regarding different types of disasters and 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 of lives, and livestock's. 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 aware the students about disasters and their impact on living beings.
2. To ensure the students for the understanding on 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 the disaster risk mitigation.

UNIT I INTRODUCTION **6 hours**

Introduction, Etymology of disaster, Concepts and definitions: disaster, hazard, vulnerability, risks, Resilience, prevention and mitigation.

UNIT II TYPES OF DISASTERS **6 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 **6 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 **6 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 **6 hours**

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, landuse 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 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

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 Introduces 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 initiates students in basics of functional design and drawing of the various buildings using the above concepts.

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 bylaws
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 form 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 for Green Building.
CO3: Compute thermal flow through different building elements.
CO4: Identify energy efficient building materials.
CO5: Compute cost of building/operation and maintenance.

Text Books:

1. Krishnan, A., Baker, N., Yannas, S., & Szokolay, S. (Eds.). (2001).
2. Climate responsive architecture, a design handbook for energy efficient buildings. New Delhi: Tata McGraw Hill Publishing Company.
3. 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

23ECE301 BIO-MEDICAL ELECTRONICS

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
This course provides the fundamental knowledge on applications of electronics in bio-medical signal measurements and processing, bio-medical instrumentation and imaging techniques.

Course Objectives:
This course enables students to

1. Acquire the basic knowledge on human physiology and biological transducers.
2. Learn about bio-electrodes and bio-amplifiers used in bio-signal acquisition.
3. Understand the working principle of bio-medical measuring instruments.
4. Study various types of imaging techniques used in medicine.
5. Learn the applications of medical instrumentation in designing artificial medical aids

UNIT I HUMAN PHYSIOLOGY AND BIOMEDICAL TRANSDUCERS 9 hours

Introduction to human physiology - Biomedical transducers for measuring displacement, velocity, force, acceleration, potential, dissolved ions and gases.

UNIT II BIO-ELECTRODES AND AMPLIFIERS 9 hours

Introduction to bio-potential, Bio-electrodes, Typical waveforms and characteristics of ECG, EMG and EEG, Bio-potential amplifiers for ECG, EMG and EEG – Lead systems and recording methods.

UNIT III BIOMEDICAL MEASURING INSTRUMENTS 9 hours

Measurement of blood pressure and temperature, Blood flow meter, Cardiac output measurement, Respiratory measurement, Blood cell counter, Impedance plethysmography.

UNIT IV MEDICAL IMAGING 9 hours

X-ray, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear imaging, Ultrasonic Imaging.

UNIT V PROSTHESES AND AIDS 9 hours

Pacemakers, Defibrillators, Heart-lung machine, Artificial kidney, Aids for the handicapped, Safety aspects

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

CO1: Understand the applications of biological transducers in medical field.

CO2: Analyze the design of bio-electrodes and bio-amplifiers.

CO3: Apply suitable measuring instruments to measure various medical parameters.

CO4: Understand and test various imaging techniques used in bio-medical diagnosis.

CO5: Analyze the applications of artificial medical aids.

Text Books:

1. W.F. Ganong, Review of Medical Physiology, 26th Edition, Tata McGraw-Hill, New Delhi, 2019.
2. J.G. Websster, ed., Medical Instrumentation, 3rd Edition, Wiley India Pvt. Ltd. 2009

Reference Books

1. A.M. Cook and J.G. Webster, eds., Medical Devices and Human Engineering, Taylor & Francis, 2014
2. R.S.Khandpur,"Handbook of Biomedical Instrumentation", 2nd edition, Tata McGraw - Hill, New Delhi, 2005
3. LeslieCromwell,"BiomedicalInstrumentationandMeasurement",Prentice-Hall, New Delhi, 2011.

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

Open Elective – I

23ECE302 VLSI DESIGN

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Description:
This course describes about various VLSI design methodologies, fundamentals of CMOS technology. It incorporates basics of MOSFET models, CMOS design rules, Design of VLSI Systems, combinational logic design, sequential logic design, logic families and VLSI Design flow.

Course Objectives:
This course enables students to

1. Study the fundamentals of CMOS circuits and its characteristics
2. Learn the design and realization of combinational digital circuits.
3. Learn the design and realization of sequential digital circuits.
4. Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
5. Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9 hours

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9 hours

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.
Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9 hours

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.
Timing Issues: Timing Classification Of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9 hours

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.
Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9 hours

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan

Course Outcomes:

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

CO1: Realize the concepts of digital building blocks using MOS transistor.

CO2: Design combinational MOS circuits and power strategies

CO3: Design and construct Sequential Circuits and Timing systems.

CO4: Design arithmetic building blocks and memory subsystems.

CO5: Apply and implement FPGA design flow and testing.

Text Books:

1. Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson , 2017.
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits:A Design perspective", Second Edition , Pearson , 2016.

Reference Books

1. Operating Systems - Internals and Design Principles. Stallings, 6th Edition2009. Pearson education.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Prentice Hall, 2011.

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

Open Elective – I

23CSE301 JAVA PROGRAMMING

		L	T	P	C
Pre-requisite	**23CSE101**	**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, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class-Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, 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_01288046454761881634 7_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

23EEE401 AI AND ML FOR ELECTRICAL ENGINEERING

	L	T	P	C
Pre-requisite:	**3**	**0**	**0**	**3**

Course Objectives:

1. To introduce the fundamentals, architectures, and approaches of Artificial Intelligence in engineering systems.
2. To understand the principles, models, and learning algorithms of Machine Learning including supervised and unsupervised techniques.
3. To explore the structure, training, and applications of Artificial Neural Networks in real-world scenarios.
4. To learn the fundamentals and implementation of Fuzzy Logic systems for decision-making and control.
5. To apply AI and ML techniques for solving Electrical Engineering problems such as load forecasting, control, and optimization.

UNIT I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9 hours

Introduction and motivation - Approaches to AI - Architectures of AI - Symbolic Reasoning System - Rule based Systems - Knowledge Representation - Expert Systems.

UNIT II OVERVIEW OF MACHINE LEARNING 9 hours

The Motivation & Applications of Machine Learning: Learning Associations, Classification, Regression; Supervised Learning; Unsupervised Learning; Reinforcement Learning; Gradient Descent: Batch Gradient Descent, Stochastic Gradient Descent; Data pre processing; Under fitting and Overfitting issues

UNIT III ARTIFICIAL NEURAL NETWORKS 9 hours

Basics of ANN - Comparison between Artificial and Biological Neural Networks - Basic Building Blocks of ANN - Artificial Neural Network Terminologies - McCulloch Pitts Neuron Model - Learning Rules - ADALINE and MADALINE Models - Perceptron Networks (Continuous and Discrete) – Perceptron Convergence Theorem - Back Propagation Neural Networks - Associative Memories – BAM and Hopfield networks.

UNIT IV FUZZY LOGIC 9 hours

Classical Sets - Fuzzy Sets - Fuzzy Properties, Operations and relations - Fuzzy Logic System - Fuzzification - Defuzzification - Membership Functions - Fuzzy Rule base - Fuzzy Logic Controller Design.

UNIT V APPLICATIONS OF AI TECHNIQUES: 9 hours

Load forecasting, Load flow studies, Economic load dispatch, Speed control of DC Motor, Speed Control of Induction Motors.

Course Outcomes:

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

CO1: Understanding the Basics and Architecture of Artificial Intelligence
CO2: Analyzing and Applying Artificial Neural Networks (ANN) Concepts
CO3: Implementing ANN Applications in Real-World Problems
CO4: Understanding and Applying Fuzzy Logic Concepts
CO5: Designing and Implementing Fuzzy Logic Applications

Text Books:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Neural Networks using MATLAB", McGraw Hill Edition, 2006.

2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, WILEY India Edition, 2012.

Reference Books:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using MATLAB", Springer International Edition, 2013.

2. Yung C. Shin and Chengying Xu, "Intelligent System - Modeling, Optimization & Control, CRC Press, 2009.

3. Kevin P. Murphy, ―Machine Learning: A Probabilistic Perspective‖, MIT Press, 2012

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

Professional Elective – II

23EEE402 PROGRAMMABLE LOGIC CONTROLLERS

	L	T	P	C
Pre-requisite: 23EEE111	**3**	**0**	**0**	**3**

Course Objectives:

The student will be able to:

1. Understand the basic functions and types of PLCs, Easy Veep software, its applications
2. Understand Classification of PLCs and applications
3. Design PLC Programming for various applications
4. Analyze PLC Troubleshooting aspects

UNIT I INTRODUCTION TO PLCs 9 hours

Basic functions of PLCs, Mechanical relays versus PLC, Different types of PLC‘s – Allen-Bradley – Micrologix: ML1000, ML1100, SLC500, Compact Logix, Mitsubishi FX series, HMI‘s, Processor and I/O cards

UNIT II PLC COMPUTATIONAL TOOL 9 hours

Introduction to Easy Veep software, Link between mechanical, electrical and programming documentation, Logic diagrams, Flip-Flop Logic, M8000, M8001 internal bits interpretation, Binary code, data table, manipulation and search engine in Mitsubishi environment Communication between PC and PLC, Communication between PC and HMI, PLC and HMI Serial Local network, Introduction to SLC500.

UNIT III PLC DEVELOPMENT 9 hours

PLC software and applications, Boolean algebra – understanding binary code, ADD and SUB functions, UP and Down Counters, Introduction to k1Y0, MOV function, CPR and ZCP functions, SHWT and SHRD instructions, Introduction to Absolutely Drum Instruction.Allen Bradley PLC: Introduction to Rockwell Software, Hardware focus, Hardware considerations (Field wiring, Master Control Relay, VFD), Basic programming and applications, Cascade control – subroutine, Different programs.

UNIT IV PLC PROGRAMMING 9 hours

Programming instructions: Instructions and binary interpretation, Bit Instruction, Timers and counters, Comparison instructions, Programming Instructions - Math instructions, Move and Logical Instructions, Discussions of programming, communications for PLC-Robotic arm, Exercise of setup and monitoring.

UNIT V APPLICATIONS 9 hours

Analog and Digital parameters by using SLC5/03-VFD-Panel Mate series 1700, Practical Troubleshooting, troubleshooting technique, Control system stability and tuning basics. Applications: Process to rewind, test, and integrate with extrusion process for wiring and fibre optic industries, Food industry – yeast, flour distribution and control. Process Medical equipment Industry – Gas analyzer, Leak tester (using CO2), plastic wrapping machines etc.

Course Outcomes:

CO1: Understand different types of PLCs, Its classification and the usage of Easy Veep software
CO2: Analyze the hardware details of Allen Bradley PLC
CO3: Design PLC Programming for various applications
CO4: Apply PLC programming concepts in different fields of Science and Technology
CO5: Develop Instruction using ADD and SUB functions, UP and Down counters

Text Books:

1. Automating manufacturing systems with PLCs by Hugh Jack, 2010.
2. PLC Hand Book (Automation direct Siemens)

Reference Books:

1. Programmable Logic Controllers by R. Bliesener, F Ebel, Festo. Didactic publishers, 2002.
2. Programmable Logic Controllers by W. Bolton, 4th Edition, Newnes, 2006.
3. Introduction to PLCs by Jay F. Hooper, 2nd Edition, Carolina Academic Press, 2006.

Online Learning Resource:

1. https://nptel.ac.in/courses/108105088

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

Professional Elective – II

23EEE403 ELECTRIC DRIVES

	L	T	P	C
Pre-requisite: 23EEE105, 23EEE108, 23EEE110	**3**	**0**	**0**	**3**

Course Objectives:

1. To introduce the fundamentals and classifications of electrical drives and their operational principles.
2. To study controlled rectifier-fed DC drives and analyze their dynamic and steady-state performance.
3. To explore chopper-controlled DC drives and their control strategies.
4. To examine variable frequency-controlled induction motor drives and slip power recovery systems.
5. To understand synchronous and stepper motor drive systems and their industrial applications.

UNIT I INTRODUCTION TO ELECTRIC DRIVES 9 hours

Electrical drives — block diagram, advantages of electric drive, parts of electric drives, choice of electrical drives, the status of DC and AC drives. Dynamics of electrical drives-fundamental torque equations, speed-torque conventions, and multi-quadrant operation; Equivalent values of drive parameters - loads with rotational and translational motion; Load torques — components, nature and classification. Concept of steady-state stability. Electric braking methods — regenerative, dynamic and plugging. Modes of operation of electrical drives — steady state, acceleration including starting and deceleration including stopping. Speed control and drive classifications, closed-loop control of drives — current limit control, torque control, speed control and position control (Block diagram only). Applications of electric drives in electric vehicles (EVs)**,** metro trains, and industrial automation systems

Overview of drive requirements for high torque and variable-speed applications

UNIT II SINGLE-PHASE AND THREE PHASE CONVERTER FED DC DRIVES 9 hours

Control of DC separately excited motor by single-phase and three-phase half and full bridged converters — voltage and current waveforms for continuous and discontinuous conduction, speed-torque expressions and characteristics. Single phase half-controlled rectifier fed DC series motor — voltage and current waveforms for continuous and discontinuous conduction, speed-torque expressions and characteristics. Multi-quadrant operation of DC separately excited DC motor fed from fully controlled rectifier - mechanical reversible switch in armature, dual converter and field current reversal. Use of converter-fed DC drives in electric propulsion systems, conveyors, and cranes. Harmonic issues and mitigation in transport drive systems

UNIT III DC CHOPPER FED DRIVES 9 hours

Control of DC separately excited motor by one ,two and four quadrant choppers - voltage and current waveforms for continuous conduction (motoring, regenerative and dynamic braking), speed-torque expressions and characteristics. Chopper control of DC series motor—operation, speed-torque expressions and characteristics. Closed loop chopper control of separately excited DC motor (Block diagram only). Regenerative braking in EVs using chopper drives. Real-world applications in e-bikes, AGVs, and battery-powered trains

UNIT IV INDUCTION MOTOR DRIVES 9 hours

Three phase induction motors — Introduction, Stator variable voltage control — speed-torque characteristics, AC voltage controllers and efficiency of induction motor under voltage control. Stator variable voltage and variable frequency control — slip speed control, torque-power limitations and modes of operation. Voltage Source Inverters (VSIs) and Current Source Inverters (CSIs) fed induction motor and closed loop operation of induction motor drives (Block diagram only).Comparison of VSI and CSI fed drives. Static rotor resistance control, slip power recovery schemes – static scherbius and kramer drive, speed-torque characteristics. Application of inverter-fed IM drives in metro rail, HVAC systems, and industrial lifts. Energy efficiency considerations in large-scale drive systems

UNIT V SYNCHRONOUS AND STEPPER MOTOR DRIVES 9 hours

Synchronous Motor Drives: Separate control and self-control of synchronous motors — operations of self-controlled synchronous motors by VSI and CSI. Load commutated CSI fed Synchronous motor—operation and speed torque characteristics. Closed loop control operation of synchronous motor drives (Block diagram only). Stepper Motor Drives: Variable reluctance and permanent magnet operation — features of stepper motor — torques Vs stepping rate characteristics and drive circuits. BLDC motor operation and control. Application of synchronous and BLDC drives in drones, autonomous vehicles, EV powertrains, and maglev systems.

Course Outcomes:

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

CO1: Understand the fundamental principles, characteristics, and dynamic performance of electric drives in industrial and transport applications..

CO2: Analyze the behavior of DC motor drives fed through single-phase and three-phase converters used in electric propulsion and automated systems.

CO3: Evaluate the performance and control of chopper-fed DC drives with emphasis on regenerative braking in electric mobility systems.

CO4: Analyze the operation and control of induction motor drives using VSI and CSI, with applications in metro rail and industrial HVAC systems.

CO5: Apply control strategies for synchronous, BLDC, and stepper motor drives, focusing on smart transportation systems such as EVs, drones, and AGVs.

Text Books:

1. Gopal K. Dubey, Fundamentals of Electric Drives, Narosa Publications, Alpha Science International Ltd, 2nd Edition, 2002.

2. M. H. Rashid (2003), Power Electronic Circuits, Devices and applications, 3rd edition, Prentice Hall of India, New Delhi, India.

3. Krishnan, Ramu. Electric motor drives: modeling, analysis, and control, 1st Edition, Pearson, 2015.

4. Austin Hughes & Bill Drury, "Electric Motors and Drives: Fundamentals, Types and Applications", 5th Edition, Newnes (Elsevier).

Reference Books:

1. M. D. Singh, K. B. Khanchandani (2008), Power Electronics, 2nd Edition, Tata McGraw Hill Publications, New Delhi.
2. VedamSubramanyam (2008), Thyristor Control of Electric drives, 1st Edition, Tata McGraw Hill Publications, New Delhi, India.
3. S. K. Pillai (2007), A First course on Electrical Drives, 2nd Edition, New Age International (P) Ltd., NewDelhi
4. P.C. Sen, Principles of Electrical Machines and Power Electronics, Wiley, 3rdEdition, 2013.

Online Learning Resource:

1. https://web.iitd.ac.in/~amitjain/Drives_VTR.pdf
2. https://sde.uoc.ac.in/sites/default/files/sde_videos/Electrical%20Drives%20and%20Controls_0.pdf
3. https://nptel.ac.in/courses/108/104/108104140/
4. https://nptel.ac.in/courses/108/102/108102046/
5. https://swayam.gov.in/nd1_noc19_ee65/preview

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

Professional Elective – III

23EEE404 COMMUNICATION SYSTEMS

		L	T	P	C
Pre-requisite:	23EEE106	**3**	**0**	**0**	**3**

Course Objectives:

1. To understand the fundamentals of communication systems and amplitude modulation techniques.
2. To learn about the angle modulation techniques and bandwidth considerations in communication systems.
3. To gain knowledge on pulse analog modulation and multiple access techniques used in digital communication systems.
4. To examine pulse modulation and digital modulation techniques used in modern communication systems.
5. To study wireless communication systems, cellular networks, and GSM technology.

UNIT I ANALOG COMMUNICATION-I 9 hours

Elements of communication systems, need for Modulation, Modulation Methods, Baseband and carrier communication Amplitude Modulation (AM), Generation of AM signals, Rectifier detector, Envelope detector, sideband and carrier power of AM, Double side band suppressed carrier (DSB-SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Single sideband (SSB) transmission, VSB Modulation.

UNIT II ANALOG COMMUNICATION-II 9 hours

Angle Modulation & Demodulation: Concept of instantaneous frequency Generalized concept of angle modulation, Bandwidth of angle modulated waves- Narrow band frequency modulation (NBFM); and Wide band FM (WBFM), Phase modulation, Pre-emphasis & De-emphasis, Illustrative Problems.

UNIT III DIGITAL COMMUNICATIONS-I (Qualitative Approach Only): 9 hours

Pulse analog modulation techniques, Generation and detection of Pulse amplitude modulation, Pulse width modulation, Pulse position modulation

Multiple Access Techniques: Introduction to multiple access techniques, FDMA, TDMA, CDMA, SDMA: Advantages and applications

UNIT IV DIGITAL COMMUNICATIONS-II (Qualitative Approach Only) 9 hours

Pulse Code Modulation, DPCM, Delta modulation, Adaptive delta modulation, Overview of ASK, PSK, QPSK, BPSK and M-PSK techniques.

UNIT V WIRELESS COMMUNICATIONS (Qualitative Approach Only) 9 hours

Introduction to wireless communication systems, Examples of wireless communication systems, comparison of 2G and 3G cellular networks, Introduction to wireless networks, Differences between wireless and fixed telephone networks, Introduction to Global system for mobile (GSM), GSM services and features.

Course Outcomes:

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

CO1: Understand the fundamentals of communication systems and amplitude modulation techniques.

CO2**:** Learn about the angle modulation techniques and bandwidth considerations in communication systems.

CO3: Gain knowledge on pulse analog modulation and multiple access techniques used in digital communication systems.

CO4**:** Get familiar with pulse modulation and digital modulation techniques used in modern communication systems.

CO5: Know about wireless communication systems, cellular networks, and GSM technology.

Text Books:

1. H Taub, D. Schilling and Gautam Sahe, ―Principles of Communication Systems‖, TMH, 2007, 3rd Edition.

2. George Kennedy and Bernard Davis, ―Electronics & Communication System‖, 4th Edition, TMH 2009.

3. Wayne Tomasi, ―Electronic Communication System: Fundamentals Through Advanced‖, 2nd edition, PHI,2001.

Reference Books:

1. Simon Haykin, ―Principles of Communication Systems‖, John Wiley, 2nd Edition.

2. Sham Shanmugam, ―Digital and Analog communication Systems‖, Wiley-India edition,2006.

3. Theodore. S.Rapport, ―Wireless Communications‖, Pearson Education, 2nd Edition,2002.

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

Professional Elective – III

23EEE405 SWITCHGEAR AND PROTECTION

	L	T	P	C
Pre-requisite: 23EEE101, 23EEE107, 23EEE112	**3**	**0**	**0**	**3**

Course Objectives:

1. The study of different Circuit Breakers and Relays.
2. The protection of Generators and Transformers.
3. To discuss the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
4. The protection of various feeder bus bars from abnormal conditions and over voltages & importance on neutral grounding for overall protection.

UNIT I CIRCUIT BREAKERS 9 hours

Circuit Breakers: Elementary principles of arc interruption, Recovery, Restriking Voltage and Recovery voltages - Restriking Phenomenon, Average, Max. RRRV, Current Chopping and Resistance Switching - CB ratings and Specifications, Selection of CB: Types and Numerical Problems. – Auto reclosures. Description and Operation of- Minimum Oil Circuit breakers, Air Blast Circuit Breakers, Vacuum and SF6 circuit breakers

UNIT II ELECTROMAGNETIC, STATIC AND NUMERICAL RELAYS 9 hours

Basic Requirements of Relays – Primary and Backup protection - Construction details of – Attracted armature, balanced beam, inductor type and differential relays – Universal Torque equation – Characteristics of over current, Direction and distance relays. Static Relays – Advantages and Disadvantages – Definite time, Inverse and IDMT static relays – Comparators – Amplitude and Phase comparators. Microprocessor based relays – Advantages and Disadvantages – Block diagram for over current (Definite, Inverse and IDMT), Distance Relays, Impedance Relays and Reactance Relays with their Flow Charts.

UNIT III PROTECTION OF GENERATORS AND TRANSFORMERS 9 hours

Protection of generators: Protection of generators against Stator faults, Rotor faults, and Abnormal Conditions. Restricted Earth fault and Inter-turn fault Protection. Numerical Problems on percentage winding unprotected. Protection of transformers: Percentage Differential Protection, Numerical Problem on Design of CTs Ratio, Buchholtz relay Protection.

UNIT IV PROTECTION OF FEEDERS, TRANSMISSION LINES AND BUSBARS 9 hours

Protection of Feeders (Radial & Ring main) using over current Relays. Protection of Transmission lines – 3 Zone protection using Distance Relays. Carrier current protection. Protection of Bus bars - Differential protection, Differential Pilot wire protection.

UNIT V PROTECTION AGAINST OVER VOLTAGES 9 hours

Generation of Over Voltages in Power Systems. -Protection against Lightning Over Voltages - Valve type and Zinc-Oxide Lighting Arresters - Insulation Coordination –BIL. Neutral Grounding, Grounded and Ungrounded Neutral Systems. - Effects of Ungrounded Neutral on system performance. Methods of Neutral Grounding: Solid, Resistance, Reactance – Arcing Grounds and Grounding Practices.

Course Outcomes:

CO1	Understand the working principles and selection criteria of various circuit breakers.
CO2	Analyze the characteristics and operation of electromagnetic, static, and numerical relays.
CO3	Apply appropriate protection methods for generators and transformers under fault conditions.
CO4	Analyze the protection schemes for feeders, busbars, and transmission lines.
CO5	Evaluate protection strategies against overvoltages and grounding practices for power system safety.

Text Books:

1. Switchgear and Protection – by Sunil S Rao, Khanna Publishers.
2. Power System Protection and Switchgear by Badari Ram, D.N Viswakarma, TMH Publications

Reference Books:

1. Protective Relaying Principles and Applications – J Lewis Blackburn, CRC Press.
2. Numerical Protective Relays, Final Report 2004 – 1009704 EPRI, USA.
3. Protective Relaying Theory and Applications - Walter A Elmore, Marcel Dekker.
4. Transmission network Protection by Y.G. Paithankar, Taylor and Francis, 2009.
5. Power System Protection- P. M. Anderson, Wiley Publishers.

Online Learning Resource:

1. https://onlinecourses.nptel.ac.in/noc22_ee101/preview

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

Professional Elective – III

23EEE406 RENEWABLE AND DISTRIBUTED ENERGY TECHNOLOGIES

	L	T	P	C
Pre-requisite: 23EEE101, 23EEE107, 23EEE112	**3**	**0**	**0**	**3**

Course Objectives:

1. To This course explores each of the principal renewable energy sources in turn. Each technology is examined in terms of the relevant physical principles; the main technologies involved; environmental impact; the size of the potential renewable resource; and the future prospects of green energy.
2. This Distributed Generation course is intended to provide knowledge of the benefits of renewable energy generation, availability of distributed generation technology, electricity generation technologies, issues related to grid interconnection, and methods of analyzing the technical and economic feasibility.

UNIT I ENERGY SCENARIO AND SOLAR ENERGY 9 hours

Introduction: Fundamentals of renewable energy sources, Types of energy, Renewable and Non-renewable energy, SWOT analysis, Global warming and climate change, World energy transformation by 2050,Prospects of renewable energy in the world, Renewable energy availability in India.

Solar Energy Fundamentals: Solar Spectrum, propagation of solar radiation from the sun to earth; solarradiation geometry: sun-earth geometry, extra-terrestrial and terrestrial radiation.

Solar Thermal: Solar Collectors, Solar parabolic trough, Solar tower, Solar cooker, Solar water heater, Solardryer, Solar Pond.

Solar Electric Power Generation: A Generic PV Cell, PV Materials, Equivalent Circuits for PV Cells, Modules and Arrays; I-V Curve under Standard Testing Conditions; Impact of Temperature and Insolation on I-V curves; Shading Impacts on I-V curves; Maximum Power Point Trackers (MPPT).

UNIT II WIND AND OTHER ENERGY SYSTEMS 9 hours

Wind Energy: Air, Wind, Global and Local Wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Classification of wind energy conversion system (WECS)- Horizontal axis- single, double and multiblade system. Vertical axis-Savonius and darrieus types.

Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft).

Tidal Power: fundamental characteristics of tidal power, harnessing tidal energy, advantages, and limitations.

UNIT III ENERGY STORAGE AND GREEN ENERGY 9 hours

Energy Storage: Stationary Battery Storage – Basics of Lead-Acid batteries, Battery Storage Capacity, Coulomb efficiency instead of energy efficiency, Battery Sizing. Different Battery storage technologies andcomparison of their performance. Introduction to Super capacitors.

Green Energy: Historical Development, Basic Operation of a Fuel Cell, Fuel Cell Thermodynamics,Entropy and the theoretical efficiency of Fuel Cells, Gibbs Free Energy and Fuel Cell efficiency, Electricaloutput of an Ideal Cell, Electrical Characteristics of Real Fuel Cells, Types of Fuel Cells, H2: Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.

UNIT IV INTRODUCTION TO DG AND ITS GRID INTEGRATION 9 hours

Introduction: Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Siting and sizing of DGs – optimal placement of DG sources in distribution systems.

Grid integration of DGs: Different types of interfaces - Inverter based DGs and rotating machine-based interfaces - Aggregation of multiple DG units. Energy storage elements: Batteries, ultracapacitors,flywheels.

Hybrid Solar-Wind Generation Systems:Architecture and configuration of hybrid systems, Complementary characteristics of solar and wind resources, Grid integration challenges and solutions for hybrid systems.Advantages: Enhanced reliability, improved energy security, load balancing, and better resource utilization.

UNIT V TECHNICAL IMPACT, ECONOMIC AND CONTROL ASPECTS OF DG 9 hours

Technical impacts of DGs: Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems

Economic and control aspects of DGs: Market facts, issues, and challenges - Limitations of DGs. Voltage control techniques, Reactive power control, Harmonics, Power quality issues. Reliability of DG based systems – Steady-state and Dynamic analysis.

Course Outcomes:

CO1: Comprehend the renewable energy scenario, anticipate future energy demand and to understand the abstraction concept of electrical energy from Solar Energy.

CO2: Understand the abstraction concept of electrical energy from wind, bio-mass and Tidal energy sources.

CO3: Understand electrical energy storage along with working of Green Energy.

CO4: Exemplify rudimentary idea of Distributed Generation.

CO5: Comprehend the technical impact, control, and economic aspects of Distributed Generation.

Text Books:

1. 1. Muhammad Kamran, Muhammad Rayyan Fazal, "Renewable Energy Conversion Systems", First Edition, Elsevier Academic Press, 2021.

2. G. D. Rai, Non-Conventional Sources of Energy, Khanna Publisher, 2004

Reference Books:

1. G N Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa, 2002.

2. Mukund R Patel, Wind and Solar Power Systems: Design, Analysis, and Operation, 2

3. H. Lee Willis, Walter G. Scott, ―Distributed Power Generation – Planning and Evaluation‖, Marcel Decker Press , 2000.

4. Gilbert M. Masters, ―Renewable and Efficient Electric Power Systems Edn., IEEE Press, Wiley, 2013.

5. N. Jenkins, J.B. Ekanayake and G. Strbac, ―Distributed Generation", 1 Edn, The Institution of Engineering and Technology, London, 2010.

Online Learning Resource:

1. 1. https://archive.nptel.ac.in/courses/121/106/121106014/#
2. 2. https://onlinecourses.nptel.ac.in/noc22_ch27/preview
3. 3. https://www.nptelvideos.com/lecture.php?id=8517

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

SKILL ENHANCEMENT COURSES

Skill Enhancement Course - I

23CSE610 DATA STRUCTURES

L	T	P	C
1	0	2	2

Pre-requisite: 23CSE101

Course Objectives:

1. To attain proficiency in essential knowledge and skills for effectively employing linear data structures and making informed decisions when utilizing them to tackle real-world practical challenges.
2. To gain a comprehensive understanding of sorting techniques, linked lists and their different types, operations, and practical applications.
3. To explore stacks & queues properties, operations and how stacks are utilized for the evaluation of mathematical expressions, including infix, postfix, and prefix notations.
4. To understand the concepts of different types of Trees like Binary Trees, Binary Search Trees and their operations and traversals.
5. To Provide an overview of Graphs representations and Spanning trees.

UNIT I INTRODUCTION & SEARCHING TECHNIQUES 6 hours

Introduction: Definition and importance of Data Structures, Types of Data Structures, Abstract data types (ADTs), Overview of time and space complexity analysis. Searching Techniques: Linear Search & Binary Search.

1. Implement a C-Program to perform Create, Insert, Delete & Reverse operations on arrays.
2. Implement a C-Program to perform Linear Search on given list of elements.
3. Implement a C-Program to perform Binary Search on given list of elements.

UNIT II SORTING TECHNIQUES & LINKED LISTS 6 hours

Sorting Techniques: Bubble sort, Merge Sort and Quick Sort.

Linked Lists: Singly linked lists: representation and operations, Overview of Doubly linked lists and Circular linked lists, Comparing arrays and linked lists.

4. Implement a C Program to sort given list of elements using Bubble Sort
5. Implement a C Program to sort given list of elements using Merge Sort
6. Implement a C Program to sort given list of elements using Quick Sort
7. Implement a C Program to perform Singly Linked list Operations.

UNIT III STACKS & QUEUES 6 hours

Stacks: Introduction to Stacks: Properties and Operations, implementing stacks using arrays and linked lists, Expression evaluation using stack.

Queues: Introduction to queues: properties and operations, implementing queues using arrays and linked lists.

8. Implement a C Program for Stack using Arrays & Linked List.
9. Implement a C Program to convert Infix expression to Postfix expression.
10. Implement a C Program for Queue using Arrays & Linked List.

UNIT IV TREES **6 hours**

Trees: Introduction to Trees, Binary Tree, Tree Traversal, Binary Search Tree – Insertion, Deletion & Traversal, Heaps: Min-Heap & Max-Heap.

11. Implement a C Program to perform Binary Tree Creation & Traversal operations.
12. Implement a C Program to perform Binary Search Tree – Insertion, Deletion & Operations.

UNIT V GRAPHS **6 hours**

Graphs: Terminology & Representations, Graph Traversals: Breadth First Search & Depth First Search Spanning Trees: Definition and Properties, Prim's and Kruskal's Algorithms.

13. Implement a C Program to perform BFS & DFS
14. Implement a C Program for Prim's and Kruskal's algorithm to generate Spanning tree.

Course Outcomes:

At the end of the course, Student will be able to
CO1: Apply their knowledge and skills in the context of Data structures, Algorithmic analysis, Searching, enabling them to solve practical problems.
CO2: Implement Sorting techniques & Linked lists and its operations.
CO3: Implement stacks and queues using both arrays & linked lists.
CO4: Implement tree operations for binary tree, binary search tree, heap tree.
CO5: Design a Graph, Perform BFS & DFS on Graphs and Implement Spanning trees.

Text Books:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.

2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson- Freed, Silicon Press, 2008.

Reference Books:

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders.

2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft.

3. Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum.

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

Skill Enhancement Course - II

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:

4. Write a program to perform the given operations on a list:
   i. Addition ii. Insertion iii. slicing
5. Write a program to perform any 5 built-in functions by taking any list.
6. 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 Enhancement Course - III

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
5. To prepare students for job interviews, group discussions, and workplace communication with confidence and clarity.

UNIT I SOFT SKILLS & COMMUNICATION SKILLS 9 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 example 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 9 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 9 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 9 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 9 hours

Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette, benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction-Cellphoneetiquette-Diningetiquette-Netiquette-Jobinterviewetiquette- 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.

Case studies may be given wherever feasible for example for Decision Making-The decision of King Lear.

Course Outcomes:

After completion of the course, students will be able to

CO1: List out various elements of soft skills
CO2: Describe methods for building professional image.
CO3: Apply critical thinking skills in problem solving
CO4: Analyse the needs of an individual and team for well-being
CO5: Assess the situation and take necessary decisions

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, 2018 ,esuo HgnihsilbuPlanoitanretnIKI

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. Dr. Rajiv Kumar Jain, Dr. Usha Jain, Life Skills(Paperback English)Publisher: Vayu Education of India, 2014

Online Resources:

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://onlinecourses.nptel.ac.in/noc24_hs15/preview
5. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

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

Skill Enhancement Course - IV

23EEE601 APPLICATIONS OF SOFT COMPUTING TOOLS IN ELECTRICAL ENGINEERING

	L	T	P	C
Pre-requisite: 23EEE105, 23EEE107, 23EEE109, 23EEE110	**0**	**1**	**2**	**2**

Course Objectives:

The objectives of this course include:

1. Understand the MATLAB and Simulink environments for simulation.
2. Apply fuzzy logic, neural networks, and soft computing tools to electrical engineering problems.
3. Model and simulate power system dynamics, power electronics converters, and battery management systems.
4. Perform stability analysis and energy management simulations.
5. Develop simulation models integrating soft computing tools and electrical systems.

Theory:

MATLAB-Introduction, different tool boxes, creation of program files, creation of Simulink files, GUI, commonly used blocks, Simpower system toolbox, control system toolbox, Sim Drive lines, Creation of functions, Project implementation through MATLAB.

UNIT-I: MATLAB & SIMULINK BASICS FOR ELECTRICAL ENGINEERING APPLICATIONS

Introduction to MATLAB interface, script files, and function files, Simulink overview: Libraries, SimPowerSystems, Control System Toolbox, Creation of functions, file operations, and block modeling basics.

Experiments:

1. Transient analysis of a given electrical network using MATLAB
2. Study the dynamics of a second-order system using Simulink
3. Simulation of fuzzy-based load tap changer in distribution transformer

UNIT-II: SOFT COMPUTING IN POWER ELECTRONICS SYSTEMS

Basics of fuzzy logic and neural networks, Design of fuzzy and PI controllers for converters, Modelling of buck and boost DC-DC converters, Controller tuning and system stability using soft computing.

Experiments:

4. Implementation of buck and boost DC-DC converters using Simulink
5. PI controller design for buck converter and stability analysis
6. Sine-PWM generation for single-phase and three-phase inverters

UNIT-III: ENERGY MANAGEMENT AND ECONOMIC DISPATCH

Economic load dispatch (ELD) using optimization techniques, ELD with and without renewable energy sources (RES), Fuzzy/AI-based optimization for thermal scheduling, Load flow basics for smart grid and distributed systems.

Experiments:

7. Economic load dispatch of (i) thermal units and (ii) thermal + RES
8. MATLAB implementation of backward/forward sweep load flow
9. Voltage profile and system losses evaluation for radial networks.

UNIT-IV: POWER SYSTEM STABILITY AND CONTROL

Transient stability concepts using equal area criterion (EAC), Reactive power control using soft computing (Ferranti effect, shunt reactors), Wide area monitoring systems and PMUs.

Experiments:

10. Transient stability analysis using EAC in MATLAB
11. Reactive power control simulation in a transmission system
12. Virtual PMU design and implementation.

UNIT-V: BATTERY MANAGEMENT SYSTEMS AND ADVANCED APPLICATIONS

Battery modelling: SoC, SoH, SOP, and thermal modelling, Use of neural networks in battery health prediction, Wide area control using soft computing in multi-area systems.

Experiments:

13. MATLAB simulation of Li-ion battery pack for SoC, SoH, voltage and temperature
14. Wide area control simulation of two-area system.
15. Battery SoH estimation using Artificial Neural Network (ANN).

Course Outcomes:

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

CO1: Explain and interpret fundamental electrical systems using soft computing tools.

CO2: Develop MATLAB/Simulink models for control, optimization, and analysis.

CO3: Analyze EEE systems through fuzzy, neural, and hybrid techniques.

CO4: Design and implement models for power system stability and battery management.

CO5: Demonstrate monitoring and optimization tools with real-time simulations.

Text Book / Reference

1. MATLAB and Simulink Crash Course for Engineers, Eklas Hossain, Springer, 2022
2. MATLAB for Engineers, Holly Moore, Pearson Education, 5th Edition
3. POWER SYSTEM STABILITY AND CONTROL, Prabha Kundur, 1ST EDN, McGraw Hill Education

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

Minor in Electrical and Electronics Engineering

Stream Name: Microgrid Technology

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

Minor

23MDEEE101 FUTURISTIC POWER SYSTEMS

		L	T	P	C
Pre-requisite:	23EEE101	**3**	**0**	**0**	**3**

Course Objectives:

1. Understand the **current and future trends** in electricity generation, distribution, and infrastructure.
2. Learn how renewable energy sources like solar, wind, and biomass are connected to the power grid.
3. Explore different energy storage systems (ESS) and how they support the modern power grid.
4. Gain knowledge about microgrids and smart grids, their structure, benefits, and real-world applications.
5. Learn about the communication technologies and IT infrastructure needed for smart power systems, including cybersecurity concerns.

UNIT-I INTRODUCTION: 9 hours

Present status of worldwide scenario of electricity generation, transmission and distribution; Energy infrastructure-Resilience and Security; Social, Technical and economic challenges; Major trends driving power system evolution; State of the art technologies in power system.

UNIT-II RENEWABLE ENERGY INTEGRATION: 9 hours

Review of renewable energy (RE) resources and systems: Solar- PV, Solar Thermal, Wind, Biomass, Micro- hydro and Fuel Cell, comparison of various RE resources; Renewable Energy Policies and present status of integration with existing grid; Large scale integration of renewable energy-Technical challenges, enabling technologies, International requirements; Renewable energy forecasting.

UNIT-III ENERGY STORAGE SYSTEMS (ESS): 9 hours

Review of energy storage components: Battery, VRB, Ultra-capacitor, Fuel Cells, Pumped Hydro-Storage and flywheels, comparison of ESS technologies; Importance of ESS in futuristic power systems; Aggregated ESS, Distributed ESS; Applications of ESS: Energy Management (Load Leveling and Peak Shifting), Fluctuation Suppression (Intermittency Mitigation), Uninterruptible Power System Low-Voltage Ride Through; Placement of the ESS to Improve Power Quality, Voltage Regulation Using ESS, ESS as Spinning Reserve.

UNIT-IV MICRO-GRID AND SMART-GRID: 9 hours

Micro-grid evolution: Micro-grid concept, importance in futuristic power system, basic architectures and control, objectives and state of the art technologies; Microgrid as a building block of Smart-grid; Smart-grid concept, Smart Grid versus conventional electrical networks, Smart-grid infrastructure, Smart Grid communication system and its cyber security, International standard IEC 61850 and its application to Smart-grid; Microgrids /smart grid and Electric Vehicles integration. Technical, Economic, Environmental and Social Benefits of Microgrid Operation. Microgrids for Rural Electrification, Review of Microgrid Best Practices through Case Studies: Strategic Planning, Operations: Commercial and Financial Considerations; Technical and Social Context.

UNIT-V COMMUNICATION AND IT INFRASTRUCTURE 9 hours

Requirements of Communication and IT infrastructure in futuristic power systems: various communication protocols, comparison of performance; IEEE standard: IEEE 802.11 Mesh Networking, IEEE 802.15.4-Wireless Sensor Networks; Communications Technologies for Smart

Course Outcomes:

Upon completion of this course, students will be able to:
CO1: Explain the global status and trends in modern power systems.
CO2: Compare renewable energy sources and describe their grid integration challenges.
CO3: Evaluate various energy storage technologies and their role in future power systems.
CO4: Describe microgrid and smart grid structures, control, and real-world applications.
CO5: Identify communication protocols, IT needs, and cybersecurity strategies in smart grids.

Textbooks:

1. Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014
2. Energy Storage for Sustainable Microgrid by David Wenzhong Gao, Elsevier, 2015
3. Introduction to the Smart Grid- Concepts, Technologies and Evolution by Salman K. Salman, IET, 2017.

Reference Books:

1. Energy Efficiency and Renewable Energy Handbook Edited by D. Yogi Goswami and Frank Kreith, 2nd Edition- 2016, CRC.
2. Clean Energy Microgrids, Edited by Shin'ya Obara and Jorge Morel IET, 2017
3. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby *et al*., Elsevier WoodHead Publishing, 2018

Online Learning Resource:

1. NPTEL Web Course on: DC Microgrid And Control System Prof. Avik Bhattacharya, IIT Roorkee
2. NPTEL Web Course on Electronics and Distributed Generation Dr. Vinod John Department of Electrical Engineering IISc Bangalore.

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

Minor

23MDEEE102 POWER ELECTRONIC CONVERTERS for ENERGY SOURCES

	L	T	P	C
Pre-requisite: 23EEE101	**3**	**0**	**0**	**3**

Course Objectives:

1. To illustrate the design philosophies used in the domain of microgrid power converters.
2. To explore the control implementations in power converters for voltage, current and power regulation for various DC and AC energy sources

UNIT-I SELECTION OF COMPONENTS FOR POWER ELECTRONICS CONVERTERS (PEC) 9 hours

Selection and Sizing of capacitors and magnetic components for PECs, design of Magnetic Components; Selection and sizing of Power Devices, Commonly used software tools for selection and sizing; Heatsink- selection and sizing.

UNIT-II DESIGN AND CONTROL OF DC-DC CONVERTERS 9 hours

Design of Buck and Boost converters, Design examples; Design of Bidirectional Converters. Design of gate driver circuits; Review of DC-DC converter modelling; Closed loop PI controller design for buck and boost converters; Current control mode and voltage control mode.

UNIT-III DESIGN AND CONTROL OF DC-AC CONVERTERS 9 hours

Design of Inverter for standalone applications; Design of grid connected Inverter with different grid synchronization strategies- ZCD, PLL; Strategies for Control of voltage, current and power output.

UNIT-IV DESIGN OF PCU FOR SPV AND WIND APPLICATION 9 hours

Various topologies of Power Converter Unit (PCU) for SPV and Wind energy systems. Design considerations of PCU for SPV and Wind energy Systems and Design Examples.

UNIT-V DESIGN OF PCU FOR ESS APPLICATIONS AND DESIGN OF AUXILIARY SYSTEM AND INTERFACES 9 hours

Design consideration for BDC converter based PCU for batteries and Ultra-capacitors. Design of current and voltage sensor interfaces; Design considerations for auxiliary power supplies; Design of protection and snubber components: Introduction to Digital Signal Processors (DSP) and microcontroller interfaces

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO1: Select and size passive components, power devices, and heat sinks required for designing power electronic converters.

CO2: Design and implement DC-DC converters (Buck, Boost, and Bidirectional) along with appropriate control strategies (voltage mode and current mode).

CO3: Design DC-AC inverters for standalone and grid-connected systems, and apply suitable synchronization and control techniques.

CO4: Design Power Converter Units (PCUs) for solar photovoltaic (SPV) and wind energy systems based on application requirements.

CO5: Design PCUs for energy storage systems (ESS), including current/voltage sensing, auxiliary power supplies, snubbers, and protection circuits; understand the role of digital controllers like DSPs and microcontrollers in converter control.

Textbooks:

1. Power Electronic Converters for Microgrids by Suleiman M. Sharkh, Mohammad A. Abusara, Georgios I. Orfanoudakis Babar Hussain, IEEE and Wiley, 2014
2. Control Circuits In Power Electronics Practical Issues In Design And Implementation Edited by Miguel Castilla, IET, 2016

Reference Books:

1. Cooperative Synchronization in Distributed Microgrid Control by Ali Bidram, Vahidreza Nasirian Ali Davoudi, and Frank L. Lewis, Springer, 2017
2. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby et al., Elseiver WoodHead Publishing, 2018.
3. Smart Microgrids- Lessons from Campus Microgrid Design and Implementation edited by Hassan Farhangi, CRC Press 2017.

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

Minor

23MDEEE201 MICROGRID POWER ELECTRONICS INTERFACE LABORATORY

L	T	P	C
0	0	3	1.5

Prerequisties 23EEE201

Course Objectives:

To study the operation of power electronic converters in microgrid applications.

1. To implement control of interfacing converters for DERs and loads.
2. To analyze grid-connected and islanded operation of microgrids.
3. To explore protection and synchronization aspects of microgrid interfaces.
4. To practically simulate DC-DC and DC-AC converters in distributed energy systems.

List of experiments

1. Simulation of Grid-Tied Inverter Using Sinusoidal PWM Control
2. Design and Analysis of DC-DC Boost Converter for PV Interface
3. Voltage Source Inverter (VSI) Control for Microgrid Applications
4. Simulation of Islanding Detection Techniques for Microgrid
5. Power Quality Analysis Using Active Power Filters
6. Control of Bidirectional DC-DC Converter for Energy Storage Interface
7. Modeling of Synchronous Reference Frame Controller for Inverter
8. Droop Control Implementation for Parallel Inverters
9. Simulation of Load Sharing in a Multi-Inverter Microgrid
10. Protection Coordination and Anti-Islanding using Relays and Logic

Course Outcomes:

CO1: Design and simulate converters used in microgrid power interface
CO2: Implement inverter control strategies for grid-connected and islanded modes.
CO3: Analyze and mitigate power quality issues in distributed systems.
CO4: Model synchronization and protection techniques for microgrids.
CO5: Develop converter control logic for integrating renewable and storage systems.

Reference Books:

1. Fang Lin Luo and Hong Ye, Power Electronics: Advanced Conversion Technologies, CRC Press.
2. Bhim Singh and Sanjeet Dwivedi, Power Electronics in Renewable Energy Systems and Smart Grid, Wiley.
3. NPTEL: Power Electronics for Microgrids by Prof. B.G. Fernandes
4. PSCAD and MATLAB Simulink User Manuals

Online Learning Resources/Virtual Labs:

NPTEL: Power Electronics for Microgrid
PSCAD/MATLAB-Based Microgrid Simulations
IEEE Xplore Microgrid Case Studies.
Virtual Labs by IIT Bombay on Microgrids

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

Minor

23MDEEE103 MICROGRID POWER AND CONTROL ARCHITECTURE

		L	T	P	C
Pre-requisite:	23EEE101	**3**	**0**	**0**	**3**

Course Objectives:

1. To study various power and control architectures adopted in DC and AC Microgrids.
2. To explore various control strategies used in power control.
3. To take insight into operations stability and protection issues related to Microgrids

UNIT-I MICROGRID POWER ARCHITECTURE 9 hours

Types of Microgrid system, AC and DC and Hybrids Microgrids, Application based Suitability of Microgrid type; Review of power architecture of various Microgrids deployed world-wide. Comparison of various Microgrid power architectures

UNIT-II AC MICROGRID AND CONTROL ARCHITECTURE 9 hours

Black-start operation, Grid Synchronisation- various Grid synchronization methods, Grid forming and grid following operations; Power Control- Real and reactive power control in AC Microgrid, simple droop control and other variants of droop control, Unit Power Flow Control, Feeder power flow control and Mixed mode control, source optimization; Centralized, decentralised, distributed and hierarchical control architecture, Local and system / supervisory level control strategies, Multi Agent System (MAS) Based Control; Control approaches used in AC Microgrids deployed worldwide. Microgrid standards IEEE 1547 series. Communication in AC Microgrids

UNIT-III DC MICROGRID AND CONTROL ARCHITECTURE: 9 hours

Power sharing in DC Microgrids, source optimization; Control approaches: Centralized, decentralised, distributed and hierarchical control architecture. Control approaches used in hybrid Microgrids. Communication in DC/Hybrid Microgrids.

UNIT-IV OPERATIONAL CONTROL IN MICROGRIDS 9 hours

Energy management in Microgrids, coordinated control, load management, grid synchronisation and islanding, Anti-islanding schemes; Various Architectural and Operational Challenges in Microgrid, Optimal operation of Microgrids.

UNIT-V MICROGRID STABILITY & PROTECTION: 9 hours

Steady-state and dynamic stability in AC and DC Microgrids, Methods to improve the stability in Microgrids; introduction to small signal and large signal stability analysis in Microgrids. Fault scenarios in DC and AC Microgrids, Protection in DC and AC Microgrids, adaptive protection, Fault current source (FCS) based protection; Protection challenges in islanded and autonomous modes of operation and ways to mitigate.

Course Outcomes:

Upon successful completion of this course, the learner will be able to:

CO1: Understand various types Microgrids based on applications, power and control architecture.

CO2: Illustrate various power control strategies adopted in DC, AC and Hybrid Microgrids.

CO3: Compare and contrast various control architectures used DC, AC and Hybrid Microgrids also various aspects related to stability in Microgrids.

CO4: Illustrate the various operational challenges in Microgrids

CO5: Comprehend the various aspects related to the stability in Microgrids

Textbooks:

1. Microgrids Design and Implementation edited by Antonio Carlos Zambroni de Souza and Miguel Castilla, Springer, 2019
2. Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014.

Reference Books:

1. Control and Dynamics in Power Systems and Microgrids by Lingling Fan, CRC Press, 2017.
2. Hybrid-Renewable Energy Systems in Microgrids- Integration, Developments and Control edited by Hina Fathimaby et al., Elseiver WoodHead Publishing, 2018
3. Urban DC Microgrid Intelligent Control and Power Flow Optimization by Manuela Sechilariu and Fabrice Locment, 2016 Elsevier

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

Minor

23MDEEE104 MICROGRID SYSTEM DESIGN

		L	T	P	C
Pre-requisite:	23EEE101, 23MDEEE103	**3**	**0**	**0**	**3**

Course Objectives:

1. To illustrate the design philosophies used in the domain of Microgrid.
2. To explore the selection of power and control architecture of Microgrids
3. To study the design aspects of AC Microgrid, DC Microgrid and their auxiliary systems

UNIT-I SELECTION/ SIZING OF MICROGRID ENERGY RESOURCES 9 hours

Factors affecting the selection and sizing of energy resources for Microgrid applications, dependency on type of loads connected, Selection/ Sizing: Renewable energy resources, Energy Storage components. Hybrid combination of RES and ESS

UNIT-II SELECTION OF POWER AND CONTROL ARCHITECTURE: 9 hours

Factors affecting the selection of Microgrid power and control architecture; Design Consideration for control implementation; Sensors: Selection of sensors and design of sensor Interfaces, design of control Interfaces. Design considerations for DSP/ Microcontroller interfaces.

UNIT-III SELECTION AND DESIGN OF COMMUNICATION ARCHITECTURE: 9 hours

Design considerations for selection of communication network for Microgrid applications; Design and implementation of communication links/ interfaces. Microg4controller programming for data transfer.

UNIT-IV DESIGN OF DC AND AC MICROGRID: 9 hours

Design DC Power Conditioning Units for RES and ESS, Unidirectional and Bidirectional Converter design, implementation of Control loop with DSP; Programming for Power sharing and Energy Management algorithms; Design of Protection system for DC Microgrid Design AC Power Conditioning Units for RES and ESS, Unidirectional and Bidirectional Converter design, implementation of Control loop with DSP; Grid Synchronization. Programming for Power sharing and Energy Management algorithms; Design of Protection system for AC Microgrid.

UNIT-V ISLANDING IN MICROGRIDS 9 hours

Selection and implementation of Islanding detection and anti-islanding scheme; Black- start and Autonomous operations in Microgrids.

Course Outcomes:

Upon successful completion of this course, the learner will be able to:

CO1: Select and size various Microgrid energy resources.
CO2: Select the power and control architecture of the Microgrid.
CO3: Select and design the Microgrid‘s communication architecture.
CO4: Illustrate the design aspects DC and AC Microgrids with their control strategies.
CO5: Illustrate the implementation of the Microgrid islanding detection and anti-islanding scheme/ blackstart operation.

Textbooks:

1. Microgrids Design and Implementation edited by Antonio Carlos Zambroni de Souza and Miguel Castilla, Springer, 2019.

2. Microgrids Architectures and Control Edited by Nikos Hatziargyriou, IEEE and Wiley, 2014.

Reference Books:

1. Energy Storage for Sustainable Microgrid by David Wenzhong Gao, Elsevier, 2015

2. Cooperative Synchronization in Distributed Microgrid Control by Ali Bidram, Vahidreza Nasirian Ali Davoudi, and Frank L. Lewis, Springer, 2017.

3. Energy Efficiency and Renewable Energy Handbook Edited by D. Yogi Goswami and Frank Kreith, 2nd Edition- 2016, CRC.

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

Minors

23MDEEE202 MODELING AND SIMULATION OF MICROGRID LABORATORY

L	T	P	C
0	0	3	1.5

Prerequisties 23EEE201

Course Objectives:

1. To develop models of distributed generation units in a microgrid environment.
2. To simulate steady-state and dynamic behavior of grid-connected and islanded microgrids.
3. To perform load flow, fault, and stability analysis for microgrids.
4. To analyze microgrid protection and control coordination.
5. To evaluate power quality and control strategies for hybrid energy systems.

List of experiments

1. Modeling of Microgrid with Solar PV and Battery in MATLAB/Simulink
2. Dynamic Simulation of Microgrid in Islanded Mode
3. Load Flow Analysis of Microgrid Using SimPowerSystems Toolbox
4. Short Circuit Analysis and Protection Coordination in Microgrid
5. Real and Reactive Power Sharing in Multi-Source Microgrid
6. Harmonic Analysis and THD Evaluation in Microgrid
7. Modeling of Microgrid Controller with Communication Delay
8. Simulation of Grid Synchronization Techniques (PLL, Droop Control)
9. Design of Energy Management System (EMS) for Microgrid
10. Frequency and Voltage Stability Analysis During Transition Modes

Course Outcomes:

CO1: Simulate and analyze grid-connected and islanded microgrid models.
CO2: Perform power flow, fault, and protection studies in microgrids.
CO3: Evaluate control strategies for hybrid energy source integration.
CO4: Analyze power quality and stability under different loading conditions.
CO5: Design EMS and assess dynamic performance of microgrids.

Reference Books

1. S. Chowdhury, Microgrids and Active Distribution Networks, IET Press.
2. K. M. Muttaqi, Power Quality in Modern Power Systems, Springer.
3. MATLAB/Simulink Tutorials for Microgrid Modeling
4. NPTEL: Distributed Generation and Microgrid by Prof. B. Singh

Online Learning Resources/Virtual Labs:

NPTEL: Distributed Generation and Microgrid
MATLAB Simulink Examples for Microgrid
DIgSILENT/ETAP Case Studies on Microgrid
IEEE PES Tutorials on Microgrid Stability and Protection

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 Electric Vehicle

Honors

23HDEEE101 E MOBILITY

		L	T	P	C
Pre-requisite:	23EEE101, 23EEE102, 23EEE104	**3**	**0**	**0**	**3**

Course Objectives:

1. Understand the fundamental concepts and principles of Electric vehicles,
2. Apply the concepts to implement battery technology,
3. Apply the concepts to implement charging technology,
4. Understand the future trends in EVs

UNIT-I INTRODUCTION 9 hours

Introduction to electric vehicles: EV verses gasoline vehicles, vehicle dynamics fundamentals, e- drivetrain, Electric motor, Power electronic in electric vehicles, Regenerative braking.

UNIT-II BATTERY TECHNOLOGY 9 hours

Battery Technology for EVs: Storage technologies for EV, Battery working principles, Battery losses, Li-ion batteries, Battery pack and battery management system.

UNIT-III CHARGING TECHNOLOGY 9 hours

Charging Technology of EVs: AC charging - Type 1,2,3, DC charging, Fast charging and its limitations, Smart charging and applications, Vehicle to X(V2X), X2V technology.

UNIT-IV FUTURE TRENDS IN EVs 9 hours

Future trends in e-Vehicles: Wireless charging of EV, On-road charging of EV, Battery technology, Solar powered EVs, Charging EVs from renewables.

UNIT-V E-MOBILITY 9 hours

E-mobility: electrification challenges, business, connected mobility and autonomous mobility case study in Indian Roadmap Perspective, Policy- EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs.

Course Outcomes:

The students will be able to:

CO1: Understanding the Fundamentals of Electric Vehicles and Vehicle Dynamics.Choose suitable motors and analyse different power electronics in EVs.
CO2: Analyzing Battery Technologies for Electric Vehicles**.**
CO3: Understanding and Evaluating Charging Technologies for Electric Vehicles**.**
CO4: Exploring Future Trends and Innovations in Electric Vehicles**.**
CO5: Understanding E-Mobility, Policy, and Integration with Smart Grids.

Textbooks:

1. Iqbal Hussain, ―Electric & Hybrid Vehicles – Design Fundamentals‖, Second Edition, CRC Press, 2011.
2. James Larminie, ―Electric Vehicle Technology Explained‖, John Wiley & Sons, 2003.

Reference Books:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, –Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals‖, CRC Press, 2010.
2. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
3. Sandeep Dhameja, –Electric Vehicle Battery Systems‖, Newnes, 2000.
4. Tariq Muneer and Irene Illescas García, –The automobile, In Electric Vehicles: Prospects and Challenges‖, Elsevier, 2017.

Online Learning Resource:

1. https://nptel.ac.in/courses/108106170

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

Honors

23HDEEE102 BATTERY MANAGEMENT SYSTEMS

		L	T	P	C
Pre-requisite:	23EEE101, 23EEE102, 23EEE104	**3**	**0**	**0**	**3**

Course Objectives:

1. Understand the basics of batteries and its parameters
2. Apply the concepts to create Battery Management System
3. Create Physical and Simulation models for Battery Management System
4. Design different Battery Management Systems

UNIT-I INTRODUCTION **9 hours**

Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging.

UNIT-II BATTERY MANAGEMENT SYSTEM: **9 hours**

Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of charge estimation, Cell total energy and cell total power.

UNIT-III BATTERY STATE OF CHARGE AND STATE OF HEALTH ESTIMATION: **9 hours**

Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing.

UNIT-IV MODELLING AND SIMULATION: **9 hours**

Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modelling approach Physics-based modelling approach, Simulating an electric vehicle, Vehicle range calculations Simulating constant power and voltage, Simulating battery packs

UNIT-V DESIGN OF BATTERY MANAGEMENT SYSTEMS: **9 hours**

Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system.

Course Outcomes:

The students will be able to:

CO1: Understand the basic parameters and characteristics of batteries and charging/discharging processes.
CO2: Analyze the functionalities and components of Battery Management Systems (BMS).
CO3: Evaluate methods for estimating State of Charge (SOC), State of Health (SOH), and cell balancing.
CO4: Develop simulation models using equivalent-circuit and physics-based approaches.
CO5: Design Battery Management Systems considering thermal, control, and energy balancing aspects.

Textbooks:

1. Plett, Gregory L. Battery management systems, Volume I: Battery modelling. Artech House, 2015.
2. Plett, Gregory L. Battery management systems, Volume II: Equivalent-circuit methods. Artech House, 2015.

Reference Books:

1. Bergveld, H.J., Kruijt, W.S., Notten, P.H.L –Battery Management Systems -Design by Modelling‖ Philips Research Book Series 2002.
2. Davide Andrea,‖ Battery Management Systems for Large Lithium-ion Battery Packs‖ Artech House, 2010.
3. Pop, Valer, et al. Battery management systems: Accurate state-of-charge indication for battery- powered applications. Vol. 9. Springer Science & Business Media, 2008.

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

Honors

23HDEEE201 BATTERY MANAGEMENT SYSTEMS AND MOTOR CONTROL LABORATORY

L	T	P	C
0	0	3	1.5

Prerequisties: 23EEE105, 23EEE109, 23EEE114

Course Objectives:

To develop practical understanding of battery management systems in EVs.

1. To implement motor control strategies including regenerative braking and FOC.
2. To integrate embedded systems for BMS and motor drive control.
3. To simulate thermal, electrical, and dynamic behaviors of EV components.
4. To evaluate safety and efficiency aspects of BMS and motor control subsystems.

List of experiments

1. Estimation of State of Charge (SoC) Using Coulomb Counting Method
2. Simulation of Passive and Active Cell Balancing Techniques
3. Thermal Analysis of Li-ion Battery Pack Under Dynamic Load
4. Design of a Basic Battery Monitoring System Using Arduino/ESP32
5. Comparative Analysis of DC and BLDC Motors for EV Applications
6. Speed Control of BLDC Motor Using PID and Field Oriented Control
7. Modeling and Simulation of Regenerative Braking in EVs
8. Detection of Faults in Battery Modules Using Threshold-Based Logic
9. Efficiency Analysis of Three-Phase Inverter for Motor Drive
10. Current Ripple Analysis in PWM-Controlled Motor Drives

Course Outcomes:

CO1: Simulate battery SoC, thermal behavior, and fault diagnostics.

CO2: Develop hardware prototypes for BMS monitoring using microcontrollers.

CO3: Analyze performance characteristics of motors for EV applications.

CO4: Simulate regenerative braking and inverter control strategies.

CO5: Integrate embedded control for motor drive and battery safety functions.

Reference Books:

1. Husain, I. Electric and Hybrid Vehicles: Design Fundamentals, CRC Press.
2. Larminie, J., & Lowry, J. Electric Vehicle Technology Explained, Wiley.
3. NPTEL Lecture Series – Battery Management Systems by Prof. Ashok Jhun
4. R.K. Rajput, Electrical Machines, Laxmi Publications.

Online Learning Resources/Virtual Labs:

1. NPTEL: Battery Management Systems
2. TI C2000 Motor Control Lab Resources
3. MATLAB/Simulink EV Examples
4. NI Multisim / PLECS Battery Simulations

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

Honors

23HDEEE103 SPECIAL MACHINES FOR ELECTRIC VEHICLES

		L	T	P	C
Pre-requisite:	23EEE101, 23EEE105, 23EEE108	**3**	**0**	**0**	**3**

Course Objectives:

1. Understand various Motor Drives useful for EV applications,
2. Apply the concepts to implement various designs,
3. Analyze performance of various Motor Drives,
4. Evaluate the usage of specific drive for EV application.

UNIT-I PERMANENT MAGNET (PM) BRUSHLESS MOTOR DRIVES **9 hours**

Structure of PM Brushless Machines, Principle of PM Brushless Machines Modeling of PM Brushless Machines, Inverters for PM Brushless Motors Motor Control, Design Criteria of PM Brushless Motor Drives for EVs, Design Examples of PM Brushless Motor Drives for EVs, Application, Advantages and Limitations for EVs.

UNIT-II SWITCHED RELUCTANCE MOTOR DRIVE: **9 hours**

Structure of SR Machines, Principle of SR Machines, SR Converters Topologies, SR Motor Control, Design Criteria of SR Motor Drives for EVs, Examples of SR Motor Drives for EVs, Application, Advantages and Limitations for EVs.

UNIT-III STATOR-PM MOTOR DRIVES: **9 hours**

Doubly-Salient PM Motor Drives, Flux-Reversal PM Motor Drives, Flux-Switching PM Motor Drives, Hybrid-Excited PM Motor Drives Flux-Mnemonic PM Motor Drives, Design Criteria of Stator-PM Motor Drives for EVs, Application, Advantages and Limitations for EVs.

UNIT-IV MAGNETIC-GEARED MOTOR DRIVES: **9 hours**

Principle of MG Machines, Modeling of MG Machines, Inverters for MG Motors, MG Motor Control, Design Criteria of MG Motor Drives for EVs, Application, Advantages and Limitations for EVs.

UNIT-V ADVANCED MAGNETLESS MOTOR DRIVES AND MULTIPHASE MOTOR DRIVES: **9 hours**

Introduction of Advanced Magnetless technology, Synchronous Reluctance Motor Drives, Doubly-Salient DC Motor Drives, Flux-Switching DC Motor Drives, Design Criteria of Advanced Magnetless Motor Drives for EVs, Application, Advantages and Limitations for EVs. Multiphase Induction Motor

Course Outcomes:

After completion of this course, student will be able to

CO1: Understanding the Fundamentals of Permanent Magnet (PM) Brushless Motor Drives.
CO2: Analyzing Switched Reluctance Motor (SRM) Drives.
CO3: Evaluating Stator-Permanent Magnet (PM) Motor Drives.
CO4: Understanding and Designing Magnetic-Gear Motor Drives.
CO5: Exploring Advanced Magnetless and Multiphase Motor Drives.

Textbooks:

1. Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, –Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design‖, CRC Press, 2004.
2. James Larminie and John Loury, –Electric Vehicle Technology – Explained‖, John Wiley & Sons Ltd, 2003.

Reference Books:

1. Sandeep Dhameja, –Electric Vehicle Battery Systems‖, Butterworth – Heinemann, 2002.
2. Ronald K Jurgen, –Electric and Hybrid – Electric Vehicles‖, SAE, 2002.
3. on Hodkinson and John Fenton, –Light Weight Electric/Hybrid Vehicle Design‖, Butterworth – Heinemann, 2001.

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

Honors

23HDEEE104 GRID INTERFACE OF ELECTRIC VEHICLES

		L	T	P	C
Pre-requisite:	23EEE101, 23EEE102, 23EEE104	**3**	**0**	**0**	**3**

Course Objectives:

1. Understand the Grid interfacing concept of EVs,
2. Analyze the EV impact on grid,
3. Design new types of charging facilities for EVs,
4. Evaluate the role of EV as ancillary service

UNIT-I INTRODUCTION TO SMART GRID AND PEV: 9 Hours

Introduction to smart grid and microgrid, Impact of PEVs on Distributed Energy Resources in the Smart Grid, V2G Technology and PEVs Charging Infrastructures.

UNIT-II IMPACT OF V2G AND G2V ON THE SMART GRID AND RENEWABLE ENERGY SYSTEMS: 9 Hours

Types of Electric Vehicles, Motor Vehicle Ownership and EV Migration, Impact of Estimated EVs on Electrical Network, Impact on Drivers and the Smart Grid, Standardization and Plug-and-Play.

UNIT-III POWER CONVERSION TECHNOLOGY IN THE SMART GRID AND EV: 9 Hours

Impacts of EV Penetration on Grid Power Profile, Requirements of Its Control and Monitoring, Hybrid EV Powertrain Architectures, Control, Monitoring and Management Strategies of EV, V2G Communication System, System model of EV, Case study of three phase fault and its impact.

UNIT-IV PLANNING, CONTROL AND MANAGEMENT STRATEGIES FOR PARKING LOTS FOR PEVS: 9 Hours

Introduction to PEV Charging Facility, Long-Term Planning for PEV Parking Lots, Control and Management of PEV Parking Lots - stages of implementation.

UNIT V PEV AS ANCILLARY SERVICE IN SMART GRID: 9 Hours

Introduction to Ancillary Services, PEV Charger Optimization, PEV as ancillary source, Control Strategies for PEVs to Follow the Individual Operation Values, Systems and Control Algorithm for Smart PEV Chargers, Avoiding the Harmonic Propagation Within the Grid, Case study.

Course Outcomes:

After completion of this course, student will be able to

CO1: Understanding the Fundamentals of Smart Grid and Electric Vehicle Integration Analyze Impact of EV on smart grid
CO2: Analyzing the Impact of EVs and V2G on the Smart Grid and Renewable Energy Systems
CO3: Applying Power Conversion Technologies for Smart Grids and Electric Vehicles
CO4: Designing Control and Management Strategies for PEV Parking Lots
CO5: Evaluating the Role of PEVs as Ancillary Services in Smart Grids

Textbooks:

1. Lu, J. and Hossain, J., Vehicle-to-grid: linking electric vehicles to the smart grid. Institution of Engineering and Technology, 2015.
2. Rajakaruna, S., Shahnia, F. and Ghosh, A. eds., Plug In Electric Vehicles in Smart Grids: Integration Techniques. Springer, 2014.

Reference Books:

1. Rajakaruna, S., Shahnia, F. and Ghosh, A. eds., Plug in electric vehicles in smart grids:charging strategies. Springer, 2014.
2. Salman, S.K., Introduction to the Smart Grid: Concepts, Technologies and Evolution (Vol. 94). IET., 2017.

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

Honors

23HDEEE202 EV SIMULATION AND MODELLING LABORATORY

L	T	P	C
0	0	3	1.5

Prerequisties 23EEE101, 23EEE107, 23EEE110, 23EEE112,

Course Objectives:

1. To simulate electric vehicle subsystems such as battery, drivetrain, and controller.
2. To analyze vehicle energy consumption and performance over standard drive cycles
3. To evaluate thermal and efficiency characteristics of power electronics and batteries.
4. To integrate renewable energy sources for EV charging infrastructure.
5. To apply modeling tools for performance assessment and optimization.

List of experiments

1. Modeling of Electric Vehicle Drivetrain in MATLAB/Simulink
2. Simulation of EV Energy Consumption Over Standard Drive Cycles
3. Range Estimation of EV Under Varying Payload and Terrain Conditions
4. Design and Simulation of Regenerative Braking Strategy
5. Battery Pack Sizing for Desired Vehicle Range
6. Modeling of Solar-Powered EV Charging System
7. Simulation of Longitudinal Dynamics of Electric Vehicle
8. Thermal Simulation of Power Electronics in EV Systems
9. Design of EV Charging Infrastructure Considering Grid Constraints
10. Performance Simulation of Electric Two-Wheeler Using ADVISOR Tool

Course Outcomes:

CO1: Model electric vehicle subsystems using simulation tools.
CO2: Analyze vehicle performance under different drive cycles and loads.
CO3: Design and evaluate battery sizing and regenerative strategies.
CO4: Simulate charging systems integrated with renewable energy.
CO5: Use MATLAB and ADVISOR tools for comprehensive EV performance analysis.

Reference Books:

1. Mehrdad Ehsani, Yimin Gao, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press.
2. C. C. Chan & K. T. Chau, Modern Electric Vehicle Technology, Oxford.
3. MATLAB/Simulink EV Toolboxes Documentation
4. NPTEL: Modeling and Simulation of EV Systems by Prof. B. G. Fernandes

Online Learning Resources/Virtual Labs:

MATLAB/Simulink EV Projects
NPTEL: Electric Vehicles – Modeling and Control
EV Virtual Labs by ARAI / IITs
ADVISOR Tool (by NREL)

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