



SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY

An Autonomous Institution | Approved by AICTE | Affiliated to Anna University
Accredited by NAAC with A++ Grade, Kuniamuthur, Coimbatore - 641008



**DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING**
(Accredited by NBA)

**AUTONOMOUS
CURRICULUM AND SYLLABI
III - IV (SEMESTERS)**

REGULATIONS 2022



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Kuniamuthur, Coimbatore – 641008

Phone : (0422)-2678001 (7 Lines) | Email : info@skcet.ac.in | Website : www.skcet.ac.in

Curriculum & Syllabi

Regulation 2022

2024-2028 Batch

**DEPARTMENT OF ELECTRICAL AND
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Batch 2024-2028)



VISION OF THE INSTITUTION

- To Produce Globally Competitive Engineers with High Ethical Values and Social Responsibilities.



MISSION OF THE INSTITUTION

- To impart the highest quality state-of-the-art technical education by providing impetus to innovation, research, and development and empowering students with entrepreneurship skills.
- To instill ethical values, imbibe a sense of social responsibility, and strive for societal well-being.
- To identify the needs of society and offer sustainable solutions through outreach programs.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING



VISION OF THE DEPARTMENT

- To provide the students with high quality technical education in the field of Electrical and Electronics Engineering enabling them to become competent and responsible engineers with employability and entrepreneurial skills.



MISSION OF THE DEPARTMENT

- To equip the students with adequate knowledge in the field of Electrical and Electronics Engineering and professional skills necessary to face the future challenges with confidence and courage.
- To enrich them to engage in research activities leading to innovative applications of technology.
- To enable them to become responsible citizens of the country with a willingness to serve the society.

I. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	Graduates will have successful career in industry that meets the needs of Indian and Multinational companies.
PEO 2	Graduates will have the ability to synthesize data and develop technical concepts for application to product design and to solve contemporary problems.
PEO 3	Graduates will work as part of teams on multidisciplinary projects with good technical, communication and interpersonal skills.
PEO 4	Graduates will fulfill the roles and responsibilities of professional electrical engineers in their chosen career with an attitude to serve the industry and society.
PEO 5	Graduates will undertake research, pursuing higher studies, thereby adopting extended learning, keeping pace with the technological developments and codes of professional practice.

II. PROGRAMME OUTCOMES (POs)

PO 1	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.
PO 2	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4).
PO 3	Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO 4	Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO 5	Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO 6	The Engineer and the World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO 7	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).
PO 8	Individual and Collaborative Team Work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO 9	Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO 10	Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 11	Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Knowledge and Attitude Profile (WK)

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
WK9	Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

III. PROGRAMME SPECIFIC OUTCOMES (PSOs)

The Graduates of **B.E – Electrical and Electronics Engineering** programme will be able to:

PSO 1	Analyze basic scientific concepts and provide solutions to Electrical and Electronics Engineering problems with a specific focus on emerging energy challenges.
PSO 2	Use relevant software, apply current techniques for data processing problems in the field of modern electronic systems for sustainable development.
PSO 3	Develop products/software to cater to the societal & Industrial needs and adapt ethical values so as to become successful electrical engineering professionals.

IV. MAPPING OF PEOs WITH POs and PSOs

PEO	POs										
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
1	3	3	3	2	2	2	1	2	2	3	3
2	3	3	3	2	2	2	1	2	2	3	3
3	3	3	3	2	2	2	1	3	3	3	3
4	3	3	3	2	2	2	1	3	3	3	3
	1- low, 2 - medium, 3 - high, '-' - no correlation										

V. MAPPING OF PEOs WITH PSOs

	PSO 1	PSO 2	PSO 3
PEO 1	3	2	3
PEO 2	3	3	2
PEO 3	2	3	3
PEO 4	3	2	3
PEO 5	2	3	2

AUTONOMOUS CURRICULA AND SYLLABI

Regulations 2022

Semester – I						
S.No	Course Code	Course Name	L/T/P	Total Hours	Credits	SDG Mapping
Theory (Internal 40 Marks & External 60 Marks)						
1	23SB102	Biology for Engineers	3/0/0	3	3	3,6,13,15
2	23EE101	Basics of Electrical Circuits	3/1/0	4	4	7,9,11,12
3	23MA101	Mathematics I	3/1/0	4	4	4,9,17
Theory with Practical (Internal 50 Marks & External 50 Marks)						
4	23EN101	Oral and Written Communication Skills	2/0/2	4	3	4,5,10,16
5	23IT101	Application Development Practices	1/0/4	5	3	8,9,11,17
6	23CS101	Problem Solving using C++	1/0/4	5	3	4,9,12,13
Practical (Internal 60 Marks & External 40 Marks)						
7	23EE102	Basics of Electrical Circuits Laboratory	0/0/2	2	1	7,9,11
Indian Knowledge System - Blended Learning (Internal 100 Marks)						
8	23TA101	Heritage of Tamils	1/0/0	1	1	4,10,11,16
Mandatory Course (Internal 100 Marks)						
9	23MC101	Induction Programme	3 weeks		0	4
Total				28	22	

Semester – II						
S.No	Course Code	Course Name	L/T/P	Total Hours	Credits	SDG Mapping
Theory (Internal 40 Marks & External 60 Marks)						
1	23EE201	Measuring Instruments and Smart Sensors	3/0/0	3	3	9,11,12,13
2	23EE204	Electron Devices and Circuits	3/0/0	3	3	7,9,12
3	23MA205	Differential Equations and Transform Techniques	3/1/0	4	4	4,9,13
4	23AS101	Applied Science	4/0/0	4	4	4,6,7,13
Theory with Practical (Internal 50 Marks & External 50 Marks)						
5	23CD201	Database Management Systems	1/0/4	5	3	9,11,16,17
6	23CY203	Programming in Java	1/0/4	5	3	4,8,9,12
Practical (Internal 60 Marks & External 40 Marks)						
7	23AS102	Applied Science Laboratory	0/0/4	4	2	4,6,7,13
8	23EE205	Electron Devices and Circuits Laboratory	0/0/2	2	1	7,9,12

Indian Knowledge System - Blended Learning (Internal 100 Marks)						
9	23TA201	Tamils and Technology	1/0/0	1	1	4,10,11,12,13
Mandatory Course (Internal 100 Marks)						
10	23MC102	Environmental Sciences	1/0/0	1	0	6,7,12,13,14,15,17
Total				32	24	

Semester – III						
S.No	Course Code	Course Name	L/T/P	Total Hours	Credits	SDG Mapping
Theory (Internal 40 Marks & External 60 Marks)						
1	23GE301	Universal Human Values	3/0/0	3	3	4,16,10
2	23EE307	Electromagnetic Field Theory	3/0/0	3	3	7,9,12
Theory with Practical (Internal 50 Marks & External 50 Marks)						
3	23EE305	DC Machines and Transformers	3/0/2	5	4	7,9,13
4	23EE308	Integrated Circuits	3/0/2	5	4	7,9,12
5	23EE306	Digital Circuits and Logic Design	3/0/2	5	4	4,9,12
6	23CSC01	Data Structures	3/0/2	5	4	4,9,17
Practical (Internal 60 Marks & External 40 Marks)						
7	23MEC04	Design Thinking and Idea Lab	0/0/2	2	1	8,9,12
Certification/Online Course						
Certification/Spoken Tutorial/Coursera/NPTEL Courses - Minimum one Course Mandatory						
Total				28	23	

Semester – IV						
S.No	Course Code	Course Name	L/T/P	Total Hours	Credits	SDG Mapping
Theory (Internal 40 Marks & External 60 Marks)						
1	23EE404	Renewable Energy and Storage Systems	3/0/0	3	3	7,9,12,13
2	23EC301	Signals and Systems	3/1/0	4	4	7,9,12
3	23EE0XX	Open / Emerging/ Industrial Elective – I	2/0/2	4	3	1-17
Theory with Practical (Internal 50 Marks & External 50 Marks)						
4	23EE407	Control Theory	3/0/2	5	4	7,9,12
5	23EE408	Induction and Synchronous Machines	3/0/2	5	4	7,9,13

6	23CS302	Python Programming	1/0/4	5	3	4,9,17
Spoken Language (Internal 100 Marks)						
7	23SLC01	Multilingual Practices	0/0/2	2	1	4,10,16
Certification/Online Course						
Certification/Spoken Tutorial/Coursera/NPTEL Courses - Minimum one Course Mandatory						
Total				29	22	

Semester – V						
S.No	Course Code	Course Name	L/T/P	Total Hours	Credits	SDG Mapping
Theory (Internal 40 Marks & External 60 Marks)						
1	23EE403	Transmission and Distribution	3/0/0	3	3	7,9,13
2	23EE501	Electric Vehicle Technology	3/0/0	3	3	7,9,11,13
3	23EE9XX	Professional Elective - I	3/0/0	3	3	1-17
Theory with Practical (Internal 50 Marks & External 50 Marks)						
4	23EE502	Power Electronics	3/0/2	5	4	7,9,12
5	23EE504	Microcontroller and Interfacing	3/0/2	5	4	7,9,12
6	23EE604	Virtual Instrumentation	2/0/2	4	3	7,9,12
Capstone Project (Internal 100 Marks)						
7	23EE505	Capstone Project - I Mern Stack	0/0/4	4	2	8,9,17
Mandatory Course (Internal 100 Marks)						
8	23MCC01	Mandatory Course- IV - Indian Constitution	1/0/0	1	0	4,10,16
Total				28	22	

Semester – VI						
S.No	Course Code	Course Name	L/T/P	Total Hours	Credits	SDG Mapping
Theory - Blended Learning (Internal 100 Marks)						
1	23GEC01	Entrepreneurship and Startups	3/0/0	3	3	8,9,10
Theory (Internal 40 Marks & External 60 Marks)						
2	23EE607	Communication Engineering	3/0/0	3	3	4,7,9
3	23EE602	Power System Protection and Switchgear	3/0/0	3	3	7,9,13
4	23EE9XX	Professional Elective - II	3/0/0	3	3	1-17

Theory with Practical (Internal 50 Marks & External 50 Marks)						
5	23EE603	Power System Analysis	3/0/2	5	4	7,9,13
6	23EC604	Embedded Systems and Connected Devices	3/0/2	5	4	7,9,12,13
Capstone Project (Internal 100 Marks)						
7	23EE605	Prototype Lab	0/0/2	2	1	8,9,12
8	23EE606	Capstone Project – II	0/0/4	4	2	4,8,9
Total				28	23	

Semester – VII						
S.No	Course Code	Course Name	L/T/P	Total Hours	Credits	SDG Mapping
Theory (Internal 40 Marks & External 60 Marks)						
1	23EE0XX	Open / Emerging/ Industrial Elective – II	3/0/0	3	3	1-17
2	23EE0XX	Open / Emerging/ Industrial Elective – III	3/0/0	3	3	1-17
3	23EE9XX	Professional Elective – III	3/0/0	3	3	1-17
4	23EE9XX	Professional Elective – IV	3/0/0	3	3	1-17
5	23EE9XX	Professional Elective – V	3/0/0	3	3	1-17
Project (Internal 60 Marks & External 40 Marks)						
6	23EE702	Project – I	0/0/6	6	3	4,9,10,16,17
Internship (Internal 100 Marks)						
7	23EES01	Employability Enhancement Skills (Internship)	28 Days		2	4,8,9,10,17
Total				21	20	

Semester – VIII						
S.No	Course Code	Course Name	L/T/P	Total Hours	Credits	SDG Mapping
1	23EE801	Project – II	0/0/24	24	12	4,8,9,12,13,17
Total				24	12	

TOTAL CREDITS – 168

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

S.No	Stream	Credits/Semester								C	%
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences Including Management (HSMC)	4	1	3	-	-	3	-	-	11	6.55
2	Basic Sciences (BSC)	7	10	-	-	-	-	-	-	17	10.12
3	Engineering Sciences (ESC)	11	6	5	3	-	-	-	-	25	14.88
4	Professional Core (PCC)	-	7	15	15	17	14	-	-	68	40.48
5	Professional Electives (PEC)	-	-	-	-	3	3	9	-	15	8.93
6	Open Electives (OEC) / Emerging Elective Courses (EEC)	-	-	-	3	-	-	6	-	09	5.36
7	Project Work (PRJ)	-	-	-	-	2	3	5	12	22	13.10
8.	Mandatory Course (MC) / Spoken Language Course	0	0	-	1	0	-	-	-	1	0.60
Total		22	24	23	22	22	23	20	12	168	100

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

S. No.	Course Work - Subject Area	AICTE Suggested Credits	SKCET Credits
1.	Humanities and Social Sciences (HS), including Management;	12*	11
2.	Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology;	32*	17
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	29*	25
4.	Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required	64*	68
5.	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	15*	15
6.	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	09*	09
7.	Project Work, Seminar and/or Internship in Industry or elsewhere.	15*	22
8.	Mandatory Courses (MC)/ Mandatory Course (MC) / Spoken Language Course	Non-credit	1
Total		176*	168

*Minor Variations is allowed as per need of the respective disciplines

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (11 Credits)

S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23EN101	Oral and Written Communication Skills	2/0/2	4	3	HSMC
2.	23TA101	Heritage of Tamils	1/0/0	1	1	HSMC
3.	23TA201	Tamils and Technology	1/0/0	1	1	HSMC
4.	23GE301	Universal Human Values	3/0/0	3	3	HSMC
5.	23GEC01	Entrepreneurship and Startups	3/0/0	3	3	HSMC

BASIC SCIENCE COURSES (17 Credits)

S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23SB102	Biology for Engineers	3/0/0	3	3	BSC
2.	23MA101	Mathematics I	3/1/0	4	4	BSC
3.	23MA205	Differential Equations and Transform Techniques	3/1/0	4	4	BSC
4.	23AS101	Applied Science	4/0/0	4	4	BSC
5.	23AS103	Applied Science Laboratory	0/0/4	4	2	BSC

ENGINEERING SCIENCE COURSES (25 Credits)

S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23EE101	Basics of Electrical Circuits	3/1/0	4	4	ESC
2.	23EE102	Basics of Electrical Circuits Laboratory	0/0/2	2	1	ESC
3.	23IT101	Application Development Practices	1/0/4	5	3	ESC
4.	23CS101	Problem Solving using C++	1/0/4	5	3	ESC
5.	23CD201	Database Management Systems	1/0/4	5	3	ESC
6.	23CY203	Programming in Java	1/0/4	5	3	ESC
7.	23CSC01	Data Structures	3/0/2	5	4	ESC
8.	23MEC04	Design Thinking and Idea Lab	0/0/2	2	1	ESC
9.	23CS302	Python Programming	1/0/4	5	3	ESC

PROFESSIONAL CORE COURSES (68 Credits)

S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23EE201	Measuring Instruments and Smart Sensors	3/0/0	3	3	PCC
2.	23EE204	Electron Devices and Circuits	3/0/3	3	3	PCC
3.	23EE205	Electron Devices and Circuits Laboratory	0/0/2	2	1	PCC
4.	23EE307	Electromagnetic Field Theory	3/0/0	3	3	PCC
5.	23EE305	DC Machines and Transformers	3/0/2	5	4	PCC
6.	23EE308	Integrated Circuits	3/0/2	5	4	PCC
7.	23EE306	Digital Circuits and Logic Design	3/0/2	5	4	PCC

8.	23EE404	Renewable Energy and Storage Systems	3/0/0	3	3	PCC
9.	23EC301	Signals and Systems	3/1/0	4	4	PCC
10.	23EE407	Control Theory	3/0/2	5	4	PCC
11.	23EE408	Induction and Synchronous Machines	3/0/2	5	4	PCC
12.	23EE403	Transmission and Distribution	3/0/0	3	3	PCC
13.	23EE501	Electric Vehicle Technology	3/0/0	3	3	PCC
14.	23EE502	Power Electronics	3/0/2	5	4	PCC
15.	23EE504	Microcontroller and Interfacing	3/0/2	5	4	PCC
16.	23EE604	Virtual Instrumentation	2/0/2	4	3	PCC
17.	23EE607	Communication Engineering	3/0/0	3	3	PCC
18.	23EE602	Power System Protection and Switchgear	3/0/0	3	3	PCC
19.	23EE603	Power System Analysis	3/0/2	5	4	PCC
20.	23EC604	Embedded Systems and Connected Devices	3/0/2	5	4	PCC

PROFESSIONAL ELECTIVE COURSES (15 Credits)

S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
ELECTIVE STREAM I - POWER ENGINEERING						
1.	23EE901	Power System Management and Monitoring	3/0/0	3	3	PEC
2.	23EE902	Power System Operation and Economics	3/0/0	3	3	PEC
3.	23EE903	Power Quality	3/0/0	3	3	PEC
4.	23EE904	High Voltage Engineering	3/0/0	3	3	PEC
5.	23EE905	Power System Automation	3/0/0	3	3	PEC
6.	23EE906	Residential Electrical Systems	3/0/0	3	3	PEC
7.	23EE938	Smart Grid Technology	3/0/0	3	3	PEC
8.	23EE939	Energy Audit and Management	3/0/0	3	3	PEC
9.	23EE940	Insulation Engineering and Condition Monitoring	3/0/0	3	3	PEC
ELECTIVE STREAM II - APPLIED ELECTRONICS						
1.	23EE907	Process Control and Instrumentation	3/0/0	3	3	PEC
2.	23EE908	Avionics Technology	3/0/0	3	3	PEC
3.	23EE909	MEMS and Nanoelectronics	3/0/0	3	3	PEC
4.	23EE910	VLSI Technology	3/0/0	3	3	PEC
5.	23EE911	Wireless Communication	3/0/0	3	3	PEC
6.	23EE941	Green Electronics and Sustainable Design	3/0/0	3	3	PEC
7.	23EE942	Radar Engineering	3/0/0	3	3	PEC
8.	23EE943	Modern Control Systems	3/0/0	3	3	PEC
9.	23EE944	ASIC Design	3/0/0	3	3	PEC
ELECTIVE STREAM III - INTEGRATED ELECTRONIC SYSTEMS						
1.	23EE912	Embedded System Design using ARM	3/0/0	3	3	PEC
2.	23EE913	Machine Learning for Embedded Applications	3/0/0	3	3	PEC
3.	23EE914	Embedded System Programming	3/0/0	3	3	PEC
4.	23EE915	Embedded Systems for Automotive Applications	3/0/0	3	3	PEC
5.	23EE916	Embedded Systems in Smart Grid	3/0/0	3	3	PEC
6.	23EE917	Embedded Control for Electrical Drives	3/0/0	3	3	PEC
7.	23EE945	Photonic Integrated Circuits	3/0/0	3	3	PEC
8.	23EE946	FPGA Design and Applications	3/0/0	3	3	PEC

9.	23EE947	Advanced Microcontroller and Microprocessor Architectures	3/0/0	3	3	PEC
ELECTIVE STREAM IV - CONVERTER AND DRIVES						
1.	23EE918	Design of Electrical Machines	3/0/0	3	3	PEC
2.	23EE919	Special Electrical Machines	3/0/0	3	3	PEC
3.	23EE920	PLC, SCADA and Automation	3/0/0	3	3	PEC
4.	23EE921	Servo Drives in Robotics	3/0/0	3	3	PEC
5.	23EE922	Modern Power Converters	3/0/0	3	3	PEC
6.	23EE923	Intelligent Controllers for Drone Technology	3/0/0	3	3	PEC
7.	23EE948	Solid State Drives	3/0/0	3	3	PEC
8.	23EE949	IoT-Enabled Drive Systems	3/0/0	3	3	PEC
9.	23EE950	Next-Generation Power Semiconductor Devices	3/0/0	3	3	PEC
ELECTIVE STREAM V - RENEWABLE ENERGY SYSTEMS						
1.	23EE924	Optimal Energy Controllers	3/0/0	3	3	PEC
2.	23EE925	Industrial Electrification using Renewable Energy System	3/0/0	3	3	PEC
3.	23EE926	Power Electronics for Renewable Energy System	3/0/0	3	3	PEC
4.	23EE927	Hybrid Smart grid Technology	3/0/0	3	3	PEC
5.	23EE928	Fuel Cell and Biogas System	3/0/0	3	3	PEC
6.	23EE929	Hybrid Wind and Solar Electric Systems	3/0/0	3	3	PEC
7.	23EE930	Rural Electrification Technologies and Economics	3/0/0	3	3	PEC
8.	23EE952	Geothermal Power Generation	3/0/0	3	3	PEC
9.	23EE953	Clean Energy and Carbon Management	3/0/0	3	3	PEC
ELECTIVE STREAM VI - E-MOBILITY						
1.	23EE931	Vehicle Charging Infrastructure	3/0/0	3	3	PEC
2.	23EE932	Vehicle Design and Fabrication	3/0/0	3	3	PEC
3.	23EE933	Autonomous Electric Vehicle	3/0/0	3	3	PEC
4.	23EE934	Vehicle - to-Grid Integration	3/0/0	3	3	PEC
5.	23EE935	Renewable Energy Integration with EV Charging	3/0/0	3	3	PEC
6.	23EE936	Plug-in Hybrid Electric Vehicles (PHEV)	3/0/0	3	3	PEC
7.	23EE937	Electric Power Train	3/0/0	3	3	PEC
8.	23EE955	Battery Management System	3/0/0	3	3	PEC
9.	23EE956	Communication Technologies in EV	3/0/0	3	3	PEC

OPEN / INDUSTRIAL EMERGING ELECTIVE (09 Credits)

S. No.	Course Code	Course Title	L/T/P	Contact hrs./ Wk	C	Cat.
1.	23EE001	Residential and Commercial Electrical Systems	3/0/0	3	3	OEC
2.	23EE002	Autonomous Vehicles	3/0/0	3	3	OEC
3.	23EE003	Special Purpose Machines	3/0/0	3	3	OEC
4.	23EE004	Renewable Energy Sources	3/0/0	3	3	OEC
5.	23EE005	Servo and Robot Drives	3/0/0	3	3	OEC
6.	23EE006	Industrial Safety Management	3/0/0	3	3	OEC
7.	23EE007	Machine Learning Applications in Energy Systems	3/0/0	3	3	EEC
8.	23EE008	Big Data Analytics for Smart Grid	3/0/0	3	3	EEC
9.	23EE009	Real Time Systems	3/0/0	3	3	EEC
10.	23EE010	Flexible and Stretchable Electronics	3/0/0	3	3	EEC

11.	23EE011	Rapid System Prototyping with FPGAs	3/0/0	3	3	EEC
12.	23EE012	Augmented and Virtual Reality	3/0/0	3	3	EEC

PROJECT WORK (20 Credits)

S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23EE505	Capstone Project – I	0/0/4	4	2	PRJ
2.	23EE605	Capstone Project – II	0/0/4	4	2	PRJ
3.	23EE606	Prototype Lab	0/0/2	2	1	PRJ
4.	23EE702	Project – I	0/0/6	6	3	PRJ
5.	23EE801	Project – II	0/0/24	24	12	PRJ

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI
Power System Management and Monitoring	Process Control and Instrumentation	Embedded System Design using ARM	Design of Electrical Machines	Optimal Energy Controllers	Vehicle Charging Infrastructure
Power System Operation and Economics	Avionics Technology	Machine Learning for Embedded Applications	Special Electrical Machines	Industrial Electrification using Renewable Energy System	Vehicle Design and Fabrication
Power Quality	Radar Engineering	Embedded System Programming	PLC, SCADA and Automation	Power Electronics for Renewable Energy System	Autonomous Electric Vehicle
High Voltage Engineering	VLSI Technology	Embedded Systems for Automotive Applications	Servo Drives in Robotics	Hybrid Smart grid Technology	Vehicle - to - Grid Integration
Power System Automation	Wireless Communication	Embedded Systems in Smart Grid	Modern Power Converters	Fuel Cell and Biogas System	Renewable Energy Integration with EV Charging
Residential Electrical Systems	Green Electronics and Sustainable Design	Embedded Control for Electrical Drives	Intelligent Controllers for Drone Technology	Hybrid Wind and Solar Electric Systems	Plug - in Hybrid Electric Vehicles (PHEV)
Smart Grid Technology	MEMS and Nanoelectronics	Photonic Integrated Circuits	Solid State Drives	Rural Electrification Technologies and Economics	Electric Power Train
Energy Audit and Management	Modern Control Systems	FPGA Design and Applications	IoT-Enabled Drive Systems	Geothermal Power Generation	Battery Management System
Insulation Engineering and Condition Monitoring	ASIC Design	Advanced Microcontroller and Microprocessor Architectures	Next-Generation Power Semiconductor Devices	Clean Energy and Carbon Management	Communication Technologies in EV

INTERN (02 Credits)

S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23EES01	Employability Enhancement Skills (Internship)		28 Days	2	INT

VALUE ADDED COURSES

(Based on student's interest)

S. No.	Course Code	Course Title	Contact hrs.	C	Sem
1.	23VA301	Circuit to Product	30	2	III
2.	23VA302	IoT based Micropython	30	2	VI
3.	23VA303	Contemporary Digital Techniques	30	2	V
4.	23VA304	FPGA-based Switched Mode Power Converters	30	2	V/VI
5.	23VA305	Phase-Locked Loop Circuit Design	30	2	V/VI
6.	23VA306	Substation Designing	30	2	V/VI
7.	23VA307	IoT using Raspberry Pi	30	2	V/VI
8.	23VA308	Recent Power Electronics and Control	30	2	V/VI
9.	23VA309	Neuro-Instrumentation	30	2	V/VI
10.	23VA504	Massive Open Online Courses (MOOC) / NPTEL	30	1	I-VIII

MANDATORY COURSES (Non-Credits)/SPOKEN LANGUAGE COURSE

(Courses conducted either by internal faculty or through MOOCs)

S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Cat.
1.	23MC101	Induction Program		3 weeks	0	MC
2.	23MC102	Environmental Sciences	1/0/0	1	0	MC
3.	23MC103	Soft Skills	1/0/0	1	0	MC
4.	23MC104	Management Organizational Behaviour	1/0/0	1	0	MC
5.	23MC105	General Aptitude	1/0/0	1	0	MC
6.	23MC106	Life Skills and Ethics	1/0/0	1	0	MC
7.	23MC107	Stress Management	1/0/0	1	0	MC
8.	23MCC01	Indian Constitution	1/0/0	1	0	MC
9.	23MC109	Essence of Indian Traditional Knowledge	1/0/0	1	0	MC
10.	23SLC01	Multilingual Practices	0/0/2	2	1	SLC

L: Lecture **T:** Tutorial **P:** Practical **C:** Credit **O:** Outside Class hours **Cat.:** Category

HSMC : Humanities and Social Sciences including Management **OEC** : Open and Emerging Elective Courses
BSC : Basic Science Courses **PRJ** : Project Work
ESC : Engineering Science Courses **INT** : Internship
PCC : Professional Core Courses **MC** : Mandatory Course
PEC : Professional Elective Courses **SLC** : Spoken Language Course

Definition of Credit:

L – Lecture	1 Hr. Lecture (L) per week	1 credit
T – Tutorial	1 Hr. Tutorial (T) per week	1 credit
P - Practical/Practice (Project and Industry based Courses)	1 Hr. Practical (P) per week	0.5 credit

SEMESTER – III

23GE301	UNIVERSAL HUMAN VALUES (Common to all branches)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.
5. Helping the students to appreciate the essential complementarities between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
6. Highlighting 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.

COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION, UNDERSTANDING HARMONY IN THE HUMAN BEING-HARMONY IN MYSELF! 15

Self-evaluation of the students -Pre-testof UHV- Purpose and motivation for the course. Self-exploration - Its content and process- A look at basic Human Aspirations. Understanding Happiness and Prosperity correctly-Understanding the needs of Self ('I') and 'Body'-Understanding the Body as an instrument of 'I'(being the doer, seer and enjoyer)-Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of 'I' with the Body- Social activities - Waste Management - Water Conservation-Soil Pollution - Physical Health and related activities - Lectures by eminent persons- Literary activities.

UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP, UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE- WHOLE EXISTENCE AS COEXISTENCE 15

Understanding values in human relationship - Understanding the harmony in the society (society being an extension of family): - Visualizing a universal harmonious order in society - Understanding the harmony in Nature-Understanding Existence as Coexistence of mutually Interacting units in all - pervasive space. Holistic perception of harmony at all levels of existence-Buddy program - Relationships - Homesickness - Managing peer pressure - Projects - Socially responsible engineers - Visit to local areas (orphanages, special children) - Physical Activities (games).

IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 15

Natural acceptance of human values- Definitiveness of Ethical Human Conduct- Basis for Humanistic Education-Humanistic Constitution and Humanistic Universal Order-Competence in professional ethics-Case studies of typical holistic technologies, management models and eco-friendly production systems - Strategy for transition from

the present state to Universal Human Order-Sum up: Self-evaluation of the students-
Post test of UHV.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Understand and take responsibilities in life and handle problems to attain sustainable solutions while keeping human relationships and human nature in mind.	[U]
CO2	Apply responsibilities towards their commitments (human values, human relationship and human society).	[AP]
CO3	Apply what they have learnt to their own self indifferent day-to-day settings in real life, at least a beginning would be made in this direction.	[AP]
CO4	Analyze ethical and unethical practices, and formulate strategies to actualize a harmonious environment wherever they work.	[AN]
CO5	Understand the harmony in nature and existence, and work out mutually on fulfilling participation in nature.	[U]

TEXTBOOKS

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. Rajni Setia, Priyanka Sharma, "Human Values", Genius Publication", Jaipur, 2019.

REFERENCE BOOKS

1. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
2. The Story of My Experiments with Truth –by Mohandas Karamchand Gandhi
3. India Wins Freedom-Maulana Abdul Kalam Azad.

WEB RESOURCES

1. <https://examupdates.in/professional-ethics-and-human-values/>
2. <http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html>
3. <https://www.yourmorals.org/schwartz.2006.basic%20human%20values.pdf>
4. <https://nptel.ac.in/courses/109/104/109104068/>
5. <https://medium.com/the-mission/the-12-important-life-skills-i-wish-id-learned-in-school-f4593b49445b>
6. <https://www.thebalancecareers.com/life-skills-list-and-examples-4147222>

23EE307	ELECTROMAGNETIC FIELD THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To understand the basic concepts of vector calculus and different co-ordinate systems.
2. To analyse electric field, magneto static fields and electro dynamic fields.
3. To understand the concepts of propagation of electromagnetic waves, Poynting vector and the role field theory plays in transmission line design

REVIEW OF VECTOR CALCULUS

10

Unit vectors - Vector algebra - Co-ordinate system: Differential elements of rectangular, cylindrical and spherical co-ordinate system - Transformation of vectors: cartesian to cylindrical and cartesian to spherical - Divergence of a vector - Divergence theorem - Curl - Stokes theorem

ELECTROSTATICS AND MAGNETOSTATICS

20

Electrostatics: Electric flux density - Gauss's law - Proof - Applications of Gauss's law in coaxial cable and differential volume element - Coulomb's law - Electric field intensity - Electric field and potential due to point, line, plane and spherical charge - Electric dipole - Energy density in electrostatic fields - Boundary conditions: Conductor and free space - Two perfect dielectrics - Capacitance of parallel plate and co-axial cable. **Magnetostatics:** Magnetic flux density - Lorentz force law - Biot-savart's law - Magnetic field due to long conductor and circular conductor - Ampere's circuital law - Application of Ampere's Law in coaxial cable - Magnetic dipole - Boundary conditions for normal and tangential component.

ELECTRODYNAMIC FIELDS

15

Faraday's law - Lenz's law - Displacement current - Displacement current density - Inductance - Magnetomotive force - Reluctance of solenoid and co-axial cable - Maxwell's equation: Static field - Time varying fields - **Electromagnetic waves:** Electromagnetic wave equation - Uniform plane waves in free space - Phase velocity - Intrinsic impedance - Propagation constant - Attenuation constant - Phase constant - Wavelength - Uniform plane waves in good conductor - Depth of penetration - Poynting vector and Poynting theorem.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to,

- CO1 Apply vector calculus to analyse the behaviour of static electric and magnetic fields. [AP]

CO2	Analyse the nature of electrostatic fields.	[AN]
CO3	Analyse the features of magnetostatic fields.	[AN]
CO4	Apply the concepts of Faraday's law, Lens law and Maxwell's equations to solve the problems of time varying electric and magnetic fields.	[AP]
CO5	Analyse and examine the characteristics of electromagnetic waves.	[AN]

TEXT BOOKS

1. Bhag Singh Guru, Hüseyin R. Hiziroglu, "Electromagnetic Field Theory Fundamentals", Cambridge university Press, PWS Publishing Company, 2nd Edition 2022.
2. Constantine A. Balanis, "Advanced Engineering Electromagnetics", Wiley, 3rd Edition, 2024.
3. William Hayt, John Buck and Akhtar, "Engineering Electromagnetics", McGraw Hill Education, 2017.

REFERENCE BOOKS

1. Matthew N.O.Sadiku, " Principles of Electromagnetics", Oxford University Press, 6th Edition, 2015.
2. John Kraus and Daniel Fleisch, "Electromagnetics with Applications", McGraw Hill Education, 5th Edition, 2017.
3. VolodymyrKrasnoholovets, "Electromagnetic Theory: New Research and Developments", Nova Science Publishers, 2025.

WEB RESOURCES

1. <https://archive.nptel.ac.in/courses/108/104/108104087/>
2. <https://www.coursera.org/learn/electrodynamics-electric-magnetic-fields#modules>
3. <https://nptel.ac.in/courses/115101005>
4. <https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/>
5. <https://www.udemy.com/course/electromagnetic-theory-a-comprehensive-course/?couponCode=ST14MT150425G3>

23EE305	DC MACHINES AND TRANSFORMERS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1. To study the basic concepts of DC generator and its characteristics.
2. To understand the construction, working principle of DC motor and analyse their performance.
3. To familiarize with the construction details and principle of operation of different types of transformers.

DC GENERATOR

15

Construction, Principle of operation - EMF equation - Types of generators , OCC and load characteristics - Armature reaction, effect of brush lead, demagnetizing and cross magnetizing ampere turns, compensating windings - Commutation, methods of improving commutation - Parallel operation of DC Generators - case study : Application of DC generators for energy storage .

DC MOTOR

15

Principle of operation, types of dc motors, torque equation - Electrical and mechanical characteristics - Need for starters, types of starters, soft starters - Braking - Speed control methods - Testing of DC motors - Case study: Application of DC motors in Electric Vehicles, Robotics, and Crane.

SINGLE PHASE AND THREE PHASE TRANSFORMERS

15

Construction -principle of operation - types - equivalent circuit - phasor diagram - regulation and efficiency - Separation of hysteresis and eddy current losses - Testing of transformers - open circuit and short circuit tests, polarity test, back - to-back test - three phase transformers - construction, types of connections and their comparative features. Autotransformer, All day efficiency - Parallel operation of transformers. Case study: Application of energy efficient transformers in distribution systems.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Analyze the open circuit and load characteristics of DC separately excited generator.
2. Examine the efficiency and speed-torque characteristic of DC motors.
3. Predict the efficiency of a DC machine under various load conditions using Swinburne's test for energy auditing.
4. Examine the speed control methods of DC Shunt motor.
5. Determination of equivalent circuit parameters of single phase transformer.
6. Verification of three-phase transformer connections to ensure phase alignment in industrial load centers.

7. Separate the hysteresis and eddy current losses in a single phase transformer to optimize core material selection in power equipment.
8. Conduct Sumpner's test to evaluate the full load efficiency of identical transformers for parallel operation in load sharing networks.
9. Simulate the operating characteristics of DC Motors for performance analysis in industrial drives using Simulation.
10. Study the magnetization characteristics of DC Shunt Generator using Virtual lab.
11. Analyze the load characteristics DC shunt generator using Virtual lab.
12. Develop a miniature conveyor belt driven by a DC motor with speed and direction control.

TOTAL (Lab): 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

CO1	Understand the constructional details and principles of DC machines.	[U]
CO2	Analyze the performance characteristics of the DC machines under various operating conditions through proper testing.	[AN]
CO3	Choose an appropriate DC motor for any industrial application and appraise its significance.	[AP]
CO4	Interpret the constructional details of different type of transformers, working principle and their performance.	[U]
CO5	Analyze various three phase transformer connections and performance testing of Transformers.	[AN]

TEXT BOOKS

1. Fitzgerald A.E., Charles Kingsley JR., Stephen D. Umans, "Electric Machinery", 7th Edition, McGraw Hill International Edition, New York, 2017.
2. Theraja B.L. and Theraja A K , "A text book of Electrical technology", S Chand and company limited,24th Edition,2025.
3. Kothari D.P. and Nagrath I.J., "Electric Machines", Tata McGraw Hill Publishing Company Limited, 2017.

REFERENCE BOOKS

1. Nagrath I. J. and Kothari D. P., "Electric Machines", McGraw Hill Education, 5th Edition, 2017
2. Bimbhra P. S., "Electrical Machinery", Khanna Publishers, 2021.
3. Gupta J.B., "Electrical Machines-I", S K Kataria & Sons, 2024.

WEB RESOURCES

1. <https://archive.nptel.ac.in/courses/108/105/108105155/>
2. <https://library.automationdirect.com/selecting-motors-industrial-applications/>
3. <https://electrical-engineering-portal.com/erection-procedure-for-power-transformer.>
4. <https://www.coursera.org/learn/motors-circuits-design>
5. https://onlinecourses.swayam2.ac.in/ntr25_ed47/preview

23EE308	INTEGRATED CIRCUITS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1. To construct the platform for understanding the various functionality of Linear Integrated Circuits.
2. To familiarize the linear and non-linear applications of IC 741 operational amplifiers.
3. To sense the concepts of VCO and PLL with its applications.
4. To interpret the real time signal analysis based on ADC and DAC IC.
5. To impart the knowledge of integrated circuits on Application specific functions.

FUNDAMENTALS OF OP-AMPS AND DIFFERENTIAL CIRCUITS

15

Basic information of Op-Amp, Differential amplifier - Differential amplifier with constant current source - current mirror - Wilson Current Mirror Circuit and Widlar Current Mirror Circuit. Characteristics of Op-Amp - frequency response - stability - OP-AMP design - inverting and non-inverting amplifiers - instrumentation amplifier - integrator and differentiator - voltage-to-current converter - Schmitt trigger - waveform generator.

SIGNAL PROCESSING AND CONVERSION CIRCUITS

15

Active Filters: LP, HP, BP, BR- Butterworth filter- Digital to Analog converters (DAC), Analog to Digital converters (ADC). Types of DAC: Weighted resistor, R-2R ladder - Sample and Hold Circuit. Types of ADC: Flash Type, Successive approximation. Astable and Monostable Multivibrators using 555 Timer.

VOLTAGE REGULATORS AND SPECIAL FUNCTION IC'S

15

VCO, PLL and its application, Analog Multiplier using Emitter Coupled Transistor Pair - IC Voltage Regulators - Three terminal fixed and adjustable voltage regulators - 723 General Purpose Regulators - Switching regulator - Audio Power Amplifier - Fiber optic ICs - AC and DC analysis using circuit simulation using SPICE.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Inverting and Non-inverting Op-amp.
2. Applications of Op-amp (Adder, Subtractor, Adder-Subtractor, Average Amplifier).
3. Integrator and Differentiator using Op-amp.
4. Instrumentation Amplifier using Op-Amp.
5. Waveform generation using Op-Amp.
6. Design of Active filters (LPF, HPF).

7. Simulation of Analog to Digital Converter using Multisim / Orcad /Pspice
8. Simulation of Digital to Analog Converter using Multisim / Orcad /Pspice
9. Simulation of Multivibrators using Multisim / Orcad /Pspice
10. Simulation of Wein bridge and RC phase shift oscillator using Multisim / Orcad /Pspice

TOTAL (Lab): 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

- | | | |
|-----|--|------|
| CO1 | Use the functional blocks of linear integrated circuits and design linear applications using operational amplifiers | [AP] |
| CO2 | Analyse the characteristics, and application areas of operational amplifiers | [AN] |
| CO3 | Apply the concepts and applications of VCO and PLL | [AP] |
| CO4 | Employ the properties of operational amplifiers to design Analog-to-Digital Converters (ADCs) and Digital-to-Analog Converters (DACs) for real-time signal processing. | [AP] |
| CO5 | Apply the principles of integrated circuits to design and implement voltage regulators | [AP] |

TEXT BOOKS

1. Roy Choudhury D. & ShailBala Jain, "Linear IntegratedCircuits", 6th Edition, New Age International Publishers, New Delhi, 2022.
2. Yashavant P. Kanetkar, "Let us C++", BPB Publications, 2020.
3. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", McGraw-Hill, 4th edition, 2016. (Reprint)

REFERENCE BOOKS

1. Salivahanan S., KanchanaBhaaskaran V S, "Linear Integrated Circuits", McGraw-Hill, 3rd edition,2023 (Reprint).
2. Michael Jacob J, "Analog Integrated Circuits and Applications", 1st Edition, Prentice Hall of India, New Delhi,2019

WEB RESOURCES

1. <http://www.electronics-tutorials.ws>
2. <http://www.allaboutcircuits.com>
3. <http://nptel.ac.in/courses/117107094/>
4. <http://www.technologystudent.com/elec1/elecex.htm>

23EE306	DIGITAL CIRCUITS AND LOGIC DESIGN	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1. To explain the principles of canonical forms and apply techniques for minimizing logic expressions.
2. To understand the various combinational and sequential logic circuits.
3. To analyze and evaluate synchronous sequential circuits.
4. To design and implement memory devices for combinational logic systems.
5. To develop and simulate Verilog code for combinational logic circuits.

LOGIC FUNCTIONS AND MINIMIZATION

15

Canonical Forms - Minterms, Maxterms, Complements, Subtraction using Complements (10's complement and 2's complement). Implementation of Boolean function using universal logic gates, Minimizing functions using Karnaugh map and Quine McClusky method (4 Variable).

COMBINATIONAL & SEQUENTIAL LOGIC CIRCUITS

15

Full Adder and Full Subtractor - Multiplexer, Demultiplexer, Implementation of combinational logic functions using Multiplexer and Demultiplexer, Encoders, Decoders, Priority Encoder. Code converters - Binary to Gray, Gray to Binary, BCD to Excess-3, Parity generator and checker - Latches and flip flops (SR, D, T, JK) - Realization of one flip flop using other flip flops, Asynchronous Up counter, Synchronous counter design using flip flops (T, JK) - Shift registers - Types of shift register - SISO, SIPO, PISO, PIPO - Application of shift registers.

SYNCHRONOUS SEQUENTIAL & PROGRAMMABLE LOGIC CIRCUITS

15

Clocked sequential circuits - Mealy model, Moore model - Analysis of clocked sequential circuits using D,T and JK Flip flops - State equations, state table, state diagram, state reduction and state assignment. ROM, PROM, Programmable Logic Devices - PLA, PAL, Implementation of combinational logic functions using PLA, PAL. Modeling of basic combinational circuits using Verilog - Gate level modeling, Data flow modeling, Behavioral modeling.

TOTAL (THEORY): 45 PERIODS

LIST OF EXPERIMENTS

1. Design a basic alarm circuit using logic gates to detect intrusions.
2. Implement and verify the truth table of adder and subtractor.
3. Synthesize and implement 2x1 Multiplexer and Demultiplexer circuit.
4. Synthesize and implement Encoder and Decoder circuits.
5. Implement BCD to 7 Segment LED display decoder with multiple input and multiple output combinational digital circuit using Virtual Lab.
6. Verify truth table of RS,T,D flip flops using Virtual Lab.

7. Simulate a digital clock module through a 4 - bit synchronous up/down counter using Virtual Lab.
8. Design and simulate 4 bit Asynchronous counter, BCD counter, Johnson counter and ring counter using Virtual Lab.
9. Design a shift register-based UART transmitter for serial communication applications using Virtual Lab.
10. Design a traffic light controller using Finite State Machine approach.

TOTAL (LAB): 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to,

CO1	Illustrate the Canonical forms and minimize the Boolean functions using K Maps and Tabulation method.	[AP]
CO2	Design and implement various combinational logic circuits.	[AP]
CO3	Design and implement various sequential logic circuits.	[AP]
CO4	Analyze and design synchronous sequential circuits using state reduction and state assignment.	[AN]
CO5	Apply the programmable logic devices and model combinational circuits using Verilog.	[AP]

TEXTBOOKS

1. Roger L. Tokheim, Patrick E. Hoppe, "Digital Electronics: Principles and Applications", McGraw Hill, 9th Edition, 2021.
2. M. Morris Mano, Michael D. Ciletti., "Digital Design", 6th Edition Reprint, Pearson education, 2020.
3. Charles H. Roth, Jr. "Digital Systems Design Using Verilog", Cengage Learning, 2nd Edition, 2020.
4. Donald P Leach, Albert Malvino, "Digital principles and Applications", Tata McGraw Hill, 8th Edition, 2014.

REFERENCE BOOKS

1. Floyd T.L., "Digital Fundamentals ", Pearson Education; 11th edition, Reprint, 2021.
2. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2021
3. Ming-Bo Lin, "Digital Systems Design and Practice: Using Verilog HDL and FPGAs", 2nd Edition, Create Space Independent Publishing Platform, 2019.

WEB RESOURCES

1. <https://archive.nptel.ac.in/courses/108/105/108105132/>
2. <https://archive.nptel.ac.in/courses/108/105/108105113>
3. <https://www.coursera.org/learn/digital-systems>
4. <http://www.technologystudent.com/elec1/dig1.htm>
5. <https://www.electronicsforu.com/technology-trends/learn-electronics/digital-electronics-basics>

23CSC01	DATA STRUCTURES	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

1. To learn the basics of data structures and linked lists, and implement common sorting techniques.
2. To gain hands-on experience in implementing stacks and queues using arrays and linked lists, and apply them to solve problems like expression evaluation and priority queuing.
3. To understand the usage of binary trees, binary search trees, and searching algorithms for efficient data storage and manipulation.
4. To explore graph representations and traversal techniques, and implement advanced sorting algorithms.
5. To learn hashing techniques and work with advanced data structures

LINKED LIST & STACK**15**

Linked List: Array vs Linked list - Types of linked list - Singly, Doubly and Circular Linked list - Applications of linked list. Stack: Stack Model, Array and Linked list implementation of Stack- Applications of Stack - Infix, Prefix and Postfix expressions - infix to postfix conversion - Expression Evaluation- Balancing Parenthesis.

QUEUE AND TREES**15**

Queue: Queue Model, Array and Linked list implementation of Queue-Priority Queue - Applications of Queue. Trees: Binary Tree - Binary Search Tree - Insertion, Deletion, Traversal- Inorder, Preorder, Postorder, Level order traversal. AVL Tree.

GRAPHS AND HASHING**15**

Graphs: Weighted and Directed graphs - Adjacency matrix and list implementation - Traversal - Breadth First Search & Depth First Search. Hashing: Direct Address Table, Hash function, Collision resolution techniques, Linear Probing, quadratic probing, double hashing. Searching Techniques: Linear Search and Binary Search. Sorting Techniques: Bubble sort, Insertion Sort & Merge Sort

**TOTAL (THEORY): 45
PERIODS**

List of Lab Experiments:

1. Implement Singly Linked List operations (Creation, Insertion, Deletion, Traversal)
2. Implement Doubly Linked List operations (Creation, Insertion, Deletion, Traversal)
3. Implement Circular Linked List operations and explore its applications
4. Implement Stack operations using Array and Linked List
5. Evaluate Infix, Prefix, and Postfix Expressions using Stacks
6. Implement Queue operations using Array and Linked List
7. Implement Breadth-First Search (BFS) and Depth-First Search (DFS) on Graphs

8. Implement Binary Tree operations (Creation, Insertion, Deletion) and Tree Traversals
9. Implement Hashing with Collision Resolution Techniques (Linear and Quadratic Probing)
10. Implement Sorting Algorithms (Merge Sort, Quick Sort, and Counting Sort) and evaluate their time complexities

TOTAL (LAB): 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES (COs):

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

- | | | |
|------------|---|------|
| CO1 | Analyze the appropriateness of using core data structures like arrays and linked lists to implement efficient algorithms. | [AN] |
| CO2 | Utilize stacks and queues to develop solutions for real-world computational challenges. | [AP] |
| CO3 | Apply binary trees, binary search trees (BSTs), traversal techniques, and searching algorithms to organize and retrieve data efficiently. | [AP] |
| CO4 | Evaluate the effectiveness of various graph algorithms and advanced sorting techniques in solving computational problems. | [AN] |
| CO5 | Design efficient solutions using hashing, searching, and sorting techniques to optimize problem-solving in real-world applications. | [AP] |

TEXT BOOKS:

1. NarasimhaKarumanchi, "Data Structures and Algorithms Made Easy", 6th Edition, CareerMonk Publications, 2022.
2. Seymour Lipschutz, "Data Structures with C (SIE)", 1st Edition, McGraw Hill Education, 2019.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 4th Edition, Pearson, 2014.
4. Ellis Horowitz, SartajSahni, and Susan Anderson-Freed, "Fundamentals of Data Structures in C/C++", Second Edition, Silicon Press, 2008.

REFERENCE BOOKS:

1. ReemaThareja, "Data Structures Using C", 3rd Edition, Oxford University Press, 2022.
2. Jean-Paul Tremblay and Paul G. Sorenson, "An Introduction to Data Structures with Applications", 2nd Edition, McGraw-Hill Education, 1984.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 3rd Edition, MIT Press, 2009.
4. DebasisSamanta, "Classic Data Structures", 2nd Edition, PHI Learning, 2009.

WEB REFERENCES:

1. <https://www.khanacademy.org/computing/computer-science/algorithms>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-006-introduction-to-algorithms-spring-2011/>
3. https://www.w3schools.com/dsa/dsa_intro.php
4. <https://techdevguide.withgoogle.com/paths/data-structures-and-algorithms/>

23MEC04	DESIGN THINKING AND IDEA LAB	L	T	P	C
		0	0	2	1

Course objectives

1. To accelerate development of indigenous products in line with the "Make in India" campaign.
2. To encourage aspiring engineers to actualize their ideas under one roof.
3. To impart multidisciplinary education to all students to promote innovation and product development
4. To initiate new ways of creative thinking and enable the students to learn the cycle of Design Thinking process for developing innovative products.
5. To promote experiential learning and entrepreneurial skills among the students.

Course contents**DESIGN THINKING**

Design Thinking: Definition, Need and Objective, Concepts and Brainstorming, Stages – Empathize, Define, Ideate, Prototype, Test. Practical Examples of Customer Challenges, Alignment of Customer Expectations with Product Design - Feedback, Re-Design and Re-Create.

INTRODUCTION TO TOOLS AND EQUIPMENT

Introduction to Hand Tools and Power Tools - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc.

Basic 2D and 3D designing using CAD tools such as FreeCAD, Sketchup, Prusa Slicer, FlatCAM, Inkspace and OpenBSP - 2D and 3D structures for prototype building using CNC machine - Basic welding and other joining techniques for assembly - Basics of 3D scanning, Point cloud data generation for reverse engineering.

Exposure to PCB prototype fabrication - Familiarity and use of soldering and de-soldering equipment - Usage of Arduino, Raspberry Pi and BeagleBone.

EXPERIMENTAL LEARNING

1. 2D profile cutting of press fit box / casing in acrylic (3 or 6 mm thickness) / polymer / cardboard / MDF (2 mm thickness) board using laser cutter and engraver.
2. Machine 3D geometry on soft material such as soft wood using CNC router.
3. Fabricate products like trusses using cutting and welding tools.
4. 3D printing of scanned geometry using FDM or SLA printer.
5. Designing a suitable PCB layout, fabrication and testing of the circuit.
6. Assemble and disassemble electronic components on a PCB using soldering and de-soldering equipment.
7. Embedded programming using Arduino, Raspberry Pi and BeagleBone.

DESIGN THINKING PROJECT

1. Design and implementation of a capstone project.

TOTAL PERIODS: 30**Course outcomes**

Upon completion of the course, students shall have ability to

- | | | |
|-----|--|------|
| CO1 | Recall the basic concepts of Design Thinking. | [U] |
| CO2 | Utilize the equipment, tools and inventories associated with Design Thinking | [AP] |

- Laboratory.
- CO3 Perform fundamental fabrication operation using hand tools, power tools, [AP]
welding equipment, laser cutter and engraver.
- CO4 Perform fundamental electrical and electronic circuit design using PCB [AP]
machine.
- CO5 Develop innovative products by implementing the design thinking approach [C]

TEXT BOOKS

1. Veeranna D.K, "Workshop / Manufacturing Practices (with Lab Manual)", AICTE's Prescribed Textbook, Khanna Book Publishing, 1st edition, 2022.
2. E. Balaguruswamy, "Design Thinking: A Beginner's Perspective", McGraw-Hill Education, 1st edition, 2024.
3. Anuja Agarwal, "Design Thinking: A Framework for Applying Design Thinking in Problem Solving", Cengage India, 1st edition, 2024.

REFERENCE BOOKS

1. Lal, D. M., "Design Thinking- Beyond the Sticky Notes", Sage Publications India Pvt. Ltd., 1st edition, 2021.
2. Kaushik Kumar and Muralidhar Kurni, "Design Thinking: A Forefront Insight", CRC Press, 1st edition, 2023.
3. Shalini Rahul Tiwari, "Design Thinking: A Comprehensive Textbook", Wiley India, 1st edition, 2024.

WEB RESOURCES

1. <https://fab-coep.vlabs.ac.in/List%20of%20experiments.html>
2. <https://www.innovationtraining.org/how-to-use-design-thinking-to-design-an-innovation-lab/>
3. <https://www.erdster.co.in/design-thinking-lab.html>
4. <https://www.coursera.org/learn/uva-darden-design-thinking-innovation>

SEMESTER – IV

23EE404	RENEWABLE ENERGY AND STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To study different non-conventional energy systems and its applications.
2. To enhance student's knowledge and interpret new technologies in energy storage system.
3. To learn techno-economical storage methods of renewable energy systems.

RENEWABLE ENERGY SOURCES

15

Importance of sustainable energy source - Present Indian and international energy scenario of conventional and sustainable energy sources - Kyoto protocol - Renewable energy contribution to sustainable development. Wind Energy system: Working, Types, Grid integration issues - Solar Energy: Module and array types, series and parallel connections, Maximum power point tracking, grid interactive solar PV systems - Other Energy System: Biomass energy, geothermal energy, tidal energy, and Ocean thermal energy conversion - Introduction to smart grid and micro grid.

ELECTRICAL ENERGY STORAGE SYSTEM

15

Role of energy storage systems, applications - Overview of energy storage technologies - Electrical energy storage: Batteries, Super capacitors, Superconducting Magnetic Energy Storage (SMES), charging methodologies, SoC, SoH estimation techniques - Hydrogen production and storage, fuel cells. Energy storage system in electric vehicle connected to renewable energy source and grid. Case study on battery management system connected with renewable energy system.

HYBRID ENERGY STORAGE SYSTEMS

15

Hybrid Energy storage systems: configurations and applications, importance of hybrid systems, advantages and disadvantages. Storage for renewable energy systems: Fuel cells and Hydrogen cells. Energy storage in Micro-grid and Smart grid. Case Study on recent advancement in Energy Storage and Management Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to,

- | | | |
|-----|--|-----|
| CO1 | Infer the importance, scenario, Kyoto protocol types of renewable energy sources. | [U] |
| CO2 | Interpret the working of Solar, wind, biomass, tidal, geothermal and ocean thermal energy in power generation. | [U] |

CO3	Illustrate the operation and importance of different energy storage	[AP]
CO4	methods and case studies.	[AN]
CO5	Analyze the integration of storage system with renewable energy systems and Electric vehicle.	[AP]

TEXT BOOKS

1. John T widwell and Tony Weir, "Renewable Energy Resources",4thEdition, Routledge, 2021.
2. Kosala Gunawardane ,Nihal Kularatna, "Energy Storage Devices for Renewable Energy-Based Systems: Rechargeable Batteries and Supercapacitors", Academic Press, 2nd Edition, 2021.
3. Khan B.H., "Non-Conventional Energy Resources",3rd Edition, Tata McGraw Hill New Delhi, 2017.

REFERENCE BOOKS

1. Jorge Garcia, "Analysis and Design of Hybrid Energy Storage Systems", Energies, MDPI, 2020.
2. Sukhatme, "Solar Energy", 4th Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.
3. Masters G., "Renewable and Efficient Electric Power Systems",3rd Edition, IEEE-Wiley Publishers, 2023.

WEB RESOURCES

1. http://unfccc.int/kyoto_protocol/items/2830.php
2. <https://www.coursera.org/learn/wind-energy>
3. https://authn.edx.org/register?course_id=course-v1%3AMITx%2B6.247x%2B2T2021&enrollment_action=enroll&email_opt_in=false
4. https://onlinecourses.nptel.ac.in/noc25_ch40/preview

23EC301	SIGNALS AND SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

1. Understanding the fundamental characteristics of signals and systems.
2. Analyzing the characterization of LTI systems in time domain.
3. Analyzing time domain and frequency domain analysis of Continuous and Discrete systems.
4. Imparting analytical skills to solve problems involving convolution integral and convolution sum.
5. Imparting the knowledge of correlation between signals

SIGNALS AND SYSTEMS

20

Signals (discrete / continuous) - Basic signals - Representation of signals, Signal classification, Types of signals, Operations on signals - Time reversal, Scaling, Shifting, Transformation of independent variables. Systems - Classification of systems- Static and dynamic, Linear and non - linear, Time - variant and time - invariant, Causal and non - causal, Stable and unstable, Continuous - time Linear Time Invariant (LTI) systems and Discrete - time Linear Shift Invariant (LSI) systems and its properties.

ANALYSIS OF CT SYSTEMS

20

Continuous-time Fourier transform (CTFT) - Existence, Properties, Inverse Fourier transform, Laplace Transform- Properties, Inverse Laplace transform, Region of convergence, Stability analysis, Relationship between Laplace and Fourier transform, system representation using differential equations - System Analysis using Laplace transform and Fourier transform – Input-output behaviour with periodic and aperiodic convergent inputs -Impulse response and step response - Frequency response , Convolution integral.

ANALYSIS OF DT SYSTEMS

20

Fourier series representation of discrete-time signals - Discrete Time Fourier Transform (DTFT) and its properties - z-transform, Properties, s-plane to z-plane mapping, Inverse z-transform, Region of convergence, Stability analysis, System representation using difference equations - Relationship between Z-transform and DTFT - System Analysis using Z-transform and DTFT - poles and zeros - stability - impulse response and step response - frequency response , convolution sum, Correlation between signals - Autocorrelation and Cross correlation.

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to,

- | | | |
|-----|--|------|
| CO1 | Acquire the knowledge of signal, system and its classifications | [R] |
| CO2 | Analyze the spectral characteristics of continuous-time periodic and aperiodic | [AN] |

signals using Fourier Transform.

- | | | |
|-----|--|------|
| CO3 | Analyze the response of LTI system using convolution integral and LSI system using convolution. | [AN] |
| CO4 | Analyze system properties based on impulse response and Frequency Response | [AN] |
| CO5 | Apply Laplace transform for the analysis of continuous-time systems and Z-transform for the analysis of discrete-time signals and systems. | [AP] |

TEXT BOOKS

1. Allan V. Oppenheim et al, "Signals and Systems", Prentice Hall of India, 2015.
2. Ramakrishna Rao P, "Signals and Systems", McGraw Hill Education, New Delhi, 2013.
3. Simon Haykin and Barry VanVeen, "Signals and systems", 2007, 2nd Edition, Wiley, India.

REFERENCE BOOKS

1. J. Roberts, "Fundamentals of Signals and Systems", Tata McGraw Hill, 2007.
2. B. P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1988.
3. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems – Continuous and Discrete", Prentice Hall, 4/E, 1998.

WEB RESOURCES

1. <http://www.nptelvideos.in/2012/12/signals-and-system.html>
2. <http://freevideolectures.com/Course/3177/Signals-and-Systems>

23CS303	Algorithm Design Techniques	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1. To enable students to analyze the performance of algorithms mathematically and apply problem-solving techniques effectively.
2. To guide students in utilizing greedy techniques for solving optimization problems, including applications in pattern matching and palindrome identification.
3. To train students in designing solutions for constraint satisfaction problems using backtracking algorithms.
4. To equip students with an in-depth understanding of advanced dynamic programming algorithms and their practical applications.
5. To facilitate learning of graph algorithms and range query optimizations, helping students implement these techniques in real-world problem-solving scenarios.

ALGORITHM COMPLEXITY ANALYSIS & GREEDY APPROACH

15

Time Complexity Analysis: Mathematical analysis of recursive and non-recursive algorithms, Master's Theorem, Sieve of Sundaram. **Recursion:** Concept of recursion, base cases, and recursive problem-solving strategies. **Greedy Algorithms:** Activity Selection Problem, Fractional Knapsack. **Industry Focus:** Demonstration of built-in functions and optimization practices in C++.

STRING ALGORITHMS AND BACKTRACKING

15

String Algorithms: Naïve Pattern Matching, Rabin-Karp Algorithm, Z Algorithm, Knuth-Morris-Pratt (KMP) Algorithm, Manacher's Algorithm for longest palindromic substring. **Backtracking:** Rat in a Maze, Permutation and Combination, N-Queen Problem. Knight's Tour Problem, Subset Sum, M-Coloring Problem, Hamiltonian Cycle Problem. Sudoku Solver, Prime Numbers after Prime P with Sum S.

DYNAMIC PROGRAMMING, GRAPH & RANGE QUERY ALGORITHMS

15

Dynamic Programming: Top-down and Bottom-up Approach, 0-1 Knapsack, Coin Change Problem, Subset Sum Problem, Minimum Cost Path. Longest Common Subsequence (LCS), Longest Increasing Subsequence (LIS), Longest Palindromic Subsequence. **Graph Algorithms:** Single Source Shortest Path Algorithm (Dijkstra's Algorithm). All-Pairs Shortest Path (Floyd Warshall Algorithm). Minimum Spanning Tree (Prim's and Kruskal's Algorithm). **Range Query Algorithms:** Range Minimum Query (RMQ) - Brute Force Approach, RMQ Using Segment Tree, RMQ using Sparse Table.

TOTAL (Theory): 45 PERIODS

LIST OF EXPERIMENTS

1. Implement time complexity analysis for recursive and non-recursive algorithms.
2. Solve the Activity Selection Problem and Fractional Knapsack using the greedy approach.
3. Implement Rabin-Karp and Knuth-Morris-Pratt (KMP) string matching algorithms.
4. Solve backtracking problems: N-Queen, Knight's Tour, Subset Sum, and Sudoku Solver.
5. Implement dynamic programming algorithms: Longest Common Subsequence (LCS), 0-1 Knapsack, and Minimum Cost Path.
6. Implement graph algorithms: Dijkstra's Algorithm, Floyd-Warshall Algorithm, and Minimum Spanning Tree (MST).
7. Solve Range Minimum Query problems using Segment Tree and Sparse Table.

TOTAL (Lab): 30 PERIODS**TOTAL: 75 PERIODS****COURSE OUTCOMES**

Upon completion of the course, students shall have ability to

CO1	Analyze the computational complexity of algorithms applied to real-world problem-solving	[AN]
CO2	Implement greedy algorithms for solving optimization problems and string-matching algorithms for pattern searching.	[AP]
CO3	Solve constraint satisfaction problems using backtracking techniques.	[AP]
CO4	Apply dynamic programming algorithms to real-world optimization and sequence-related challenges.	[AP]
CO5	Assess the efficiency and applicability of graph algorithms and range query techniques for solving optimization problems	[AN]

TEXT BOOKS

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", 4th Edition, The MIT Press, April 5, 2022.
2. Jon Kleinberg and ÉvaTardos, "Algorithm Design", 2nd Edition, Pearson, 2022.
3. AnanyLevitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2019.
4. NarasimhaKarumanchi, "Data Structures and Algorithms Made Easy", 6th Edition, CareerMonk Publications, 2022.

REFERENCE BOOKS

1. Steven S. Skiena, "The Algorithm Design Manual", 3rd Edition, Springer, 2020.
2. Robert Sedgewick, Kevin Wayne, "Algorithms", 4th Edition, Addison-Wesley, 2021.
3. Aditya Bhargava, "Grokking Algorithms", 2nd Edition, Manning Publications, 2024.
4. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures and Algorithms in Java", 6th Edition, Wiley India, June 21, 2022

WEB RESOURCES

1. <https://www.coursera.org/learn/cpsc-8400-design-and-analysis-of-algorithm>
2. <https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/pages/syllabus/>
3. https://onlinecourses.nptel.ac.in/noc25_cs23/preview
4. <https://www.codechef.com/learn/course/college-design-analysis-algorithms>

23EE407	CONTROL THEORY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1. To understand the methods of system representation and to derive their transfer function models.
2. To provide an adequate knowledge of systems in time domain and its stability analysis.
3. To accord basic knowledge in obtaining the open loop and closed loop frequency responses of systems.
4. To introduce the design of controllers and compensators.

SYSTEM MODELLING

15

Basic elements of control systems - Open loop and closed loop systems - Transfer function modelling: Electrical systems and Mechanical system - Translational, Rotational. State-space modeling: Electrical systems and Mechanical system - Block diagram models - Signal flow graph - Introduction to stepper and servo motor - Case study: Modelling of inverted pendulum-cart system.

TIME AND FREQUENCY RESPONSE ANALYSIS

15

Time domain specifications - Types of test signals - Step response of first and second order system - Steady state error - Generalized error coefficients - Concept of stability - Routh Hurwitz criterion - Root locus technique - Frequency domain specifications - Bode plot - Polar plot.

CONTROLLERS AND COMPENSATORS

15

Design of P, PI, PD and PID controllers - Compensators: Introduction to lag, lead and lag-lead networks - Lag compensator design using Bode plot - Controllability and Observability – Electro-Mechanical Systems: Introduction - problem setup and design requirements, optimal control of electro-mechanical systems using PID controller - Introduction to Fuzzy Logic Controllers: Architecture, major components and design steps.

TOTAL (THEORY): 45 PERIODS

LIST OF EXPERIMENTS

1. Model the mechanical, electrical system and simulate its behaviour to derive its transfer function.
2. Simulate different block arrangements and reduce as a single transfer function.
3. Determination of transfer function of armature controlled DC motor.
4. Determination of transfer function of field controlled DC motor.
5. Position control of servo motor and stepper motor systems.
6. Study and operation of inverted pendulum system using V-lab.

7. Determination of response for different test inputs of first and second order system using V-lab.
8. Time response analysis for a second order system using simulation.
9. Analyse the stability of a linear system by Bode plot and Polar plot using V-lab.
10. Design of P, PI, PD and PID controllers for type-0 and type-1 system using simulation.
11. Design of lag compensator for uncompensated system using simulation.
12. Controller realization for an electro-mechanical system using simulation.
13. Design of fuzzy logic controller for real time applications using Simulation.

TOTAL (LAB): 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to,

- | | | |
|-----|--|------|
| CO1 | Construct the mathematical model of various control systems and obtain the transfer function of a system. | [AP] |
| CO2 | Analyze the first and second order systems in time domain. | [AN] |
| CO3 | Analyze the frequency response using Bode plot and Polar plot and examine the stability of the control systems using Root locus, Routh-Hurwitz criteria methods. | [AN] |
| CO4 | Design the controllers and compensators. | [AP] |
| CO5 | Manipulate the design steps of electro-mechanical system and fuzzy logic controller for real time applications. | [AP] |

TEXT BOOKS

1. Nagrath I. J. and Gopal M., "Control Systems Engineering", 7th Edition, New Age International Publishers, 2022.
2. Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Pearson, New Delhi, 2015.
3. FaridGolnaraghi and Benjamin C. Kuo, "Automatic Control systems", 10th Edition, Wiley, 2017.

REFERENCE BOOKS

1. Norman S. Nise, "Control Systems Engineering", 8th Edition, Wiley, New Delhi, 2024.
2. Richard C. Dorf, Robert H. Bishop, "Modern Control Engineering", 13th Edition, Pearson Education, New Delhi, 2016.
3. Nagoorkani A., "Control Systems Engineering", 3rd Edition, RBA Publications, 2018.

WEB RESOURCES

1. <https://archive.nptel.ac.in/courses/107/106/107106081/>
2. <https://www.coursera.org/learn/modeling-feedback-systems>
3. https://onlinecourses.nptel.ac.in/noc22_ee21/preview
4. <https://www.udemy.com/course/fuzzy-logic-matlab/?couponCode=NVDIN35>
5. <https://www.colorado.edu/ecee/academics/online-programs/ms-ee-coursera/curriculum/systems-and-controls>

23EE408	INDUCTION AND SYNCHRONOUS MACHINES	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

1. To know the concepts of rotating magnetic field.
2. To impart the knowledge of synchronous and induction machines
3. To analyze the performance of synchronous and induction machines.

SYNCHRONOUS MACHINES

20

Introduction - MMF distribution - Rotating Magnetic Field. Alternators: Constructional details- Principle of operation and types of Rotor- EMF equation- Armature reaction - Voltage regulation - EMF, MMF and ZPF- Two Reaction Theory - Synchronization and Synchronizing Power - Parallel operation. Synchronous motors: Starting methods, Phasor diagram, V and Inverted - V Curves, Hunting and its suppression, Effect of change in Excitation, Synchronous Condenser. Case study: Synchronous motor industrial applications.

INDUCTION MACHINES

15

Three phase induction motors: Constructional details - Principle of operation and types of Rotor - Slip - Starting and Maximum torque - Slip-Torque Characteristics, No Load and Blocked Rotor test - Equivalent Circuit- Circle Diagram - Crawling and Cogging. Single-Phase Induction Motors: Constructional details - Principle of Operation and types - Double Field Revolving Theory - Equivalent Circuit and its applications. Types of Motors used in Electric Vehicles. Case study: Maglev in transportation.

STARTING AND SPEED CONTROL METHODS OF INDUCTION MOTORS

10

Need for Starting - Types of Starters - Rotor Resistance, Star- Delta, Autotransformer and Soft Starters, Speed control - Change of Voltage, Frequency, Number of Poles, V/F Control - Braking Methods, Case study on Industry based Soft Starters.

TOTAL (THEORY):45 PERIODS

LIST OF EXPERIMENTS

1. Assess the power generation performance of alternator under varying electrical loads in standalone wind power plant and also perform the experiment using Virtual lab
2. Determine voltage regulation in an isolated generation unit using the pessimistic internal voltage buildup method and also perform the experiment using Virtual lab
3. Estimate the voltage regulation in an alternator using optimistic approach
4. Evaluate voltage regulation of a synchronous generator using potier method
5. Investigate the regulation of salient pole synchronous generator to determine the

- direct axis and quadrature axis reactance.
6. Analyze synchronous motor characteristics under varying excitation for industrial power factor correction
 7. Evaluate the performance of synchronous motor performance using Virtual lab with variable field excitation.
 8. Evaluate torque and speed performance of a single phase and three phase asynchronous motor under loaded operation.
 9. Determine equivalent circuit parameters of an Induction motor through standard test procedures.
 10. Simulate performance behavior of single and three phase induction motor systems under diverse operating conditions
 11. Demonstrate braking performance of a three phase induction motor used in conveyor or elevator control systems.
 12. Demonstrate the mini project on automatic fan speed control of single phase induction motor using temperature sensor.

TOTAL (LAB): 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES

Upon completion of the course, students shall have ability to

- | | | |
|-----|---|------|
| CO1 | Illustrate the construction and operation of salient and non-salient pole alternators and synchronous motors. | [U] |
| CO2 | Examine the performance of synchronous machines by various methods | [AP] |
| CO3 | Interpret the construction and operation of single and three phase Induction motor. | [U] |
| CO4 | Analyze the performance of induction machines by various methods. | [AN] |
| CO5 | Investigate the operation of various starters and speed control methods of induction motor. | [AN] |

TEXTBOOKS

1. Fitzgerald A.E., Charles Kingsley, JR., Stephen D. Umans, "Electric Machinery", 6th Edition, McGraw Hill International Edition, New York, 2017.
2. Sen P.C., "Principles of Electric Machines and Power Electronics", Wiley, 2013.
3. D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2017.

REFERENCE BOOKS

1. Nagrath I. J. and Kothari D. P., "Electric Machines", McGraw Hill Education, 5th Edition, 2017
2. Bimbhra P. S., "Electrical Machinery", 7th Edition, Khanna Publishers, 2011.
3. Theraja B.L. and Theraja A K, "A text book of Electrical technology, S Chand and company limited, 24th Edition, 2025.

WEB RESOURCES

1. <http://nptel.ac.in/syllabus/syllabus.php?subjectId=108105018>
2. <http://freevidelectures.com/Course/2335/Basic-Electrical-Technology/23>
3. <https://www.electrical4u.com/deep-bar-double-cage-induction-motor/>
4. <https://www.coursera.org/learn/motors-circuits-design>

23CS302	PYTHON PROGRAMMING	L	T	P	C
		1	0	4	3

COURSE OBJECTIVES

1. To understand the basics of python programming.
2. To have a basic understanding of functions, modules, and object-oriented programming principles to enable the creation of modular and maintainable code.
3. To gain foundational knowledge of web development, including database management, consuming APIs, and developing web applications using Python web frameworks like Flask or Django.
4. To develop a solution for real-time datasets using tools.

PYTHON FUNDAMENTALS

5

Python Basics: Syntax, semantics, data types, variables, and operators-Control Flow Statements: if, for, while - Functions and Modules: Defining functions, parameters, scope, and working with modules/packages- **Object-Oriented Programming:** Classes, objects, inheritance, polymorphism, encapsulation, abstraction. **Introduction to NumPy and Pandas:** NumPy: Arrays, slicing, indexing, and basic operations - Pandas: DataFrames, Series, and basic data manipulation

ERROR HANDLING, FILE I/O, AND NLP

5

Error Handling: Using try, except, finally, and custom exceptions - **File I/O:** Reading and writing text, CSV, and JSON files, using context managers - **Data Visualization with Matplotlib:** Line plots, bar charts, scatter plots, and customizations - **Introduction to NLP:** Tokenization, stemming, lemmatization, Using SpaCy or NLTK for part-of-speech tagging and Named Entity Recognition (NER). **Basic preprocessing:** Removing stopwords and normalizing text.

WEB DEVELOPMENT FOUNDATIONS

5

HTTP and APIs: Basics of HTTP, RESTful API principles, and consuming APIs using Python (requests library) - **Database Integration:** CRUD operations using an ORM (SQLAlchemy) - **Introduction to Web Frameworks:** Flask - Routing, request handling, and response generation -**Advanced Pandas and NumPy:** Data merging, handling missing values, and statistical analysis - **Generative AI Basics:** Overview of GANs, VAEs, and GPT models with Python.

TOTAL (Theory): 15 PERIODS

LIST OF EXPERIMENTS

1. Implementation of control flow statements in Python
2. Implementation of functions and modules in Python
3. Implementation of object-oriented programming concepts in Python
4. Implementation of error handling in Python
5. Implementation of file input and output operations in Python
6. Implementation of data visualization using Matplotlib
7. Implementation of Natural Language Processing (NLP) techniques
8. Implementation of API consumption using Python
9. Implementation of CRUD operations using SQLAlchemy
10. Implementation of Flask-based REST API.

TOTAL (Lab): 60 PERIODS**TOTAL: 75 PERIODS****COURSE OUTCOMES**

Upon completion of the course, students shall have ability to

CO1	Apply Python programming fundamentals, including syntax, control flow, functions, modules, and object-oriented concepts.	[AP]
CO2	Demonstrate the ability to manipulate data using NumPy and Pandas for data analysis and visualization.	[AP]
CO3	Implement error handling strategies and perform file input/output operations.	[AP]
CO4	Apply data visualization techniques using Matplotlib and utilize NLP methods to analyze and process textual data.	[AP]
CO5	Develop web applications using frameworks and implement CRUD operations with SQLAlchemy for database integration.	[AP]

TEXTBOOKS

1. Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Apress, 2023.
2. Paul Barry, "Head First Python: A Brain-Friendly Guide", O'Reilly Media, 2024.
3. David Amos, Dan Bader, Joanna Jablonski, Fletcher Heisler, "Python Basics: A practical introduction to Python 3", 4th Edition, Real python Publication, 2021.
4. Eric Matthes, "Python Crash Course: A Hands-On, Project-Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. Fabrizio Romano, "Learn Web Development with Python", 1st Edition, Kindle Edition, 2018.

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1. Daniel J. Crowley, "Python Machine Learning: A Practical Approach to Building Intelligent Systems", Springer, 2023.
2. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly Media, 2023.
3. Joel Grus, "Data Science from Scratch: First Principles with Python", 2nd Edition, O'Reilly Media, 2019.

WEB RESOURCES

1. <https://realpython.com/python-web-applications/>
2. <https://www.python.org/about/gettingstarted/>
3. <https://www.programiz.com/python-programming>
4. <https://www.datacamp.com/community/tutorials/python-statistics-data-science>



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