KPR Institute of Engineering and Technology

Learn Beyond (Autonomous, NAAC "A")

Avinashi Road, Arasur, Coimbatore.

Great Place To Work. Certified MAR 2022 - MAR 2023 INDIA

B.E. – Electrical and Electronics Engineering

Curriculum and Syllabi

Regulation - 2021

CONTROLLED COPY

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I. Vision and Mission of the Institute

Vision

To become a premier institute of academic excellence by imparting technical, intellectual and professional skills to students for meeting the diverse needs of the industry, society, the nation and the world at large.

Mission

- Commitment to offer value-based education and enhancement of practical skills
- Continuous assessment of teaching and learning processes through scholarly activities
- Enriching research and innovation activities in collaboration with industry and institutes of repute
- Ensuring the academic processes to uphold culture, ethics and social responsibility

II. Vision and Mission of the Department

Vision

To be a premier centre for quality education, innovation and research in the field of Electrical and Electronics Engineering to meet the global challenges with professional ethics and social consciousness.

Mission

- Provide a holistic environment to students through knowledge-centric and skill-based education
- Collaborate with industries for effective research and innovation in Electrical Engineering and allied areas
- Enable students to serve the society through prolific ideas with professionalism and ethical values

III. Program Educational Objectives (PEOs)

The Graduates of B.E. Electrical and Electronics Engineering, after four years of graduation, will

PEO1: Apply the acquired knowledge and skills to meet the emerging needs of the society and also excel in their chosen profession.

PEO2: Adapt to emerging technologies and continuously upskill through active research in Electrical Engineering and allied areas.

PEO3: Demonstrate leadership skills and practice their profession conforming to ethical and human values.

IV. Program Outcomes (POs)

Graduates of Electrical and Electronics Engineering will be able to

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

PO2 **Problem analysis:** Identify, formulate, review 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 the public health and safety, and the cultural, societal, and environmental considerations.

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PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods 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 access 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 norms of the engineering practice.

PO9 Individual and team work: 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 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.

V. Program Specific Outcomes (PSOs)

The Graduates of Electrical and Electronics Engineering will be able to

PSO1: Analyse, design and test power electronic components integrated with computer-based systems to meet industrial and societal needs.

PSO2: Deploy modern engineering tools to model, simulate, fabricate and integrate electrical systems with renewable energy to enhance sustainability.

VI. PEO/PO Mapping

Following three levels of correlation should be used:

1: Low

2: Medium

3. High

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	3	-	-	-	-	3	3	-	-
PEO2	3	3	3	3	3	2	2	3	2	3	3	3
PEO3	3	3	3	3	-	2	2	2	-	3	3	3

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B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS – 2021

For the students admitted in 2021

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR I - VIII SEMESTERS



SEMESTER I

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
	THEORY COURSES							
1	U21MA102	Calculus and Linear Algebra	BSC	2	1	0	0	3
2	U21EE101	Foundation for Electrical Engineering	ESC	3	0	0	0	3
	THEORY COURSE WITH LABORATORY COMPONENT							
3	U21EN101	English for Technologists	HSMC	1	0	2	0	2
4	U21PH101	Engineering Physics	BSC	2	0	2	0	3
5	U21CY101	Engineering Chemistry	BSC	2	0	2	0	3
6	U21CSG01	Problem Solving and C Programming	ESC	2	0	2	0	3
	LABORATORY COURSES							
7	U21MEG01	Engineering Graphics	ESC	0	0	4	0	2
8	U21MEG02	Manufacturing Practices	ESC	0	0	4	0	2
	MANDATORY NON CREDIT COURSES							
9	U21MYC01	Induction program	MNC	Three Weeks				
			TOTAL	**12**	**1**	**16**	**0**	**21**

SEMESTER II

Sl.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
	THEORY COURSES							
1	U21MA201	Laplace Transforms and Complex Variables	BSC	3	1	0	0	4
2	U21PH201	Materials Science	BSC	2	0	0	0	2
3	U21EE201	Electric Circuit Analysis	ESC	3	0	0	0	3
4	U21MEG04	Basics of Civil and Mechanical Engineering	ESC	3	0	0	0	3
	THEORY COURSE WITH LABORATORY COMPONENT							
5	U21EN201	Personality Enhancement	HSMC	1	0	2	0	2
6	U21CSG02	Python Programming	ESC	2	0	2	0	3
7	U21EE202	Digital Electronics and Applications	PCC	2	0	2	0	3
	LABORATORY COURSES							
8	U21EE203	Electric Circuits Laboratory	ESC	0	0	4	0	2
	MANDATORY NON CREDIT COURSES							
9	U21MYC02	Environmental Sciences	MNC	1	0	0	0	0
			TOTAL	**17**	**1**	**10**	**0**	**22**

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SEMESTER III

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
	THEORY COURSES							
1	U21MA303	Fourier Analysis and Boundary Value Problems	BSC	3	1	0	0	4
2	U21EE301	Electromagnetic Theory	ESC	2	1	0	0	3
3	U21EE302	Electrical Machines-I	PCC	3	0	0	0	3
4	U21EE303	Analog Electronics and Applications	PCC	3	0	0	0	3
	THEORY COURSE WITH LABORATORY COMPONENT / THEORY COURSE WITH PROJECT COMPONENT							
5	U21CSG03	Data Structures	ESC	2	0	2	0	3
6	U21EE304	Measurements and Instrumentation	PCC	2	0	2	0	3
	LABORATORY COURSES / LABORATORY COURSE WITH PROJECT COMPONENT							
7	U21EE305	Electrical Machines Laboratory – I	PCC	0	0	4	0	2
8	U21EE306	Analog Electronics and Applications Laboratory	PCC	0	0	4	0	2
	MANDATORY NON CREDIT COURSES							
9	U21MYC03	Essence of Indian Traditional Knowledge	MNC	1	0	0	0	0
			TOTAL	16	2	12	0	23

SEMESTER IV

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
	THEORY COURSES							
1	U21MA404	Statistics and Numerical Methods	BSC	3	0	0	0	3
2	U21EE401	Electrical Machines-II	PCC	3	0	0	0	3
3	U21EE402	Control Systems	PCC	3	0	0	0	3
4		Open Elective – I	OEC	3	0	0	0	3
	THEORY COURSE WITH LABORATORY COMPONENT / THEORY COURSE WITH PROJECT COMPONENT							
5	U21CSG04	Java Programming	ESC	2	0	2	0	3
6	U21EE403	Transmission and Distribution	PCC	2	0	2	0	3
	LABORATORY COURSES / LABORATORY COURSE WITH PROJECT COMPONENT							
7	U21SSG01	Soft Skills – I	HSMC	0	0	2	0	1
8	U21EE404	Electrical Machines Laboratory – II	PCC	0	0	4	0	2
9	U21EE405	Control Systems Laboratory	PCC	0	0	4	2	3
	MANDATORY NON CREDIT COURSES							
10	U21MYC04	Indian Constitution	MNC	1	0	0	0	0
			TOTAL	17	0	14	2	24

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SEMESTER V

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
	THEORY COURSES							
1	U21EE501	Power System Analysis	PCC	2	1	0	0	3
2	U21EE502	Power Electronics and Drives	PCC	3	0	0	0	3
3		Professional Elective – I	PEC	3	0	0	0	3
4		Professional Elective – II	PEC	3	0	0	0	3
5		Open Elective – II	OEC	3	0	0	0	3
	THEORY COURSE WITH LABORATORY COMPONENT / THEORY COURSE WITH PROJECT COMPONENT							
6	U21EE503	Microprocessor, Microcontroller and Applications	PCC	2	0	2	0	3
	LABORATORY COURSES / LABORATORY COURSE WITH PROJECT COMPONENT							
7	U21SSG02	Soft Skills – II	HSMC	0	0	2	0	1
8		[Live in Labs-I]	HSMC	-	-	-	-	[3]
9	U21EE504	Power Electronics and Drives Laboratory	PCC	0	0	4	2	3
10	U21EE505	Power Engineering Laboratory	PCC	0	0	4	0	2
	MANDATORY NON CREDIT COURSES							
11	U21MYC05	Cyber Security Essentials	MNC	1	0	0	0	0
			TOTAL	17	1	12	2	24

SEMESTER VI

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
	THEORY COURSES							
1	U21EE601	Protection and Switchgear	PCC	3	0	0	0	3
2	U21EE602	Embedded System Design	PCC	3	0	0	0	3
3	U21AMG02	Machine Learning	PCC	3	0	0	0	3
4		Professional Elective – III	PEC	3	0	0	0	3
5		Professional Elective – IV	PEC	3	0	0	0	3
6		Open Elective – III	OEC	3	0	0	0	3
	LABORATORY COURSES / LABORATORY COURSE WITH PROJECT COMPONENT							
7	U21SSG03	Soft Skills – III	HSMC	0	0	2	0	1
8		[Live in Labs-II]	HSMC	-	-	-	-	[3]
9	U21EE603	Embedded System Design Laboratory	PCC	0	0	4	2	3
10	U21AMG03	Machine Learning Laboratory	PCC	0	0	2	0	1
	MANDATORY NON CREDIT COURSES							
11	U21MYC06	Introduction to UN SDGs: An Integrative Approach	MNC	1	0	0	0	0
			TOTAL	19	0	08	2	23

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SEMESTER VII

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
	THEORY COURSES							
1	U21EE701	Principles of Management	HSMC	3	0	0	0	3
2		Professional Elective – V	PEC	3	0	0	0	3
3		Professional Elective – VI	PEC	3	0	0	0	3
4		Open Elective – IV	OEC	3	0	0	0	3
	LABORATORY COURSES / LABORATORY COURSE WITH PROJECT COMPONENT							
5	U21EE702	Electrical Application Laboratory	PCC	0	0	2	2	2
6	U21EE703	Project Work Phase – I	EEC	0	0	0	4	2
			TOTAL	**12**	**0**	**2**	**6**	**16**

SEMESTER VIII

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EE801	Project Work Phase – II	EEC	0	0	0	20	10
			TOTAL	**0**	**0**	**0**	**20**	**10**

INDUSTRIAL TRAINING / INTERNSHIP

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEI01	Industrial Training / Internship**	EEC	0	0	0	0	2
			TOTAL	**0**	**0**	**0**	**0**	**2**

***Four Weeks during any semester vacation from III to VI Semester**

NCC CREDIT COURSES:

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21NCC01	National Cadet Corps I	-	1	0	2	0	2
2	U21NCC02	National Cadet Corps II	-	1	0	2	0	2
3	U21NCC03	National Cadet Corps III	-	1	0	2	0	2
4	U21NCC04	National Cadet Corps IV	-	2	0	2	0	3
5	U21NCC05	National Cadet Corps V	-	1	0	2	0	2
6	U21NCC06	National Cadet Corps VI	-	2	0	2	0	3
				8	**-**	**12**	**-**	**14**

NCC Credit Course (Level 1 – Level 6) are offered for NCC students only. The grades earned by the students will be recorded in the mark sheet, however the same shall not be considered for the computation of CGPA.

TOTAL CREDITS: 165

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PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Power Systems	Vertical II Converters and Drives	Vertical III Electric and Hybrid Vehicles	Vertical IV Artificial Intelligence for Electrical Engineering	Vertical V Embedded Systems	Vertical VI Energy Engineering
Power System Operation and Control	Advanced Semiconductor Devices	Battery Management Systems	Artificial Intelligence Applications in Power Systems	Smart Sensors and Applications	Power Plant Technology
High Voltage Engineering	SMPS and UPS	Electric Vehicles and Dynamics	Data Science for Electrical Engineers	MEMS and its Applications	Fuel Cell Technology
Microgrid	Electrical Machine Design	EV Standards and Testing	Fundamentals of AR and VR	Discrete Time Signal Processing	Solar Energy Technology
Computer Aided Power System Analysis	HVDC Transmission	Hybrid Electric Vehicles	Artificial Neural Networks and Applications	Real Time Operating Systems	Bio Energy Technology
Power Quality	Advanced Electric Motors and Control	Electric Vehicles in Smart Grid	Fuzzy Logic Control	Computer Networks for Electrical Engineers	Wind Energy Technology
Power System Security	Flexible AC Transmission Systems	Automotive Transmission	Deep Learning for Electrical Engineering	Software for Embedded Systems	Energy Efficient Buildings
EHVAC Transmission	Analysis of Inverters	Energy Storage Systems	Tensor Flow for Engineering Applications	IoT System Design and Security	Electrical Energy Utilization and Cost Estimation
Smart Grid Technologies	Simulation of Power Converters	IoT in EV Applications	Fundamentals of Natural Language Processing	Advanced Industrial Automation	Energy Management and Auditing

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VII. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VII.

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PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I: POWER SYSTEMS

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEP01	Power System Operation and Control	PEC	3	0	0	0	3
2	U21EEP02	High Voltage Engineering	PEC	3	0	0	0	3
3	U21EEP03	Microgrid	PEC	3	0	0	0	3
4	U21EEP04	Computer Aided Power System Analysis	PEC	3	0	0	0	3
5	U21EEP05	Power Quality	PEC	3	0	0	0	3
6	U21EEP06	Power System Security	PEC	3	0	0	0	3
7	U21EEP07	EHV AC Transmission	PEC	3	0	0	0	3
8	U21EEP08	Smart Grid Technologies	PEC	3	0	0	0	3

VERTICAL II: CONVERTERS AND DRIVES

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEP09	Advanced Semiconductor Devices	PEC	3	0	0	0	3
2	U21EEP10	SMPS and UPS	PEC	3	0	0	0	3
3	U21EEP11	Electrical Machine Design	PEC	3	0	0	0	3
4	U21EEP12	HVDC Transmission	PEC	3	0	0	0	3
5	U21EEP13	Advanced Electric Motors and Control	PEC	3	0	0	0	3
6	U21EEP14	Flexible AC Transmission Systems	PEC	3	0	0	0	3
7	U21EEP15	Analysis of Inverters	PEC	3	0	0	0	3
8	U21EEP16	Simulation of Power Converters	PEC	3	0	0	0	3

VERTICAL III: ELECTRIC AND HYBRID VEHICLES

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEP17	Battery Management Systems	PEC	3	0	0	0	3
2	U21EEP18	Electric Vehicles and Dynamics	PEC	3	0	0	0	3
3	U21EEP19	EV Standards and Testing	PEC	3	0	0	0	3
4	U21EEP20	Hybrid Electric Vehicles	PEC	3	0	0	0	3

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5	U21EEP21	Electric Vehicles in Smart Grid	PEC	3	0	0	0	3
6	U21EEP22	Automotive Transmission	PEC	3	0	0	0	3
7	U21EEP23	Energy Storage Systems	PEC	3	0	0	0	3
8	U21EEP24	IoT in EV Applications	PEC	3	0	0	0	3

VERTICAL IV: ARTIFICIAL INTELLIGENCE FOR ELECTRICAL ENGINEERING

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEP25	Artificial Intelligence Applications in Power Systems	PEC	3	0	0	0	3
2	U21EEP26	Data Science for Electrical Engineers	PEC	3	0	0	0	3
3	U21EEP27	Fundamentals of AR and VR	PEC	3	0	0	0	3
4	U21EEP28	Artificial Neural Networks and Applications	PEC	3	0	0	0	3
5	U21EEP29	Fuzzy Logic Control	PEC	3	0	0	0	3
6	U21EEP30	Deep Learning for Electrical Engineering	PEC	3	0	0	0	3
7	U21EEP31	Tensor Flow for Engineering Applications	PEC	3	0	0	0	3
8	U21EEP32	Fundamentals of Natural Language Processing	PEC	3	0	0	0	3

VERTICAL V: EMBEDDED SYSTEMS

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEP33	Smart Sensors and Applications	PEC	3	0	0	0	3
2	U21EEP34	MEMS and its Applications	PEC	3	0	0	0	3
3	U21EEP35	Discrete Time Signal Processing	PEC	3	0	0	0	3
4	U21EEP36	Real Time Operating Systems	PEC	3	0	0	0	3
5	U21EEP37	Computer Networks for Electrical Engineers	PEC	3	0	0	0	3
6	U21EEP38	Software for Embedded Systems	PEC	3	0	0	0	3
7	U21EEP39	IoT System Design and Security	PEC	3	0	0	0	3
8	U21EEP40	Advanced Industrial Automation	PEC	3	0	0	0	3

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VERTICAL VI: ENERGY ENGINEERING

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEP41	Power Plant Technology	PEC	3	0	0	0	3
2	U21EEP42	Fuel Cell Technology	PEC	3	0	0	0	3
3	U21EEP43	Solar Energy Technology	PEC	3	0	0	0	3
4	U21EEP44	Bio Energy Technology	PEC	3	0	0	0	3
5	U21EEP45	Wind Energy Technology	PEC	3	0	0	0	3
6	U21EEP46	Energy Efficient Buildings	PEC	3	0	0	0	3
7	U21EEP47	Electrical Energy Utilization and Cost Estimation	PEC	3	0	0	0	3
8	U21EEP48	Energy Management and Auditing	PEC	3	0	0	0	3

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OPEN ELECTIVES – I (SEMESTER: IV)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEX01	Electrical Safety Practices and Standards	OEC	3	0	0	0	3
2	U21EEX02	Electric Vehicles	OEC	3	0	0	0	3

OPEN ELECTIVES – II (SEMESTER: V)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEX03	Energy Technology	OEC	3	0	0	0	3
2	U21EEX04	Home Automation	OEC	3	0	0	0	3

OPEN ELECTIVES – III (SEMESTER: VI)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEX05	Battery Technology	OEC	3	0	0	0	3
2	U21EEX05	Energy Audit	OEC	3	0	0	0	3

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OPEN ELECTIVES – IV (SEMESTER: VII)

SI.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	J	C
1	U21EEX06	Solar PV System: Installation and Maintenance	OEC	3	0	0	0	3
2	U21EEX07	Optimization Techniques for Engineering Applications	OEC	3	0	0	0	3

Scheme of Credit distribution – Summary

SI.NO.	Stream	Credits/Semester								Credits
		I	II	III	IV	V	VI	VII	VIII	
1.	Humanities and Social Sciences including Management (HSMC)	2	2	-	1	1	1	3	-	10
2.	Basic Science Courses (BSC)	9	6	4	3	-	-	-	-	22
3.	Engineering Science Courses (ESC)	10	11	6	3	-	-	-	-	30
4.	Professional Core Courses (PCC)	-	3	13	14	14	13	2	-	59
5.	Professional Elective Courses (PEC)	-	-	-	-	6	6	6	-	18
6.	Open Elective Courses (OEC)	-	-	-	3	3	3	3	-	12
7.	Employability Enhancement Courses (EEC)	-	-	-	-	-	-	2	10	12
8.	Industrial Training/ Internship	-	-	-	-	-	-	-	2	2
9.	Mandatory Non-Credit Course (MNC)	-	-	-	-	-	-	-	-	-
Total		**21**	**22**	**23**	**24**	**24**	**23**	**16**	**12**	**165**

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SEMESTER I

U21MA102	CALCULUS AND LINEAR ALGEBRA (For EE)	Category: BSC				
		L	T	P	J	C
		2	1	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of matrices and calculus which will enable them to model and analyze physical phenomena involving continuous change
- To understand the methodologies involved in solving problems related to fundamental principles of calculus
- To understand postulates of vector spaces and linear transformations

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply eigenvalue and diagonalization techniques to solve matrix-related problems in electrical engineering systems (Apply)

CO2: Utilize partial differentiation and Jacobians to optimize multivariable functions relevant to engineering applications (Apply)

CO3: Calculate areas, volumes, and other physical quantities by applying double and triple integration Techniques (Apply)

CO4: Explain the fundamental concepts of vector spaces, including basis, dimension, and linear independence (Understand)

CO5: Apply linear transformation concepts to represent and solve problems involving coordinate changes in electrical engineering contexts (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO5	2	2	1	-	-	-	-	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I MATRICES **6 + 3**

Eigen values and eigen vectors – Properties (without proof) – Cayley Hamilton theorem (without proof) – Diagonalization using orthogonal transformation – Applications

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UNIT II FUNCTIONS OF SEVERAL VARIABLES 6 + 3

Partial derivatives – Total derivative – Jacobians – Taylor's series expansion – Extreme values of functions of two variables – Lagrange multipliers method

UNIT III MULTIPLE INTEGRALS 6 + 3

Double integrals – Change of order of integration – Triple integrals – Applications: Area and volume

UNIT IV VECTOR SPACES 6 + 3

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions

UNIT V LINEAR TRANSFORMATION 6 + 3

General linear transformations – Kernel and range – Matrices of general linear transformation – Geometry linear operators – Change of basis

Contact Periods:

Lecture: 30 Periods Tutorial: 15 Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition Wiley India Pvt Ltd, New Delhi, 2018.
2. Howard Anton and Chris Rorres, "Elementary Linear Algebra", 11th edition, John Wiley & Sons Inc, 2013.

REFERENCES:

1. Bali N P and Dr Manish Goyal, "A text book of Engineering Mathematics", 12th edition, Laxmi Publications, 2016.
2. Thomas G B and Finney R L, "Calculus and Analytic Geometry", 9th edition, Pearson Education India, 2018.
3. Maurice D Weir, Joel Hass and Christopher Heil, "Thomas Calculus", 14th edition, Pearson Education, India, 2018.
4. Gilbert Strang, "Linear Algebra and its Applications", 4th edition, Cengage India Pvt. Ltd, 2005.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Seminar / MCQ	Written Test	*Individual Assignment / Seminar / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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KPRIET

SEMESTER I

		Category: ESC				
U21EE101	FOUNDATION FOR ELECTRICAL ENGINEERING	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce fundamental electrical principles, basic electrical quantities, and safety practices relevant to simple electrical systems
- To provide knowledge of electrical accessories and lighting devices for appropriate selection in residential and industrial applications
- To familiarize students with wiring practices, illumination standards, and utility supply concepts for understanding basic electrical installations and energy consumption estimation

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Solve simple DC and AC circuit problems using basic electrical quantities and principles considering electrical safety (Apply)
CO2: Apply the characteristics of electrical accessories such as lamps, fuses, and circuit breakers to select suitable components for given applications (Apply)
CO3: Construct basic residential and industrial wiring layouts using standard wiring practices and safety norms (Apply)
CO4: Implement illumination principles and lighting standards to design basic lighting schemes for different workplaces (Apply)
CO5: Estimate energy consumption and electricity cost for given loads using utility supply and tariff concepts (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	2	2	1	-	-	-	2	1	-
CO2	3	2	1	1	-	-	-	1	-	-	-	2	-	1
CO3	3	2	1	1	-	2	2	1	-	-	-	2	-	1
CO4	3	2	1	1	3	1	1	1	-	-	-	2	-	1
CO5	3	2	1	1	-	2	2	1	-	-	-	3	-	1
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

SYLLABUS:

UNIT I FUNDAMENTALS OF ELECTRICITY 9

Evolution of electricity – Electrical quantities: DC and AC Current, Voltage, resistance, inductance, capacitance, frequency, impedance triangle – Types of loads – Electrical and mechanical – Electrical Safety measures

UNIT II ELECTRICAL ACCESSORIES 9

Types of Lamps – Incandescent lamp, fluorescent lamp, CFL – Basics of fuses, relays, switches, MCBs, ELCBs and cables

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UNIT III RESIDENTIAL AND INDUSTRIAL WIRING 9

Introduction to electrical wiring layouts: Residential, staircase and industrial wiring – Importance of grounding, neutral and earthing – Types of earthing – Measurement of earth resistance – Field visit

UNIT IV LIGHTING SCHEMES USING DIALux 9

DIALux demo – Lighting plan – Standards of Illumination – Floor lighting – Building lighting – Outdoor lighting – Industrial lighting – Street lighting

UNIT V UTILITY SUPPLY AND TARIFF 9

Basics of utility supply – Single phase and three phase connection schemes – Electrical tariff and types – Calculation of energy – Introduction to energy audit and importance of energy saving

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Kothari D.P. and Nagrath I.J., "Basic Electrical Engineering", 3rd edition, Tata McGraw-Hill Education, 2011
2. Uppal S.L., "Electrical Wiring, Estimating and Costing", 8th reprint, Khanna Publishers, 2018

REFERENCES:

1. Theraja B.L., "Fundamentals of Electrical Engineering and Electronics", 28th edition, S Chand & Company, 2020
2. "General Aspects of Energy Management and Energy Audit", Bureau of Energy Efficiency, Ministry of Power, Government of India
3. Open-source tools like DIALux, Relux and LuxRender

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="2">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (100 Marks)</th><th colspan="2">Assessment II (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td></td><td></td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td>200</td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER I

U21EN101	**ENGLISH FOR TECHNOLOGISTS** (Common to AD, BM, CH, CE, CS, CS(AIML), EE, EC, ME, MI, IT)	**Category: HSMC**					
		L	**T**	**P**	**J**	**C**
		1	0	2	0	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To infer and interpret the meaning of Technical, Business, Social and Academic contexts.
- To enhance the listening skills and facilitate effective pronunciation.
- To make effective presentation and conversation in technical and professional environment.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Use correct language mechanics to communicate clearly and accurately in spoken and written contexts (Understand)

CO2: Improve speaking skills in academic and social contexts (Apply)

CO3: Enhance both reading and writing skills to excel in professional career (Analyze)

CO4: Evaluate different perspectives on a topic (Analyze)

CO5: Comprehend global business communication through advanced listening and personality development (Understand)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO5	-	-	-	-	-	-	-	2	-	3	-	1	-	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I SUBJECTIVE INTROSPECTION 9

Module: 1 Vocabulary Building

Activity: Word Puzzles, Snappy words, Word Sleuthing

Module: 2 Introducing and Sharing Information

Activity: Get to know oneself, Introducing Peer Members

Module: 3 Opinion Paragraph

Activity: Note making, analyzing and writing a review

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UNIT II CAREER ENHANCEMENT 9

Module:4 Reading Comprehension

Activity: Reading Newspaper articles/Blogs, Sentence completion

Module:5 E-mail Communication

Activity: Drafting personal and professional emails

Module:6 Career Profiling

Activity: Resume Writing & Digital Profiling

UNIT III LANGUAGE ADEPTNESS 9

Module:7 Rewriting passages

Activity: Conversion of voices & Rephrasing Articles

Module:8 Enhancing Pronunciation skills

Activity: Listening to short technical Reels and reproducing it

Module:9 Making Conversations

Activity: Role play & Narrating Incidents

UNIT IV TECHNICAL WRITING 9

Module:10 Spotting Errors

Activity: Proof reading, Rewriting sentences

Module:11 Data interpretation

Activity: Interpretation of Graphics/Charts/Graphs

Module:12 Expository Writing

Activity: Picture inference, Captions for Posters& Products

UNIT V LANGUAGE UPSKILLING 9

Module:13 Listening for Specific Information

Activity: TED talks/Announcement/Documentaries

Module:14 Presentation

Activity: Extempore & Persuasive Speech

Module:15 Team Communication

Activity: Team building activities, Group Discussion

LIST OF EXERCISES

1. Introducing oneself
2. Role play
3. Listening to short technical Reels
4. Listening to TED Talks/ Announcements/ Documentaries
5. Presentation
6. Group Discussion

Contact Periods:

Lecture: 15 Periods	Tutorial: – Periods	Practical: 30 Periods	Project:	– Periods
			Total:	45 Periods

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TEXT BOOKS:

1. Ashraf Rizvi, "Effective Technical Communication", 2nd edition, Mc Graw – Hill. India 2017.
2. Rod Ellis, "English for Engineers & Technologists", Vol. II: (English for Engineers and Technologist: A Skills Approach). 2nd edition, Orient Black Swan, 1990.

REFERENCES:

1. Raymond Murphy, "Intermediate English Grammar", 2nd edition, Cambridge University Press, 2009.
2. Thomas L Means, "English and Communication for Colleges", 4th edition, Cengage 2017.
3. Using English: "A Course book for Undergraduate Engineers and Technologists", 1st edition, Orient Black Swan, 2017.

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th>End Semester Examinations</th></tr>
<tr><td colspan="2">Assessment I
(Theory)
(100 Marks)</td><td colspan="2">Assessment II
(Practical)
(100 Marks)</td><td rowspan="3">Practical Examinations

(Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>*Individual Assignment / Seminar / MCQ</td><td>Written Test</td><td>Evaluation of Laboratory Observation, Record
(Rubrics Based Assessments)</td><td>Test</td></tr>
<tr><td>40</td><td>60</td><td>75</td><td>25</td></tr>
<tr><td colspan="2">25</td><td colspan="2">25</td><td>50</td></tr>
<tr><td colspan="4">50</td><td>50</td></tr>
<tr><td colspan="5">Total: 100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER I

		Category: BSC				
U21PH101	ENGINEERING PHYSICS (Common to all branches)	L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the fundamental principles of laser and fibre optics with their applications
- To acquire the knowledge of ultrasonic waves, thermal conductivity and properties of liquids
- To understand the concepts of crystals

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Illustrate the types of laser for various industrial and medical applications (Understand)

CO2: Apply the principles of fibre optics in sensors, communication and medical applications (Apply)

CO3: Identify the properties and production methods of ultrasonic waves for engineering and medical Applications (Apply)

CO4: Utilise the concepts of thermal conductivity and viscosity of liquids for various engineering applications (Apply)

CO5: Apply the concepts of various crystals for the design of ingots and Silicon wafers (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO4	3	2	1	1	-	-	-	-	-	-	-	-	-	1
CO5	3	2	1	1	-	-	-	-	-	-	-	-	-	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I LASER **6**

Laser characteristics – Spontaneous and stimulated emission – Pumping methods – CO_2 laser – Semiconductor laser – Material Processing – Selective laser Sintering – Hologram – Medical applications (Opthalmology)

UNIT II FIBER OPTICS **6**

Total internal reflection – Numerical aperture and acceptance angle – Classification of optical fibers (Materials, modes and refractive index profile) – Fiber optical communication system – Displacement and temperature sensor – Medical Endoscopy

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UNIT III ULTRASONICS 6

Properties of ultrasonic waves – Piezoelecrtic generator – Acoustic grating – Applications of ultrasonics in industry – SONAR – NDT – Ultrasonic scanning methods – Fetal heart movement

UNIT IV THERMAL PHYSICS AND PROPERTIES OF FLUIDS 6

Modes of heat transfer – Thermal conductivity – Lee's disc method – Solar thermal power generation – Hybrid vehicles – Microwave oven – Surface tension and coefficient of viscosity – Poiseuille's flow experiment

UNIT V CRYSTAL PHYSICS 6

Unit cell – Bravais lattices – SC, BCC, FCC structures – Miller indices – d spacing in cubic lattice – Crystal growth from melt: Bridgeman Technique – Silicon ingots from Czochralski method – Silicon wafers from ingots and its applications

LIST OF EXPERIMENTS

1. Determination of the wavelength of a given laser source
2. Determination of acceptance angle and numerical aperture of an optical fibre
3. Determination of velocity of sound and compressibility of a liquid using Ultrasonic interferometer
4. Determination of thermal conductivity of a bad conductor using Lee's disc method
5. Determination of viscosity of the given liquid using Poiseuille's flow method

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Bhattacharya D K and Poonam Tandon, "Engineering Physics", 2nd edition, Oxford University Press, Chennai, 2017
2. Marikani A, "Engineering Physics", 3rd edition, PHI publishers, Chennai, 2021

REFERENCES:

1. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", 2nd edition, Pearson India Education Services Private Limited, Chennai, 2018
2. Avadhanulu M N, Kshirsagar P G and Arun Murthy TVS, "A Text book of Engineering Physics", 2nd edition, S Chand Publishing, New delhi, 2018
3. Thyagaran K, Ajoy Ghatak, "Lasers – Fundamantals and Applications", 2nd edition, Laxmi Publications Pvt Limited, New delhi, 2019
4. https://nptel.ac.in/downloads/104104085/
5. https://nptel.ac.in/courses/122107035/8/

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EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER I

U21CY101	ENGINEERING CHEMISTRY (Common to all BE./B.Tech. courses)	Category: BSC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To inculcate the fundamentals of water technology and electrochemistry
- To gain basic knowledge of corrosion of metals and alloys
- To acquire knowledge about the properties of fuels and applications of polymers

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply water technology principles for the treatment and quality assessment of industrial and domestic water systems (Apply)
CO2: Illustrate the principles and applications of electrochemical cells, fuel cells, and solar cells (Understand)
CO3: Discuss various corrosion processes and the industrial methods used for corrosion prevention (Understand)
CO4: Describe fuel analysis, synthesis, related problems, and pollution prevention techniques (Understand)
CO5: Explain polymer basics, types, processing techniques, and engineering applications (Understand)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	1	-	1	-	-	1	-	-
CO2	2	1	-	-	-	-	1	-	1	-	-	1	-	1
CO3	2	1	-	-	-	-	1	-	1	-	-	1	-	-
CO4	2	1	-	-	-	-	1	-	1	-	-	1	-	-
CO5	2	1	-	-	-	-	1	-	1	-	-	1	-	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I CHARACTERISTICS OF WATER AND ITS TREATMENT 6

Characteristics of water – Hardness – Types, Dissolved oxygen, Total dissolved solids, Disadvantages due to hard water in industries – (Scale, Sludge, Priming, Foaming and Caustic embrittlement), Water softening methods – Lime-soda, Zeolite, Ion exchange processes and reverse Osmosis and their applications. Specifications of domestic water (ICMR and WHO).

Water treatment for municipal supply – Sedimentation with coagulant – Sand Filtration – Chlorination, Disinfection methods – UV treatment, Ozonolysis, Electro dialysis

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UNIT II ELECTROCHEMISTRY AND ENERGY STORAGE SYSTEMS 6

Introduction, Electrodes – (Calomel electrode), Electrochemical series and its applications, Brief introduction to conventional primary and secondary batteries – (Pb acid, Lithium)

Fuel cells – Polymer membrane fuel cells, Solid-oxide fuel cells – Working principles, advantages, applications. Solar cells – Dye sensitized solar cells – Working principles, characteristics and applications

UNIT III CORROSION AND ITS CONTROL 6

Types – Dry – Chemical corrosion and Wet – Galvanic and differential aeration (Pitting, Crevice, pipeline) – Factors influencing rate of corrosion – Corrosion control methods – Sacrificial anode and impressed current method – Protective coating – Electroplating – Ni plating.

Alloys – Ferrous (stainless steel), Heat treatment – Non-ferrous alloys (Brass -Dutch metal, German Silver) – Composition, properties and uses

UNIT IV FUELS AND COMBUSTION 6

Fuels- Solid fuel: Coal - Analysis of coal (Proximate analysis only) – Liquid fuel – Manufacture of synthetic petrol (Bergius process) – Octane number, cetane number, Knocking in engines- Anti-knocking agents, Gasoline additives, Gaseous fuel: Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Composition only.

Calorific value – Higher and lower calorific values – Flue gas analysis (ORSAT method). Measurement of calorific value using bomb calorimeter, Three-way catalytic converter – Selective catalytic reduction of NO_x

UNIT V POLYMERS 6

Introduction – Monomer, dimers, functionality, degree of polymerisation, transition glass temperature Classification of polymers, Difference between thermoplastics and thermosetting plastics, Engineering application of plastics - ABS, PVC, PTFE and Bakelite.

Types of compounding of plastics – Moulding, Injection moulding, Extrusion moulding, Compression moulding

Conducting polymers – Polypyrrole, Polyacetylene, Polyaniline – Structure and applications, Composites – FRP – Properties and applications

LIST OF EXPERIMENTS

1. Determination of total, permanent and temporary hardness of a given sample water by EDTA method
2. Estimation of ferrous ion by potentiometric titration
3. Estimation of Copper in Brass by EDTA method
4. Determination of percentage of moisture, volatile, ash and carbon content in a given sample of coal.
5. Determination of molecular weight and degree of polymerization of an oil sample by viscosity measurement (Ostwald's viscometer).
6. Determination of chloride content in the water sample
7. Determination of strength of HCl by pH metric method

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Jain P C and Monika Jain, "Engineering Chemistry", 16th edition, Dhanpat Rai Publishing Company, Pvt. Ltd., New Delhi, 2015
2. Vairam S, Kalyani P and Suba Ramesh, "Engineering Chemistry", 2nd edition, Wiley India Pvt. Ltd, New Delhi, 2014

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REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", 2nd edition, Scientific International Pvt. Ltd, New Delhi, 2014
2. Prasanta Rath, "Engineering Chemistry", 1st edition, Cengage Learning India, Pvt. Ltd, Delhi, 2015
3. Shikha Agarwal, "Engineering Chemistry, Fundamentals and Applications", 1st edition, Cambridge University Press, 2015
4. https://nptel.ac.in/courses/113/104/113104008/

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER I

U21CSG01	PROBLEM SOLVING AND C PROGRAMMING (Common to All Branches)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide exposure to problem-solving through programming
- To develop computational thinking perspective of one's own discipline
- To write, compile and debug programs using C language

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Formulate the algorithmic solutions for a given computational problem (Understand)

CO2: Describe modularization, structures and pointers in C language (Understand)

CO3: Design and implement algorithms for a given problem using C control structures (Apply)

CO4: Apply the C programming constructs for searching and sorting techniques (Apply)

CO5: Solve real time problems using suitable non-primitive data structures in C (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	1	1	-	-	1	-
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CO3	3	2	1	1	-	-	-	-	1	1	-	-	1	-
CO4	3	2	1	1	-	-	-	-	1	1	-	1	1	-
CO5	3	2	1	1	-	-	-	-	1	1	1	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I COMPUTATIONAL THINKING 6

Computational Thinking – Modern Computer – Information based Problem solving – Real world information and Computable Data – Data types and data encoding – Number Systems – Introduction to programming languages – Basics of C programming – variables– Data types – keywords – C program structure – Simple programs in C

UNIT II ALGORITHMIC APPROACH 6

Logic – Boolean Logic – Applications of Propositional logic – Problem Definition – Logical Reasoning and Algorithmic thinking – Pseudo code and Flow chart – Constituents of algorithms – Sequence, Selection and Repetition – Problem understanding and analysis – Control structures in C – Algorithm design and implementation using control structures

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UNIT III SEARCHING, SORTING, AND MODULARIZATION 6

Data Organization – Arrays – Introduction to Searching and Sorting – Linear Search, Binary Search – Basic sorting techniques – Two-dimensional arrays – Matrix manipulation – Modularization – Functions – Function prototype – Function definition – Function call – Built-in functions (string functions and math functions) – Recursion

UNIT IV STRUCTURES AND POINTERS 6

Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Example Program – Sorting of names – Parameter passing – Pass by value – Pass by reference – Structure – Nested structures – Pointer and Structures – Array of structures – Example Program using structures and pointers – Unions

UNIT V FILES 6

Files – Types of file processing – Sequential access – Random access – Sequential access file – Example Program – Finding average of numbers stored in sequential access file – Random access file – Example Program – Transaction processing using random access files – Command line arguments

LIST OF EXPERIMENTS

A. Lab Programs

1. Using IO Statements, get higher secondary marks of a student. Calculate and display the medical and engineering cut-off marks. [Assume the calculation formula]
2. Develop a C program to emulate the operations of an ATM using control structures. Authentication, Deposit, Withdrawal, and Balance check and pin change operations are to be supported.
3. Develop a calculator to perform the operations including addition, subtraction, multiplication, division and square of a number.
4. Given different prices of a vegetable which is varying through the day (from morning to evening), find out the best buy price and sell price for the maximum profit. Eg. For the prices [33, 35, 28, 36 39, 25, 22, 31], best buy is at 28 and best sell is at 39.
5. Collect height and weight of 4 of your friends and calculate their body mass index. Use 2 dimensional array to store the values.
6. Weights of 10 students of your class who are standing in a line is given in a random order. Find out if there is a heavy person whose weight is the sum of previous two persons.
7. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
8. From a given paragraph perform the following using built-in functions:
   a) Find the total number of words.
   b) Capitalize the first word of each sentence.
9. Solve Towers of Hanoi using recursion.
10. Develop an expense manager which reads date, product, price and product category. The program should display the total expense amount based on product category or date as per user's selection. Use structures.
11. Develop a banking application to store details of accounts in a file. Count the number of account holders based on a search condition such as - whose balance is less than the minimum balance.

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B. Mini Project (SAMPLE)

Create a Railway Reservation system with the following modules of Booking,

- Availability checking
- Cancellation
- Prepare chart

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. David D. Railey and Kenny A.Hunt , "Computational Thinking for Modern problem Solver", 1st Edition, CRC Press, 2014
2. Brian W. Kernighan and Dennis Ritchie, "The C Programming Language", 2nd Edition, Pearson, 2015

REFERENCES:

1. Paolo Ferragina and Fabrizio Luccio, "Computational Thinking First Algorithms", Then Code" ,1st Edition,Springer International Publishing, 2018
2. Reema Thareja, "Programming in C", 2nd Edition, Oxford University Press, 2016
3. Paul Deitel and Harvey Deitel, "C How to Program", 7th Edition, Pearson Publication
4. Juneja, B. L and Anita Seth, "Programming in C",1st Edition, Cengage Learning India Pvt. Ltd., 2011
5. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", 1st Edition, Oxford University Press, 2009

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th colspan="2">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (Theory) (100 Marks)</th><th colspan="2">Assessment II (Practical) (100 Marks)</th><th rowspan="2">Theory Examinations (Examinations will be conducted for 100 Marks)</th><th rowspan="2">Practical Examinations (Examinations will be conducted for 100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)</td><td>Test</td></tr>
<tr><td>40</td><td>60</td><td>75</td><td>25</td><td></td><td></td></tr>
<tr><td colspan="2">25</td><td colspan="2">25</td><td>25</td><td>25</td></tr>
<tr><td colspan="4">50</td><td colspan="2">50</td></tr>
<tr><td colspan="6">Total: 100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SEMESTER I

		Category: ESC				
U21MEG01	ENGINEERING GRAPHICS	L	T	P	J	C
		0	0	4	0	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To expose the standards and conventions followed in preparation of engineering drawings
- To develop graphic skills for communication of concepts, ideas and engineering drawings
- To expose on 2D & 3D drawings and its projections

COURSE OUTCOME:

Upon completion of the course, the student will be able to

CO1: Sketch the curves and orthographic projections of points as per BIS conventions (Apply)

CO2: Illustrate the orthographic projections of straight lines and plane surfaces (Apply)

CO3: Sketch the orthographic projections of solids, lateral surfaces of frustums, truncated solids and its development (Apply)

CO4: Develop the lateral surfaces of simple solids (Apply)

CO5: Interpret the orthographic and isometric views of simple components (Apply)

CO PO Mapping:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	1	-	-	-	1	-	1
CO2	2	1	-	-	2	-	-	-	-	-	-	1	-	1
CO3	3	2	1	1	2	-	-	-	-	-	-	2	-	1
CO4	3	2	1	1	2	-	-	-	-	-	-	1	-	1
CO5	2	1	-	-	2	-	-	-	-	-	-	1	-	1

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

BASICS OF ENGINEERING DRAWING AND CAD (Not for examination)

Introduction – Drawing instruments and its uses – Sheet layout – BIS conventions – Lines – Lettering and dimensioning practices – Lines – Co – Ordinate points – Axes – Poly lines – Square – Rectangle – Polygons – Splines – Circles – Ellipse – Text – Move – Copy – Off – Set – Mirror – Rotate – Trim – Extend – Break – Chamfer – Fillet – Curves – Constraints viz. agency – Parallelism – Inclination and perpendicularity

UNIT I CONICS, SPECIAL CURVES AND PROJECTION OF POINTS **12**

Construction of parabola – Ellipse and hyperbola using eccentricity method – Construction of involutes for squares and circles – Construction of Tangent and normal to the above curves – Introduction –

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Method of projection – Planes of projection – Reference line and notations – Orthographic Projection of points – Points in all four quadrants

UNIT II PROJECTION OF STRAIGHT LINES AND SURFACES 12

Projection of straight lines – Lines inclined to HP / VP plane – Inclined to both HP and VP planes (straight lines are assumed to be in first quadrant only) – Projection of planes – Projection of square – Rectangle – Pentagon – Hexagon and circular plane – Inclined to both the plane by change of position method

UNIT III PROJECTION OF SOLIDS 12

Introduction – Projection of solids – Prisms – Pyramids – Cylinders and cones with axis inclined to both the planes (Solids resting on HP only)

UNIT IV DEVELOPMENT OF LATERAL SURFACES OF SOLIDS 12

Introduction – Cutting plane – Sectional views of right regular solids resting with base on HP – Prisms – Pyramids – Cylinder and cone – True shapes of the sections – Development of lateral surfaces of right regular prisms – pyramids – Cylinders – Cones resting with base on HP only – Development of the frustums and truncations

UNIT V ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS 12

Orthographic projection – Simple machine components using free hand sketching – Isometric projection – Simple Solid exercises and combination of solids

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. ND Bhat & VM Panchal, "Engineering Drawing", 51st edition, Charotar Publishing House, Gujarat, 2013.
2. Venugopal K. and Prabhu Raja V, "Engineering Graphics", 6th edition, New Age International (P) Limited, 2019.

REFERENCES:

1. Natrajan K.V., A text book of Engineering Graphics, 21st edition, Dhanalakshmi Publishers, Chennai, 2017.
2. Sam Tickoo, AutoCAD 2013 for Engineers and Designers, 1st edition, Dream tech Press, 2013.
3. Annaiah M H & Rajashekar Patil, Computer Aided Engineering Drawing, 4th edition, New Age International Publishers,,2012.
4. Basant Aggarwal, Engineering Drawing, 1st edition, Tata Mc Graw Hill Education Private Limited, 2010.
5. Kulkarni D M, A.P.Rastogi, A.K.Sarkar, "Engineering Graphics with AutoCAD", Revised edition, PHI Learning Private Limited, New Delhi, 2010.

EVALUATION PATTERN:

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
75	25	
100		100
60		40
100		

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SEMESTER I

U21MEG02	MANUFACTURING PRACTICES	Category: ESC				
		L	T	P	J	C
		0	0	4	0	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide exposure on workshop tools and additive manufacturing processes
- To provide hands on training experiences in sheet metal, carpentry welding and plumbing operations
- To provide hands on experience on soldering and simple electrical circuit wiring

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify the various tools and measuring equipment used for assembly and dismantling practice (Apply)

CO2: Develop simple components using 3D printer (Apply)

CO3: Fabricate products using sheet metal and carpentry (Apply)

CO4: Perform operations such as welding and plumbing (Apply)

CO5: Connect and test the electrical and electronics components for the given circuit diagram (Apply)

CO PO Mapping:

PCs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	1	-	1	-	1	1	-	1	-	-
CO2	3	1	1	-	3	-	1	-	2	1	-	2	-	-
CO3	3	1	1	-	1	-	1	-	3	2	-	1	-	-
CO4	3	1	1	-	1	-	1	-	3	2	-	1	-	-
CO5	3	1	1	-	1	-	1	-	3	2	-	1	-	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

SYLLABUS:

UNIT I PRODUCT WORKSHOP 9

Disassemble the product of sub assembly – Measure various dimensions using measuring instruments. Free hand rough sketch of the assembly and components – Name of the components and indicate the various materials used – Study the functioning of the assembly and parts – Study the assembly and components design for compactness – Processing – Ease of assembly and disassembly – Assemble the product or subassembly

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UNIT II ADDITIVE MANUFACTURING WORKSHOP 9

Study of 3 axis 3D printing machine – Methods of 3D printing – SLA and FDM methods – Pre –processing – Geometry creation – Support generation and slicing – Post Processing – Requirement and Techniques Support Removal – Sanding – Acetone treatment – Polishing

UNIT III SHEET METAL AND CARPENTRY WORKSHOP 9

Study of tools and equipment – Draw development drawing of simple objects on sheet metal (cone – Cylinder – Pyramid – Prism – Tray etc.) – Fabrication of components using small shearing and bending machines – Riveting practice – Study of carpentry process – Fabrication of wood joints like Lap – Tee – Dovetail and mortise & tenon joint

UNIT IV WELDING AND PLUMBING WORKSHOP 9

Study of tools and equipment – Study of various welding – Arc welding practice – Fitting – Square butt joint and lap joint – Plumbing tools – Make a piping joint to a simple piping layout (should include cutting – Threading and pipe fixing)

UNIT V ELECTRICAL AND ELECTRONICS ENGINEERING WORKSHOP 9

Study of tools and equipment – Study of basic electrical components and symbols – Simple Wiring – Staircase Wiring – fluorescent wiring – Study of soldering tools and methods of soldering

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Project: – Periods

Total: 60 Periods

LIST OF EXPERIMENTS

1. Study on measuring instruments used in workshop practices.
2. Dismantling, measuring and reassembling of centrifugal pump.
3. 3D prototyping of simple components using FDM method.
4. 3D Printing of simple geometric shapes using SLA printer.
5. Fabrication of sheet metal tray and funnel.
6. Fabrication of wood joints.
7. Preparation of MS plate for Lap, butt and Tee joints using arc welding
8. Installation of water lines for washbasin and showers faucets.
9. Preparation of wiring for tube light, staircase and electric fan.
10. Soldering of a simple circuit consists of THC and SMD components.

TEXT BOOKS:

1. Hajra Choudhury, "Elements of Mechanical Engineering", 11th edition, Media Promoters, 2010.
2. S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy the Elements of Workshop Technology – Vol I & II, 11th edition, Media Promoters and Publishers, Mumbai, 2001

REFERENCES:

1. Workshop manual prepared by Department of Mechanical Engineering

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EVALUATION PATTERN:

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	
75	25	
100		100
60		40
100		

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SEMESTER II

U21MA201	**LAPLACE TRANSFORMS AND COMPLEX VARIABLES** (Common to CE, EE, CH, ME, MI)	**Category: BSC**					
		L	**T**	**P**	**J**	**C**
		3	**1**	**0**	**0**	**4**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the mathematical aspects of conversion time domain to frequency domain using Laplace transform and Inverse Laplace transform vice versa
- To use the concepts of complex analysis, in the study of heat flow, fluid dynamics and electrostatics
- To understand the concepts of singularities in the various domains of engineering fields

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply Laplace transform properties and theorems to convert time-domain engineering problems into frequency-domain representations (Apply)
CO2: Utilize inverse Laplace transform techniques to obtain time - domain solutions from frequency – domain equations in engineering systems (Apply)
CO3: Explain the properties of analytic functions and Cauchy-Riemann equations in the context of complex variable theory (Understand)
CO4: Apply Cauchy's integral theorem and formula to evaluate complex contour integrals in engineering applications (Apply)
CO5: Compute residues and apply the residue theorem to evaluate definite integrals arising in engineering problems (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	-
CO3	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO4	2	2	-	1	-	-	-	-	-	-	-	-	1	-
CO5	3	3	-	2	-	-	-	-	-	-	-	1	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I LAPLACE TRANSFORM **9 + 3**

Laplace transform – Conditions for existence – Transform of elementary functions – Standard properties (statement only) – Transforms of unit step function – Impulse function – Periodic function – Initial and final value theorems – Convolution theorem (without proof)

UNIT II INVERSE LAPLACE TRANSFORM **9 + 3**

Inverse Laplace transform – Standard properties (statement only) – Second order linear differential equations with constant coefficients

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UNIT III COMPLEX DIFFERENTIATION **9 + 3**

Analytic functions: Cauchy-Riemann equations (Cartesian form) and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Construction of analytic functions – Bilinear transformations

UNIT IV COMPLEX INTEGRATION **9 + 3**

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula

UNIT V SINGULARITIES AND RESIDUES **9 + 3**

Taylor's and Laurent's series expansions – Singular points – Classification of singularities – Residues – Cauchy's residue theorem

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley India Pvt Ltd, New Delhi, 2018.
2. Grewal B S, "Higher Engineering Mathematics", 44th edition, Khanna Publishers, New Delhi, 2017.

REFERENCES:

1. Bali N P and Dr Manish Goyal, "A text book of Engineering Mathematics", 12th edition, Laxmi Publications, 2016.
2. Thomas G B and Finney R L, "Calculus and Analytic Geometry", 14th edition, Pearson Education India, 2018.
3. James Stewart, "Calculus: Early Transcendental", 7th edition, Cengage Learning, New Delhi, 2015.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Seminar / MCQ	Written Test	*Individual Assignment / Seminar / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER II

		Category: BSC				
U21PH201	**MATERIALS SCIENCE** (Common to all branches except BME)	**L**	**T**	**P**	**J**	**C**
		2	0	0	0	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To gain the knowledge of conducting and semiconducting materials
- To understand the concepts of magnetic, dielectric and optical properties of materials
- To enhance the knowledge of new engineering materials

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Understand the electrical characteristics of conducting materials (Understand)

CO2: Apply the properties and types of semiconducting materials for the design of various semiconductor devices (Apply)

CO3: Examine the various types of magnetic materials for engineering applications (Analyze)

CO4: Develop the fundamental concepts of dielectric and optical materials (Apply)

CO5: Examine the properties and preparations of new engineering materials and make use of characterization techniques for industrial applications (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	1	-
CO4	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-	1	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I CONDUCTING MATERIALS 6

Classical free electron theory – Expression for electrical conductivity and thermal conductivity – Wiedemann - Franz law – Drawbacks – Fermi distribution function – Density of energy states in metals

UNIT II SEMICONDUCTING MATERIALS 6

Intrinsic and Extrinsic semiconductor – Carrier concentration in n-type semiconductor – P-type semiconductor(qualitative) – Applications of semiconductors – Solar cell – LED – Hall effect and its experimental determination

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UNIT III MAGNETIC MATERIALS 6

Origin of magnetism – Dia, para and ferro magnetic materials – Domain theory – Soft and hard magnetic materials – Magnetic bubble memories – GMR sensor

UNIT IV DIELECTRIC AND OPTICAL MATERIALS 6

Dielectrics – Types of polarisation – Electronic polarisation – Dielectric breakdown – Ferroelectrics – Applications of dielectrics – Classification of optical materials – Nonlinear optics – Applications

UNIT V NEW ENGINEERNG MATERIALS AND CHARACTERIZATION TECHNIQUES 6

SMA – SiC – GaN – Rheological materials – Nanomaterials – Synthesis (Ball milling and CVD) – Quantum dot, quantum wire and quantum well (qualitative) – Characterisation techniques – Powder XRD (qualitative) – SEM

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 30 Periods

TEXT BOOKS:

1. Wahab M A, "Solid State Physics: Structure and Properties of Materials", 3rd edition, Narosa Publishing House, Chennai, 2018
2. Marikani A, "Materials Science", 1st edition, PHI publishers, Chennai, 2017

REFERENCES:

1. Pillai S O "Solid State Physics", 9th edition, New Age International Publishers, New Delhi, 2020
2. Bangwei Zhang, "Physical Fundamentals of Nanomaterials", Chemical Industry Press, China, 2018
3. Joginder Singh Galsin, "Solid State Physics – An Introduction to Theory", Academic Press, India, 2019
4. https://nptel.ac.in/courses/108/108/108108122/
5. https://nptel.ac.in/courses/113/105/113105081/

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER II

		Category: ESC				
U21EE201	ELECTRIC CIRCUIT ANALYSIS	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce the fundamental principles of electrical circuits, AC analysis, and three-phase systems
- To provide comprehensive knowledge of network reduction techniques, network theorems, transient response, resonance, and coupled circuits
- To develop systematic analytical thinking and problem-solving ability in the analysis of electrical networks and systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply fundamental circuit laws, phasor concepts, and complex impedance to determine voltages, currents, power, power factor, and energy in AC and DC circuits (Apply)

CO2: Examine electrical networks using network reduction techniques and network theorems to obtain equivalent circuit parameters and maximum power transfer conditions (Analyze)

CO3: Implement three-phase circuit principles to determine voltages, currents, and power in balanced and unbalanced star and delta connected systems (Apply)

CO4: Analyze transient responses and two-port network parameters to predict circuit behavior under DC and AC excitations (Analyze)

CO5: Investigate resonance and coupled circuit characteristics to evaluate frequency response, bandwidth, quality factor, and tuning performance (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	2
CO2	3	3	2	2	-	-	-	-	-	-	-	1	-	2
CO3	3	2	1	1	-	-	-	-	-	-	-	1	-	2
CO4	3	3	2	2	-	-	-	-	-	-	-	1	-	2
CO5	3	3	2	2	-	-	-	-	-	-	-	1	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I BASIC CIRCUIT ANALYSIS 9

Ohm's law and Kirchoff's laws – Complex impedance – Phasor diagram – Voltage and current division – Source transformation – Mesh and nodal analysis – Power, power factor and energy

UNIT II NETWORK REDUCTION TECHNIQUES 9

Star and delta conversion – Superposition theorem – Thevenin's and Norton's theorem – Maximum power transfer theorem

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UNIT III THREE PHASE CIRCUITS 9

Three phase system – Phasor diagram – Three phase three wire – Three phase four wire – Balanced and unbalanced star and delta load – Power measurement

UNIT IV TRANSIENT RESPONSE AND TWO PORT NETWORKS 9

Transient response of RL, RC and RLC circuits with DC and AC excitations – Two port networks – Z and Y parameters

UNIT V RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance – Frequency response, quality factor, bandwidth and half power frequencies – Coupled circuits – Self and mutual inductance – Coupling coefficient – Dot rule – Single tuned circuits

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Sudhakar A and Shyammohan S Palli, "Circuits and Network Analysis", 5th edition, McGraw-Hill Education, New Delhi, 2019
2. William H. Hayt, Jr., Jack E. Kemmerly, Steven M. Durbin, "Engineering Circuit Analysis", 8th edition, McGraw-Hill Education, New Delhi, 2013

REFERENCES:

1. Joseph A. Edminister, Mahmood Nahvi, "Electric Circuits", 5th edition, Schaum's outline series, McGraw Hill Education, New Delhi, 2017
2. Allan H. Robbins, Wilhelm C. Miller, "Circuits Analysis Theory and Practice", 5th edition, Cengage Learning, India, 2013
3. Charles K. Alexander, Matthew N. O. Sadiku, "Electric Circuits", 6th edition, McGraw Hill Education, New Delhi, 2019

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER II

		★Category: ESC				
U21MEG04	BASICS OF CIVIL AND MECHANICAL ENGINEERING (for B.E Electrical and Electronics Engineering)	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To familiarize with the basic mechanical elements, cycles and power plants.
- To learn the concepts of safety and Industrial principles.
- To provide knowledge about different types of building materials.
- To teach the difference between conventional and modern infrastructure systems.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify and explain basic mechanical elements and fluid power components (Understand)

CO2: Select mechanical cycles, power plants, and internal combustion engines for suitable applications (Apply)

CO3: Implement industrial safety practices and software tools in industries (Apply)

CO4: Understand the building materials and structures (Understand)

CO5: Identify and relate the various infrastructures and their services (Apply)

CO–PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	1	-	-	-	-	-	1	-	1
CO2	3	2	-	-	-	1	-	-	-	-	-	1	-	1
CO3	3	2	-	-	-	1	-	-	-	-	-	1	-	1
CO4	3	2	-	-	-	1	-	-	-	-	-	1	-	1
CO5	3	2	-	-	-	1	-	-	-	-	-	1	-	1
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

SYLLABUS:

UNIT I BASIC MECHANICAL ELEMENTS 9

Basic Concepts and demonstration: Bearings – Gears – Belt drives – Chain drives – Cable drives – chain block – Conveyers – Shafts – Keys – Spline shafts – Springs – Fasteners – screws – Bolts – Nuts and their specifications Fundamental Hydraulics and Pneumatics – Valves and Cylinders

UNIT II MECHANICAL CYCLES, POWER PLANTS AND IC ENGINES 9

Rankine Cycle – Refrigeration and Air conditioning – VARC and VCRC systems – Power Plants – Steam – Gas – Diesel – Hydroelectric and Nuclear Power plants – Turbines and Pumps – Classification and functions – IC Engines – SI and CI engines – Two stroke and four stroke Engines

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UNIT III INDUSTRIAL ENGINEERING 9

Introduction to safety engineering – Evolution of Safety – Improvements Required – Safety Organization – Safety Functions – Workplace Operations Requiring Safety – Safety Benefits – Software in Mechanical Industry – introduction to Modelling and Analysis software – Basic Concepts and Application of IoT to industrial processes

CIVIL ENGINEERING

UNIT IV BUILDING MATERIALS AND COMPONENTS 9

Building Materials: Introduction – Bricks – Stones – Sand – Cement – Mortar – Concrete – Steel – Wood – Smart materials. **Surveying:** Objects – Classification – **Sub Structures:** Soil – Classification – Bearing capacity – Foundation – Function – Requirements – Types of foundations – **Super Structures:** Brick masonry – Stone masonry – Beams – Columns – lintels – Roofing – Flooring – Plastering – Damp proofing – Weathering course

UNIT V BASIC INFRASTRUCTURE AND SERVICES 9

Introduction to Highways – Railways – Airways and Waterways – Building Information Modelling (BIM) – Solid waste management system – Concept of Green Building – Benefits of Green Buildings – Green Building Materials – Smart Cities

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Basant Agarwal and C.M. Agarwal, "Basics of Mechanical Engineering", 3rd edition, Wiley India Pvt. Ltd, New Delhi, 2018.
2. Shanmugam Gand Palanichamy MS,"Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., NewDelhi,1996.

REFERENCES:

1. Palanikumar, K. "Basic Mechanical Engineering", ARS Publications, 2010.
2. Venugopal K. and Prabhu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2010.
3. Seetharaman S.,"Basic Civil Engineering", Anuradha Agencies,2005.
4. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2010.

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER II

U21EN201	**PERSONALITY ENHANCEMENT** (Common to AD, BM, CH, CE, CS, CS(AIML), EE, EC, ME, MI, IT)	**Category: HSMC**					
		L	**T**	**P**	**J**	**C**	
		1	**0**	**2**	**0**	**2**	

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop of personality traits that contributes in the professional environment
- To create a basic awareness about the significance of soft skills in professional and interpersonal communications
- To enhance the level of self-confidence that helps to excel in the leadership skills

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Nurture a deep understanding of personality development and interpersonal relationship for overall self-development (Understand)

CO2: Communicate proficiently in high-end interviews and in all social situations (Understand)

CO3: Synthesize complex concepts and present them in speech and writing (Analyze)

CO4: Negotiate and lead teams towards success (Understand)

CO5: Present ideas in an effective manner using web tools (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	1	-	-
CO2	-	-	-	-	-	-	-	1	2	3	-	1	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO5	-	-	-	-	-	-	-	1	-	3	-	-	-	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

SYLLABUS:

UNIT I LEXICAL REASONING 9

Module:1 Establishing Associations

Activity: Verbal Analogy, Logical Reasoning

Module:2 Lateral Thinking

Activity: Reasoning and Assertions

Module:3 Sentence Completion

Activity: Cloze Test, Single Word Substitutes

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UNIT II SOCIAL CORRESPONDENCE 9

Module: 4 Etiquettes

Activity: Brain storming & performing in actions

Module: 5 Introspection

Activity: SWOT Analysis, Goal Setting

Module: 6 Co-verbal Gesture

Activity: Body Language, Non verbal cues

UNIT III ART OF NETWORKING 9

Module: 7 Addressing a Multitude

Activity: Welcome address, Vote of Thanks, Public Speaking

Module: 8 Persuasive Communication

Activity: Making Technical Presentation

Module: 9 Career Oriented Communication

Activity: Face to face Conversation, Mock Interview

UNIT IV CRITICAL THINKING 9

Module: 10 Organizing ideas

Activity: Mind Mapping

Module: 11 Problem Solving Skills

Activity: Conflict management, Case Study

Module: 12 Critical Review

Activity: Book/ Movie Review, Comparative Analysis

UNIT V CONTENT WRITING 9

Module: 13 Reports

Activity: Writing Event Report, Project Report

Module: 14 Writing for Digital platform

Activity: Writing Posts, Blogs

Module: 15 Developing Content

Activity: Product Description, Writing Proposals

LIST OF EXERCISES

1. Listening to Inspirational Speech
2. Listening to Product Description
3. Book/Movie Review
4. Presentation
5. Mock Interview
6. Public Speaking

Contact Periods:

Lecture: 15 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 45 Periods

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TEXT BOOKS:

1. Meenakshi Raman & Sangeetha Sharma. "Professional English: for AKTU",1st edition, Oxford University Press. 2018.
2. Barun. K.Mitra. "Personality Development and Soft Skills", 2nd edition, OUP India, 2016.

REFERENCES:

1. Mathew Allen. "Smart Thinking: Skills for Critical Understanding and Writing", 2nd edition, OUP India, 2016.
2. Means, Thomas L, "English and Communication for Colleges", 4th edition, Cengage, 2017
3. Using English: "A Coursebook for Undergraduate Engineers and Technologists", 1st edition, Orient Black Swan, 2017

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th>End Semester Examinations</th></tr>
<tr><td colspan="2">Assessment I
(Theory)
(100 Marks)</td><td colspan="2">Assessment II
(Practical)
(100 Marks)</td><td rowspan="2">Practical Examinations
(Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>Individual Assignment / Seminar / MCQ</td><td>Written Test</td><td>Evaluation of Laboratory Observation, Record
(Rubrics Based Assessments)</td><td>Test</td></tr>
<tr><td>40</td><td>60</td><td>75</td><td>25</td><td></td></tr>
<tr><td colspan="2">25</td><td colspan="2">25</td><td>50</td></tr>
<tr><td colspan="4">50</td><td>50</td></tr>
<tr><td colspan="5">Total: 100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER II

U21CSG02	PYTHON PROGRAMMING (Common to All Branches)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand syntax and semantics of python programming
- To implement programs using python data structures
- To gain expertise in using python libraries for solving real time problems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Describe the basic concepts of tokens, data types, operators, expressions, and input–output operations in Python (Understand)

CO2: Demonstrate Python programs using control statements and user-defined functions (Apply)

CO3: Solve engineering problems using built-in data structures such as strings, lists, tuples, sets, and dictionaries (Apply)

CO4: Implement exception handling and file-handling mechanisms in Python (Apply)

CO5: Use NumPy and Pandas libraries for data manipulation and computation (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	1	1	-	1	1	-
CO2	3	2	1	1	-	-	-	-	1	1	-	1	1	-
CO3	3	2	1	1	-	-	-	-	1	1	-	2	1	-
CO4	3	2	1	1	-	-	-	-	1	1	-	2	1	-
CO5	3	2	1	1	2	-	-	-	1	1	1	2	1	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)						3: Substantial (High)					

SYLLABUS:

UNIT I LANGUAGE BASICS 6

Python interpreter and interactive mode – Tokens – Data types – Numbers and math functions – Input and Output operations – Comments – Reserved words – Indentation – Operators and expressions – Precedence and associativity – Type conversion – Debugging – Common errors in Python

UNIT II CONTROL STATEMENTS, FUNCTIONS, AND MODULES 6

Selection – Conditional branching statements – if – if-else – Nested-if – if-elif-else statements – Iterative statements – while – for loop – break – continue and pass statements – Functions – Function Definition and Function call – Variable scope and Lifetime – Return statement – Lambda functions or Anonymous functions – Recursion – Modules and Packages

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UNIT III PYTHON DATA STRUCTURES 6

Strings – Slicing – Immutability – Built-in string methods and functions – Concatenating – Appending and Multiplying strings – String modules – List – Creation – Accessing values – Slicing – List methods – In-built functions for Lists – Tuples – Creation – Operations on tuples – Traversing – Indexing and Slicing – Tuple assignment – In-built functions for tuples – Sets – Creation – Operations – Dictionaries – operations and methods

UNIT IV EXCEPTION AND FILE HANDLING 6

Exceptions – Errors and Exceptions – Handling exception – Built-in and User-defined exceptions – Files – Types – Operations – Open – Read – Write – Close

UNIT V NUMPY and PANDAS 6

Numpy – Introduction – Computations using NumPy functions – Computation on Arrays – Aggregation – Indexing and Sorting – Pandas – Introduction and Basic Pandas Concepts – Data frames – Data Handling

LIST OF EXPERIMENTS

1. Programs on selection and Iteration operations.
2. Get an integer input from a user. If the number is odd, then find the factorial of a number and find the number of digits in the factorial of the number. If the number is even, then check the given number is palindrome or not.
3. Strings and its operations.
4. Given two strings, PRINT (YES or NO) whether the second string can be obtained from the first by deletion of none, one or more characters.
5. List and its operations.
6. Programs for positive and negative indexing.
7. Program to check if the given list is in Ascending order or Not.
8. Tuples and its operations.
9. Python program to convert a tuple to a string.
10. Python program to reverse a tuple.
11. Sets and its operations.
12. Python program to check if a set is a subset of another set.
13. Dictionaries and its operations.
14. Python program to iterate over dictionaries using for loops.
15. Computations using NumPy functions.
16. NumPy program to convert a list of numeric value into a one-dimensional NumPy array.
17. NumPy program to convert a list and tuple into arrays.
18. Data manipulations using Pandas.
19. Program to convert a NumPy array and series to data frames.
20. Program to add, subtract, multiple and divide two Pandas Series.
21. Program to retrieve and manipulate data using data frames.

Contact Periods:

Lecture: 30 Periods	Tutorial: – Periods	Practical: 30 Periods	Project: – Periods
			Total: 60 Periods

TEXT BOOKS:

1. Reema Thareja, "Python programming: Using problem solving approach", 1st Edition, Oxford Press, 2017
2. William McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2nd Edition, Shroff/O'Reilly Publication, 2017

REFERENCES:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016

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2. Ashok Namdev Kamthane and Amit Ashok Kamthane, "Programming and Problem Solving with Python", 2nd Edition, McGrawHill Education, 2018
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", 1st Edition, Pearson India Education Services Pvt. Ltd., 2016
4. https://python-iitk.vlabs.ac.in/List%20of%20experiments.html
5. http://greenteapress.com/wp/think-python/

EVALUATION PATTERN:

Continuous Internal Assessments				**End Semester Examinations**	
Assessment I (Theory) (100 Marks)		**Assessment II (Practical) (100 Marks)**		**Theory Examinations (Examinations will be conducted for 100 Marks)**	**Practical Examinations (Examinations will be conducted for 100 Marks)**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SEMESTER II

		Category: PCC				
U21EE202	**DIGITAL ELECTRONICS AND APPLICATIONS**	**L**	**T**	**P**	**J**	**C**
		2	**0**	**2**	**0**	**3**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide the fundamental knowledge of digital number systems, Boolean algebra and logical reasoning required for digital circuit development
- To introduce the principles and methods involved in the design of combinational and sequential digital circuits
- To present the programmable logic devices and digital logic families with emphasis on hardware realization and system level integration

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Compute various number systems and simplify the logical expressions using Boolean postulates (Apply)

CO2: Implement combinational logic circuits using K-map (Apply)

CO3: Design the synchronous sequential logic circuits using flip-flops and counters (Apply)

CO4: Analyze the behavior of asynchronous sequential logic circuits (Analyze)

CO5: Develop the programmable logic devices and digital logic families using transistors (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	2	1	-	1	2	-
CO2	3	2	1	1	-	-	-	1	2	1	-	1	2	-
CO3	3	2	1	1	1	-	-	1	2	1	-	1	2	-
CO4	3	3	2	2	-	-	-	1	2	1	-	1	2	-
CO5	3	2	1	1	-	-	-	1	2	1	-	1	2	-
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

SYLLABUS:

UNIT I NUMBER SYSTEMS AND BOOLEAN ALGEBRA 9

Review of number systems – Number system conversion – Binary codes – Parity and Hamming code – Basic logic gates – Boolean algebra: De-Morgan's theorem

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UNIT II COMBINATIONAL CIRCUITS 9

Switching functions and simplification using K-maps – Design of adder, subtractor, comparators, multiplexers and demultiplexers – Applications

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flip-flops: SR, D, JK and T – Analysis of synchronous sequential circuits – Design of synchronous sequential circuits – Counters – State diagram, state reduction, state assignment, asynchronous and synchronous type

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Analysis of asynchronous sequential logic circuit – Fundamental and pulse mode, state reduction, state assignment – Asynchronous design problem, transition table, flow table – Race conditions

UNIT V PROGRAMMABLE LOGIC DEVICES, MEMORY AND LOGIC FAMILIES 9

X Memories: ROM, PROM, PLA, PAL, PLD – Digital logic families: RTL, DTL, TTL, ECL, MOS families

LIST OF EXPERIMENTS (Indicative)

1. Parity generator and checker
2. Verification of logic gates
3. Implementation of arithmetic circuits
4. Parking system using multiplexer
5. Digital counters

Contact Periods:

Lecture: 30 Periods	Tutorial: – Periods	Practical: 30 Periods	Project: – Periods
			Total: 60 Periods

TEXT BOOKS:

1. Morris Mano M, Michael D. Ciletti, "Digital Design with an Introduction to the Verilog HDL, VHDL and System Verilog", 6th edition, Pearson Education, 2018
2. David J. Comer, "Digital Logic and State Machine Design", 3rd edition, Oxford University Press, 2012

REFERENCES:

1. Sournitra Kumar Mandal, "Digital Electronics Principles and Application", 1st edition, McGraw-Hill Education, 2017
2. William Keitz, "Digital Electronics - A Practical Approach with VHDL", 1st edition, Pearson Education, 2013
3. R.P.Jain, Thomas.L.Floyd, "Digital Fundamentals", 11th edition, Pearson Education, 2017

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EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER II

		Category: ESC				
U21EE203	ELECTRIC CIRCUITS LABORATORY	L	T	P	J	C
		0	0	4	0	2

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide practical exposure to electrical circuits through simulation and experimental methods.
- To develop understanding of transient and steady-state behavior of electrical circuits using analytical and experimental approaches.
- To impart knowledge of resonance phenomena and three-phase circuits through systematic laboratory investigations.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Implement basic circuit laws to calculate electrical circuit parameters using simulation and experimental techniques (Apply)

CO2: Simplify electrical circuits using network theorems to obtain equivalent circuits accurately (Apply)

CO3: Compute three-phase power using two-wattmeter method (Apply)

CO4: Examine the transient behavior of RL, RC, and RLC circuits under DC and AC excitation (Analyze)

CO5: Implement resonance principles to obtain the characteristics of series and parallel resonance circuits (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	3	-	-	1	2	1	-	1	-	2
CO2	3	3	2	2	3	-	-	1	2	1	-	1	-	2
CO3	3	2	1	1	-	-	-	1	2	1	-	1	-	2
CO4	3	3	2	2	3	-	-	1	2	1	-	1	-	2
CO5	3	2	1	1	3	-	-	1	2	1	-	1	-	2
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

LIST OF EXPERIMENTS

1. Simulation and experimental verification of Ohm's and Kirchhoff's laws
2. Simulation and experimental verification of an electric circuit using mesh and nodal analysis
3. Simulation and experimental verification of Thevenin's theorem
4. Simulation and experimental verification of Norton's theorem
5. Simulation and experimental verification of superposition theorem
6. Simulation and experimental verification of maximum power transfer theorem
7. Measurement of three phase power using two wattmeter method
8. Simulation of RL, RC and RLC transients with DC and AC excitation

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9. Determination of resonance frequency, half power frequencies, bandwidth and quality factor of a series and parallel resonance circuit

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Project: – Periods

Total: 60 Periods

EVALUATION PATTERN:

Continuous Internal Assessments		**End Semester Examinations**
Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test	
75	25	
100		100
60		40
100		

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SEMESTER III

U21MA303	FOURIER ANALYSIS AND BOUNDARY VALUE PROBLEMS (Common to CE, EE, ME, MI)	Category: BSC				
		L	T	P	J	C
		3	1	0	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of partial differential equations and its solutions
- To understand the concept of Fourier series and Fourier transform techniques in the field of engineering
- To understand the mathematical aspects that contribute to the solution of one and two dimensional PDEs

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Illustrate the formation and classification of partial differential equations for engineering applications with appropriate mathematical notation (Understand)

CO2: Apply Fourier series techniques including half-range series and Parseval's identity to analyze periodic functions in engineering applications with 70% accuracy (Apply)

CO3: Apply Fourier transform pairs and convolution theorem to analyze spectral characteristics of signals in communication systems using standard mathematical procedures (Apply)

CO4: Apply Fourier series solutions to solve initial-boundary value problems for one-dimensional wave and heat equations with appropriate boundary conditions (Apply)

CO5: Apply Fourier series solutions with separation of variables to solve two-dimensional steady-state heat flow equations in Cartesian coordinates without conceptual errors (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	-	1	-	-	2	1	-
CO2	3	2	1	2	2	1	-	-	1	-	-	2	1	-
CO3	3	2	1	3	3	1	-	-	1	-	-	2	1	-
CO4	3	3	2	3	3	2	-	-	1	-	-	3	1	-
CO5	2	3	2	3	3	2	-	-	1	-	-	3	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I PARTIAL DIFFERENTIAL EQUATIONS **9 + 3**

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations – Lagrange's linear equation – Solution methods for second order homogeneous equations with constant coefficients

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UNIT II FOURIER SERIES **9 + 3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range series – Parseval's identity – Harmonic analysis

UNIT III FOURIER TRANSFORM **9 + 3**

Fourier transform pair – Fourier sine and cosine transforms – Properties (without proof) – Transforms of simple functions – Convolution theorem – Parseval's identity

UNIT IV ONE DIMENSIONAL BOUNDARY VALUE PROBLEMS **9 + 3**

Fourier series solution – Vibration of strings – One dimensional wave equation – One dimensional heat flow equation (unsteady state)

UNIT V TWO DIMENSIONAL BOUNDARY VALUE PROBLEMS **9 + 3**

Fourier series solution – Two dimensional (steady state) heat flow equations (Cartesian form only) separation of variables

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Project – Periods

Total 60 Periods

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics",10th edition Wiley India Pvt Ltd, New Delhi, 2018.
2. Grewal B. S, "Higher Engineering Mathematics", 44th edition, Khanna Publishers, 2017.

REFERENCES:

1. Bali N.P and Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications; 12th edition, 2016.
2. Wylie C. R. and Barrett L. C, "Advanced Engineering Mathematics", 6th edition, Tata McGraw-Hill, New Delhi, 2016.
3. Narayanan S, Manicavachagom Pillay T. K. and Ramanaiah G, "Advanced Mathematics for Engineering Students", Vol. II & III, 2nd edition, S. Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Seminar / MCQ	Written Test	*Individual Assignment / Seminar / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER III

		Category: ESC				
U21EE301	ELECTROMAGNETIC THEORY	L	T	P	J	C
		2	1	0	0	3

PRE–REQUISITES:

- U21EE201: Electric Circuit Analysis, U21MA102: Calculus and Linear Algebra

COURSE OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic fields
- To impart knowledge on the concepts of electrostatic fields and magnetic fields
- To acquire the knowledge on application of electromagnetic fields

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply the vector calculus for cartesian, cylindrical and spherical coordinate systems (Apply)

CO2: Examine the electric field intensity in various geometric using appropriate laws (Analyze)

CO3: Determine the electric potential for different geometrical configurations (Apply)

CO4: Analyze magnetostatic fields by determining the magnetic field intensity (Analyze)

CO5: Implement EMF and MMF generation principles along with Maxwell's equations to solve problems in electromagnetic systems (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	-	-	1	2	-
CO2	3	2	1	1	1	-	-	-	1	-	-	1	2	-
CO3	3	2	1	-	1	-	-	-	1	-	-	1	3	-
CO4	3	2	1	1	1	-	-	-	1	-	-	1	2	-
CO5	3	3	1	-	1	-	-	-	1	-	-	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I CO-ORDINATE SYSTEMS **6+3**

Introduction to co-ordinate system: Rectangular, Cylindrical, Spherical – Differential elements – Point and vector transformation – Del operator – Divergence, Curl and Gradient – Divergence theorem and Stoke's theorem

UNIT II ELECTROSTATICS I **6+3**

Coulomb's Law – Principle of superposition – Electric field intensity – Electric field intensity due to discrete charges – Electric field due to continuous uniform charge distribution: infinite and finite line, circular disc and sheet – Electric flux density – Gauss Law and its proof – Applications

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UNIT III ELECTROSTATICS II 6+3

Electric potential – Potential due to infinite line charge, circular disc – Electric potential due to dipole moment – Polarization – Potential gradient – Equipotential surface – Continuity equation – Capacitance: parallel plate, sphere – Laplace's and Poisson's equation – Boundary conditions – Energy and energy density – Applications

UNIT IV MAGNETOSTATICS 6+3

Lorentz force equation – Force on current element – Force on parallel conductor – Biot-Savart Law – Magnetic field intensity – Finite and infinite, circular loop – Ampere's circuital law – Magnetic flux density – Dipole moment – Torque – Boundary conditions – Inductance of solenoid and Toroid – Energy and energy density – Applications

UNIT V APPLICATION OF ELECTROMAGNETICS 6+3

Faraday's law – Transformer EMF and Motional EMF – Maxwell's equations: Ampere's circuital law, Faraday's law and Gauss's law – Poynting theorem – Poynting vector – Relationship between circuit theory and field theory

Contact Periods:

Lecture: 30 Periods Tutorial: 15 Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Mathew N.O. Sadiku, Kulkarni S. V, "Principles of Electromagnetic Fields", 6th edition, Oxford University Press, 2015
2. William Hayt Jr. John A. Buck and Jaleel Akhtar M, "Engineering Electromagnetics", 9th edition, TMH publishing Co. Ltd., 2020

REFERENCES:

1. Gangadhar K A, "Electromagnetic Field Theory", 16th edition, Khanna Publishers, 2015
2. Joseph.A. Edminister and Vishnu Priye "Schaum's Outline Series Theory and Problems of Electromagnetics", 5th edition, Tata McGraw Hill, 2017
3. Ghosh S and Lipika Datta, "Electromagnetic Field Theory", 1st edition, Tata McGraw Hill, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Roll Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER III

		Category: PCC				
U21EE302	ELECTRICAL MACHINES – I	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- U21EE201: Electric Circuit Analysis

COURSE OBJECTIVES:

- To introduce the operating principles, constructional features, and characteristics of DC generators, DC motors, and transformers
- To provide comprehensive knowledge on performance analysis, losses, efficiency, and testing methods of DC machines and transformers
- To familiarize students with practical applications, testing standards, and industrial relevance of electrical machines and transformer connections

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Implement DC generator principles and characteristics to determine the operating performance in practical power applications (Apply)

CO2: Analyze DC motor characteristics and control methods to select suitable drives for industrial and traction applications (Analyze)

CO3: Examine losses and efficiency of DC machines using standard testing methods and performance analysis (Analyze)

CO4: Apply transformer equivalent circuits and performance parameters to assess regulation and efficiency under load conditions (Apply)

CO5: Investigate transformer testing and connection schemes to optimize the performance and to assess operational suitability in power systems (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	-	2
CO2	3	3	2	2	-	-	-	-	-	-	-	1	-	2
CO3	3	3	1	1	-	-	-	-	-	-	-	1	-	2
CO4	3	2	2	2	-	-	-	-	-	-	-	1	-	2
CO5	3	3	2	1	-	-	-	-	-	-	-	1	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I DC GENERATORS 9

Operating principle – Construction – Armature winding and connections – EMF equation – Methods of excitation – Armature reaction – Commutation – Compensating winding – Characteristics of DC shunt and series generators – Parallel operation – Battery charging and electro-plating

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UNIT II DC MOTORS 9

Principle of operation – Back EMF – Torque equation – Types of motors – Characteristics – Starting and speed control – Application in traction, lathes and elevators – Case studies

UNIT III TESTING OF DC MACHINES 9

Losses and efficiency – Power stages – Testing of DC machines – Open circuit and load tests on generator, Brake test, Swinburne's test and Hopkinson's test – Testing standards – IEC, NEMA

UNIT IV TRANSFORMERS 9

Construction – Principle of operation – EMF equation – No-load and load condition – Phasor diagram – Equivalent circuit – Losses and efficiency – Separation of losses – Voltage regulation – Parallel operation – Auto transformer

UNIT V TESTING OF TRANSFORMERS AND THREE PHASE TRANSFORMERS 9

All day efficiency – Testing – Load test, OC and SC test, Sumpner's test, Polarity test, Voltage ratio test – Three phase transformers – Connections – Scott connection – Introduction to high frequency transformers

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Kothari D.P and Nagrath I.J., "Electric Machines", 5th edition, McGraw-Hill Education Pvt. Ltd, 2017
2. Stephen J. Chapman, "Electric Machinery Fundamentals", 5th edition, McGraw-Hill Education Pvt. Ltd, 2011

REFERENCES:

1. Gupta B.R., 'Fundamental of Electric Machines', 3rd edition, New age International Publishers, Reprint, 2015
2. Rajput R.K., 'Electrical Machines', 6th edition, Laxmi Publications, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER III

		Category: PCC				
U21EE303	ANALOG ELECTRONICS AND APPLICATIONS	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- U21PH201: Materials Science

COURSE OBJECTIVES:

- To introduce the application of semiconductor devices in basic electronic circuits and practical systems
- To provide conceptual understanding of the characteristics and performance analysis of operational amplifiers for real-time applications
- To familiarize students with the design and implementation of electronic systems using special integrated circuits and voltage regulator ICs for real-world applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply the principles of semiconductor devices to design basic electronic circuits such as rectifiers, voltage regulators, and amplifier (Apply)
CO2: Analyze the DC and AC characteristics of operational amplifiers and evaluate the effect of feedback on gain, bandwidth, stability, and performance of amplifier circuits (Analyze)
CO3: Apply operational amplifier concepts to design and implement converters, active filters, waveform generators and data conversion circuits (Apply)
CO4: Analyze the operation and performance of special integrated circuits such as timers, phase-locked loops, voltage-controlled oscillators, and battery monitoring ICs (Analyze)
CO5: Analyze voltage regulator circuits, including linear and switching regulators, to ensure efficient power management and voltage regulation in electronic systems (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	1	-	-	-	-	1	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO4	3	3	2	2	-	1	1	-	-	-	-	1	2	-
CO5	3	3	2	2	-	1	1	-	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I SEMICONDUCTOR DEVICES 9

Construction and Characteristics: PN Junction Diodes – Zener Diodes – BJTs – Field Effect Transistors – MOSFET – Applications: Half-wave and full-wave rectifier – Shunt voltage regulator – CE configuration

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UNIT II CHARACTERISTICS OF OP AMP 9

Ideal characteristics of Op-Amp – Functional blocks of Op-Amp – Inverting and non-inverting amplifiers – Multistage amplifiers – Feedback: Introduction to the concept of feedback – Positive and negative feedback – Properties of feedback – Feedback topologies – DC characteristics – AC characteristics – Differential amplifier

UNIT III APPLICATIONS OF OP AMP 9

V/I and I/V converters – Summer – Differentiator – Integrator – Instrumentation amplifier – First order low pass and high pass active filters – Waveform generators – Clippers – Clampers – Peak detector – Sample and Hold circuit – D/A converters – A/D converters

UNIT IV SPECIAL ICs 9

555 Timer IC – Monostable mode – Astable mode – Applications – 566 Voltage controlled oscillator – 565 Phase lock loop – BQ76PL536-Q1 battery monitoring and protection – Applications

UNIT V VOLTAGE REGULATORS 9

IC voltage regulators – LM78XX, 79XX – Fixed voltage regulators – Low Drop Out (LDO) linear regulator – Switching regulator – SMPS – TPS61170

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Roy Choudhary D. and Sheil B. Jani, "Linear Integrated Circuits", 4th edition, New Age Publisher, 2018
2. Adel S Sedra, Kenneth C Smith and Arun N Chandorkar, "Microelectronic Circuits – Theory and Applications", 7th edition, Oxford University Press, 2017
3. David A. Bell, "Op-amp & Linear ICs", 3rd edition, Oxford University Press, 2013

REFERENCES:

1. Robert F. Coughlin and Fredrick F. Driscoll, "Op-amp and Linear ICs", 6th edition, PHI Learning Pvt. Ltd., New Delhi, 2012
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th edition, McGraw Hill, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER III

U21CSG03	DATA STRUCTURES (Common to AM, BM, CB, EC, EE, IT)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITE:

- U21CSG01: Problem Solving and C Programming

COURSE OBJECTIVES:

- To understand the concepts of ADT and list operations
- To Learn linear data structures – stacks and queues
- To apply Tree and Graph structures

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Implement linear data structures and their operations for the given applications (Apply)
CO2: Apply various operations on stack and queue data structures for suitable applications (Apply)
CO3: Perform searching, sorting, and hashing techniques to organize and retrieve the data efficiently (Apply)
CO4: Utilize tree structures to organize and manipulate hierarchical data (Apply)
CO5: Apply various graph-based operations for solving real-time problems(Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	1	-	2	2	-
CO2	3	2	1	1	-	-	-	-	1	1	-	2	2	-
CO3	3	2	1	1	-	-	-	-	1	1	-	2	2	-
CO4	3	2	1	1	-	-	-	-	1	1	-	2	2	-
CO5	3	2	1	1	-	-	-	-	1	1	-	2	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I LINEAR DATA STRUCTURES – LIST 6

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list-based implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of linked list

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 6

Stack ADT – Operations – Applications – Evaluating arithmetic expressions – Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – DeQueue – Applications of queues

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UNIT III SEARCHING, SORTING, AND HASHING TECHNIQUES 6

Introduction to Searching – Types of search – Linear Search – Binary Search – Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Hashing – Hash Functions – Separate Chaining – Open Addressing – Rehashing

UNIT IV NON-LINEAR DATA STRUCTURES - TREES 6

Tree ADT – Tree traversals – Binary Tree ADT – Expression trees – Implementation of expression tree – Applications of trees – Binary search tree ADT – Operations in binary search tree – Introduction to Heap – Properties

UNIT V NON-LINEAR DATA STRUCTURES - GRAPHS 6

Introduction to Graph – Types of graph – Graph traversal – Breadth-first traversal – Depth-first traversal – Topological Sort – Minimum spanning tree algorithms – Shortest path algorithm – Dijkstra's algorithm

LIST OF EXPERIMENTS (INDICATIVE)

1. Write a function program to perform the following operations on a singly linked list
   i. Create a list cube
   ii. Insert an element to the list
   iii. Delete the maximum element from the list
   iv. Arrange the list in a sorted order
   v. Display the elements of the list
2. Write a main method to demonstrate the above functionalities
3. Creation of Array and linked list implementation of Stack and Queue ADTs
4. Implementation of quick, heap, and shell sort
5. Program to sort the elements in ascending order using selection sort and bubble sort
6. Implementation of hashing technique
7. Develop a program to perform a linear and binary search
8. Program to construct an expression tree for a given expression and perform various tree traversal methods.
9. Implement Prim's algorithm with the following functionalities
   i. Read a set of vertices minimum of six from the keyboard
   ii. Get the number of edges and form the graph
   iii. Find the value of each edge by using the distance formula for two points.
   iv. Develop a Minimum Spanning Tree for the graph
   v. Find the total length of all edges. Write a main method to execute the above functionalities
10. Choose an appropriate data structure and create a token system for banking service (withdrawal, deposit, and money transfer)
11. Create a food delivering system that allocates the path for the delivery of food using appropriate data structures
12. Create a book rack allocation system in a library, which allocates appropriate space for the books based on category using appropriate data structures

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Contact Periods:

Lecture 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Reema Thareja, "Data structures using C", 1st Edition, Oxford University Press, 2018
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, University Press, 2017

REFERENCES:

1. R. Venkatesan, S. Lovelyn Rose, "Data Structures", 1st Edition, Wiley, 2019.
2. Seymour Lipschutz, "Data structures with C", 4th Edition, McGraw Hill Education, 2017

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th colspan="2" rowspan="2">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (Theory) (100 Marks)</th><th colspan="2">Assessment II (Practical) (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)</td><td>Test</td><td rowspan="2">Theory Examinations (Examinations will be conducted for 100 Marks)</td><td rowspan="2">Practical Examinations (Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>40</td><td>60</td><td>75</td><td>25</td></tr>
<tr><td colspan="2">25</td><td colspan="2">25</td><td>25</td><td>25</td></tr>
<tr><td colspan="4">50</td><td colspan="2">50</td></tr>
<tr><td colspan="6">Total: 100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SEMESTER III

		Category: PCC				
U21EE304	**MEASUREMENTS AND INSTRUMENTATION**	**L**	**T**	**P**	**J**	**C**
		2	**0**	**2**	**0**	**3**

PRE–REQUISITES:

- U21PH201: Materials Science

COURSE OBJECTIVES:

- To introduce the principles of measurement and instrumentation for electrical and non-electrical quantities
- To provide understanding of the working and performance characteristics of electrical, electronic, storage, and display instruments
- To impart knowledge of sensors, transducers, and comparative measurement techniques for practical engineering applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Implement the principles of measurement systems including standards, characteristics, errors, and calibration to assess measurement accuracy and reliability (Apply)

CO2: Analyze the construction and working of electrical and electronic measuring instruments to interpret measurement results (Analyze)

CO3: Employ comparative measurement techniques using DC and AC bridges and potentiometers for accurate determination of electrical parameters (Apply)

CO4: Examine the operation of storage and display devices used in instrumentation systems for effective data acquisition and visualization (Analyze)

CO5: Apply sensors and transducers for measurement applications to obtain reliable measurement data (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	1	2	1	-	1	2	-
CO2	3	3	2	1	1	-	-	1	2	1	-	1	2	-
CO3	3	3	2	1	2	-	-	1	2	1	-	1	3	-
CO4	3	3	2	1	1	-	-	1	2	1	-	1	2	-
CO5	3	3	2	1	2	-	-	1	2	1	-	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I MEASUREMENT SYSTEMS 6

Functional elements of instrument – Standards of measurements – Static and dynamic characteristics – Errors in measurement – Calibration

UNIT II ELECTRICAL AND ELECTRONIC INSTRUMENTS 6

Construction and working principle of moving coil and moving iron instruments – Dynamometer type wattmeter – Single phase induction type energy meter – Digital voltmeters: Integrating type, successive approximation – Instrument transformer

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UNIT III COMPARATIVE METHOD OF MEASUREMENTS 6

DC potentiometers: Crompton's and Duo Range type – AC potentiometers – DC bridges: Wheatstone, Kelvin's double bridge – AC bridges: Maxwell and Schering bridge

UNIT IV STORAGE AND DISPLAY DEVICES 6

X-Y recorder – Cathode Ray Oscilloscope, Digital Storage Oscilloscope – Data loggers – Hard disk drive – Solid state drive

UNIT V SENSORS AND TRANSDUCERS 6

Hall effect sensors – Proximity sensors – Temperature sensors – Soil and moisture sensors – Classification of transducers – RTD, Strain gauge, LVDT, Piezoelectric, Thermoelectric – Sensor fusions

LIST OF EXPERIMENTS (Indicative)

1. Calibration of single phase energy meter
2. Measurement of low / medium resistance using Kelvin's double bridge / Wheat stone's bridge
3. Measurement of Capacitance and Inductance using AC bridges
4. Measurement of EMF using potentiometer
5. Measurement of temperature using sensors
6. Study of measuring instruments and storage devices

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project – Periods

Total 60 Periods

TEXT BOOKS:

1. Sawhney A.K., "A Course in Electrical and Electronic Measurement and Instrumentation", 18th edition, Dhanpat Rai & Co., 2015
2. Albert D Helfrick and William D Cooper, "Modern Electronic Instrumentation and Measurement Techniques", 1st edition, Pearson India Education, 2016

REFERENCES:

1. Stout M.B., "Basic Electrical Measurements", Revised edition, Prentice Hall of India Pvt Ltd., 2018
2. Gupta J.B., "A Course in Electronics and Electrical Measurements and Instrumentation", 14th edition, S.K.Kataria & Sons, Delhi, 2014
3. Patranabis D., "Sensors and Transducers", 2nd edition, PHI Learning, 2013

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EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER III

U21EE305	ELECTRICAL MACHINES LABORATORY – I	Category: PCC				
		L	T	P	J	C
		0	0	4	0	2

PRE-REQUISITES:

- U21EE203: Electric Circuits Laboratory

COURSE OBJECTIVES:

- To enable students to experimentally verify performance characteristics of DC machines and transformers
- To provide hands-on experience in conducting standard tests on DC machines and transformers
- To develop the ability to evaluate efficiency, losses, and control methods of DC machines and transformers

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Experimentally determine the performance characteristics of DC shunt and compound generators (Apply)

CO2: Analyze and differentiate the load characteristics of DC shunt, series, and compound motors (Analyze)

CO3: Analyze the performance of DC machines by predetermining the efficiency and losses using standard testing methods (Analyze)

CO4: Implement and assess speed control techniques of DC motors for industrial applications (Apply)

CO5: Determine the performance parameters of single-phase transformers and demonstrate three-phase transformer connections (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	2	1	-	1	-	2
CO2	3	3	2	2	1	-	-	1	2	1	-	1	-	2
CO3	3	3	2	2	-	-	-	1	2	1	-	1	-	2
CO4	3	2	1	1	1	-	-	1	2	1	-	1	-	2
CO5	3	2	1	1	1	-	-	1	2	1	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of DC shunt generator
2. Load characteristics of DC compound generator
3. Load test on DC shunt and compound motor
4. Load test on DC series motor
5. Swinburne's test
6. Speed control of DC motor
7. Load test on single phase transformer
8. Open circuit and short circuit tests on single phase transformer
9. Separation of losses in single phase transformers
10. Connections of three phase transformers

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Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Project – Periods

Total 60 Periods

EVALUATION PATTERN:

Continuous Internal Assessments		**End Semester Examinations**
Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test	
75	25	
100		100
60		40
100		

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SEMESTER III

		Category: PCC				
U21EE306	ANALOG ELECTRONICS AND APPLICATIONS LABORATORY	L	T	P	J	C
		0	0	4	0	2

PRE-REQUISITES:

- U21PH201: Materials Science, U21EE202: Digital Electronics and Applications

COURSE OBJECTIVES:

- To introduce the principles and working concepts of rectifiers, voltage regulators, and transistor circuits
- To provide analytical exposure to multivibrator and operational amplifier circuits for practical understanding
- To impart design concepts of regulated power supplies for real-time electronic applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Examine the rectifier and voltage regulator circuits using semiconductor devices (Analyze)

CO2: Diagnose the transistor characteristics in different configurations (Analyze)

CO3: Design and optimize the multivibrator circuits using IC 555 timer (Apply)

CO4: Analyze operational amplifier circuits for different applications (Analyze)

CO5: Investigate the regulated power supply designs for real-time applications (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	2	1	-	1	2	-
CO2	3	3	2	2	2	-	-	-	2	1	-	1	2	-
CO3	3	3	2	2	2	-	-	-	2	1	-	1	2	-
CO4	3	3	2	2	2	-	-	-	2	1	-	1	2	-
CO5	3	3	2	2	2	-	-	-	2	1	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

LIST OF EXPERIMENTS

1. Half wave and Full wave rectifier with and without filter
2. Zener Diode characteristics and Zener as voltage regulator
3. Input and Output characteristics of various transistor configuration
4. Astable and Monostable multivibrators using NE555 timer
5. PLL characteristics and frequency multiplier using PLL
6. DC power supply using LM317 and LM723
7. Inverting, Non-inverting and Differential Amplifiers
8. Pulse generation using operational amplifier

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9. Wave shaping circuits
10. Study of SMPS

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Project: – Periods

Total: 60 Periods

EVALUATION PATTERN:

Continuous Internal Assessments		**End Semester Examinations**
Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test	
75	25	
100		100
60		40
100		

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SEMESTER IV

U21MA404	STATISTICS AND NUMERICAL METHODS (Common to EE, ME & MI)	Category: BSC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the concepts of probability and statistics in the field of engineering
- To understand the concepts of testing the hypothesis for large and small samples
- To understand the concepts in design of experiments in the field of engineering

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply probability axioms and Bayes' theorem to compute conditional probabilities in engineering experiments (Apply)
CO2: Apply t, chi-square, and F tests to perform hypothesis testing for engineering data analysis (Apply)
CO3: Apply completely randomized and randomized block designs to plan engineering experiments (Apply)
CO4: Apply Newton-Raphson and Gauss elimination methods to solve systems of engineering equations (Apply)
CO5: Apply Runge-Kutta and Euler methods to solve first-order differential equations in engineering applications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	-	-	-	-	-	-	2	1	-
CO2	3	2	1	3	2	1	-	-	1	-	-	2	1	-
CO3	3	3	2	3	2	2	-	1	1	-	-	3	1	-
CO4	3	2	1	2	3	1	-	-	-	-	-	2	1	-
CO5	3	3	2	3	3	2	-	1	1	-	-	3	1	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I PROBABILITY 9

Probability – Axioms of probability – Conditional probability – Total probability – Baye's Theorem – Discrete and continuous random variable

UNIT II TESTING OF HYPOTHESIS 9

Large sample test for single mean and difference of means – Small sample test: t distribution – Chi square distribution – F distribution

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UNIT III DESIGN OF EXPERIMENTS 9

One way and two way classifications – Completely randomized design – Randomized block Design – Latin square design

UNIT IV SYSTEM OF EQUATIONS 9

Newton Raphson method – Gauss elimination method – Gauss Jordon method – Iterative methods of Gauss Jacobi and Gauss Seidel

UNIT V NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 9

Taylor's series method – Euler method – Modified Euler method – Fourth order Runge kutta method for solving first order differential equations

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total: 45 Periods

TEXT BOOKS:

1. Johnson R A, Miller I, Freund J, Miller and Freund's, "Probability and Statistics for Engineers", 8th edition, Pearson Education, Asia,2015
2. Grewell B S, "Numerical methods in Science and Engineering", 9th edition, Khanna Publishers, 2015
3. Gupta S C and Kapoor V K, "Fundamentals of Mathematical Statistics", 10th edition, Sultan Chand Publishers, 2014

REFERENCES:

1. Bali N P and Manish Goyal "A textbook of Engineering Mathematics", 12th edition, Laxmi Publishers, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Seminar / MCQ	Written Test	*Individual Assignment / Seminar / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SEMESTER IV

		Category: PCC				
U21EE401	ELECTRICAL MACHINES – II	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- U21EE302: Electrical Machines - I

COURSE OBJECTIVES:

- To provide a comprehensive understanding of the construction, operating principles, and performance characteristics of synchronous generators and induction motors
- To introduce appropriate starting, speed control, and braking techniques for evaluating and improving the performance of AC motors for specific applications
- To impart knowledge for the selection of suitable AC motors and special electrical machines based on industrial and domestic requirements

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Investigate synchronous generator construction and operation to evaluate voltage regulation, armature reaction and parallel operation (Analyze)

CO2: Apply synchronous motor principles to determine torque, power factor, and operating characteristics under varying excitation and load conditions (Apply)

CO3: Examine three-phase induction motor performance using equivalent circuits and torque–slip characteristics (Analyze)

CO4: Implement suitable starting, speed control, and braking methods for induction motors to meet specified operational requirements (Apply)

CO5: Analyze single-phase induction motors and special machines to select suitable machines for industrial and domestic applications (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	1	-	-	-	-	1	2	-
CO2	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	1	1	1	-	-	-	-	1	2	-
CO4	3	2	1	-	1	-	-	1	-	-	-	1	2	-
CO5	3	2	1	-	1	1	1	-	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I SYNCHRONOUS GENERATOR 9

Construction and types – EMF equation – Armature reaction – Voltage regulation – EMF and MMF methods – Parallel operation – Two reaction theory for salient pole alternator – Slip test

UNIT II SYNCHRONOUS MOTOR 9

Principle of operation – Starting methods – Torque equation – Effect of varying field current and load – V and Inverted V curves – Synchronous condenser – Hunting – Damper winding

UNIT III THREE PHASE INDUCTION MOTOR 9

Construction – Types – Principle of operation – Slip – Torque Equation – Torque-Slip characteristics – Cogging and crawling – Equivalent circuit – Power flow diagram – Losses and efficiency – No load and blocked rotor tests – Double cage induction motors – Induction generator – Submersible motor

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UNIT IV STARTING AND SPEED CONTROL OF INDUCTION MOTOR 9

Starters – Types – DOL, star-delta, auto transformer and rotor resistance starter – Soft starters – Speed control – Number of poles, cascaded connection and V/f Control – Slip power recovery scheme – Braking

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Construction – Double field revolving theory – Starting methods – Capacitor start – Capacitor run induction motor – Shaded pole induction motor – Equivalent circuit – Servo motor – Stepper motor – Linear induction motor – Applications

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Stephen J Chapman, "Electric Machinery Fundamentals", 4th edition, McGraw - Hill Education Pvt. Ltd, 2010
2. Kothari D P and Nagrath I J, "Electric Machines", 5th edition, McGraw - Hill Publishing Company Ltd, 2017

REFERENCES:

1. Gupta B R, "Fundamental of Electric Machines" 3rd edition, New Age International Publishers, Reprint 2015.
2. Bimbhra P S, "Electrical Machinery", 2nd edition, Khanna Publishers, 2017
3. Gupta J B, "Theory and Performance of Electrical Machines", 2nd edition, S K Kataria & Sons Publishers, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / MiniProject / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SEMESTER IV

		Category: PCC				
U21EE402	CONTROL SYSTEMS	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- U21MA102: Calculus and Linear Algebra, U21EE201: Electric Circuit Analysis

COURSE OBJECTIVES:

- To develop the ability to model electrical and mechanical systems and obtain their transfer functions
- To build analytical skills to examine time-domain and frequency-domain behavior of LTI systems
- To enable application of stability analysis methods and controller design techniques for closed-loop control systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply modeling techniques to determine the transfer function of electrical and mechanical systems (Apply)

CO2: Investigate the Linear Time Invariant (LTI) systems in the time domain and analyze their response characteristics (Analyze)

CO3: Analyze the frequency response of LTI systems using Bode and polar plots (Analyze)

CO4: Examine the stability of LTI systems using Routh–Hurwitz criterion, Root Locus, and Nyquist plot (Analyze)

CO5: Apply controller and compensator design techniques for closed-loop control systems (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	-	-	1	1	1	-	1	2	-
CO2	3	2	2	1	1	-	-	1	1	1	-	1	2	-
CO3	3	2	2	1	1	-	-	1	1	1	-	1	2	-
CO4	3	2	2	1	1	-	-	1	1	1	-	1	2	-
CO5	3	2	2	1	1	-	-	1	1	1	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I SYSTEM MODELING 9

Elements – open and closed loop systems – Transfer function – Electrical systems – Mechanical systems: Translational and rotational system – Electrical analogy – Block diagram reduction – Signal flow graph

UNIT II TIME RESPONSE ANALYSIS 9

Time response - Standard test signals – order and type – Time response of first order systems – Step response of second order system – Time domain specifications – Steady state errors – Error constants

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UNIT III FREQUENCY RESPONSE ANALYSIS 9

Frequency Response – Bode plot – Polar plot – Determination of closed loop response from open loop response – Frequency domain specifications – Correlation between time and frequency domain specification

UNIT IV STABILITY ANALYSIS 9

Stability – Characteristics equation – necessary and sufficient conditions for stability – BIBO stability – Routh Hurwitz's criterion – Construction of root locus – Effect of pole-zero addition on the root locus – Relative stability – Nyquist stability criterion

UNIT V COMPENSATOR DESIGN AND CONTROLLER 9

Need for compensator and controllers – Design procedure – Lag network and lead network using bode plot – Controller – P, PI, PID controller

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Nagrath, I J., & Gopal, M, "Control Systems Engineering", 6th edition, New Age International Publishers, 2017
2. Ogata, K. "Modern Control Engineering", 5th edition, Upper Saddle River, NJ: Prentice Hall, 2015

REFERENCES:

1. Richard C. Dorf & Bishop, R H "Modern Control Systems", 13th edition, Pearson Prentice Hall, 2017
2. Nise, N S "Control Systems Engineering", 8th edition, John Wiley & Sons, 2018
3. Golnaraghi, F., & Kuo, B, "Automatic Control Systems", 1st edition, McGraw-Hill Education, 2018

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / MiniProject / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SEMESTER IV

U21CSG04	JAVA PROGRAMMING (Common to AM, BM, CB, CS, EC, EE, IT)	Category: ESC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- U21CSG01: Problem Solving and C programming

COURSE OBJECTIVES:

- To describe object-oriented programming paradigm and its principles
- To implement programs with Core Java features and API
- To develop applications with Java Collections

COURSE OUTCOMES:

Upon completion of the course- the student will be able to

CO1: Apply basic java constructs to build simple Java applications (Apply)
CO2: Implement object oriented programming concepts for real time applications and create packages (Apply)
CO3: Utilize Java exception handling techniques to ensure robust program execution (Apply)
CO4: Implement multithreaded programming for concurrent applications and various I/O streams for file handling (Apply)
CO5: Develop Java collection framework to manage and process the data (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	1	1	-	2	1	-
CO2	3	2	1	1	-	-	-	-	1	1	-	2	1	-
CO3	3	2	1	1	-	-	-	-	1	1	-	2	1	-
CO4	3	2	1	1	-	-	-	-	1	1	-	2	1	-
CO5	3	2	1	1	-	-	-	-	1	1	-	2	1	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

SYLLABUS:

UNIT I OBJECT ORIENTED DEVELOPMENT AND JAVA BASICS 6

Object Oriented Programming – Concepts – Abstraction – Encapsulation – Comparison with function oriented programming – Characteristics of Java – Java Environment – JVM and JDK – Classes – Constructors – Methods – Static members – Comments – Data Types – Variables – Operators – Control Flow

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UNIT II PACKAGES AND INHERITANCE 6

Defining a Package – Importing Packages – Inheritance – Creating super classes and sub classes – Access modifiers – Constructors in sub classes – Polymorphism – Method overloading – Method overriding – Abstract classes and abstract methods – Interfaces – Defining an interface – Implementing interface – Extending interfaces – Object class

UNIT III EXCEPTION HANDLING 6

Exceptions – Throwing and catching exceptions – Checked and unchecked exceptions – Exception hierarchy – Built in exceptions – Creating own exception – Chained exceptions – Stack Trace Elements

UNIT IV I/O STREAMS AND MULTITHREADING 6

Input / Output Basics – Scanner class – Streams – Byte streams and Character streams comparison – Reading from and Writing to Console and Files – Multithreaded Programming – The Java Thread Model – Creating multiple threads – Thread class – Runnable Interface

UNIT V COLLECTIONS 6

Collections Framework Overview – Basics of List – Set – Queue – Programs using Array list – HashMap and HashSet – Hashcode and equals methods

LIST OF EXPERIMENTS (Indicative)

1. Write a Java program to create a class Student with private data members and public methods to implement encapsulation and abstraction.
2. Develop a Java program to implement constructor overloading and method overloading.
3. Develop a Java program to implement run-time polymorphism with inheritance.
4. Develop a Java program to implement inheritance using Interfaces and Abstract classes. Use packages.
5. Develop a Java program to demonstrate exception handling
6. Develop a multithreaded java program using a Thread class and Runnable interface
7. Develop a Java program to implement basic console IO and File IO.
8. Develop a Java program to store multiple objects in an Array List and to implement search and sort operations.

Contact Periods:

Lecture: 30 Periods	Tutorial: – Periods	Practical: 30 Periods	Project:	– Periods
			Total:	60 Periods

TEXT BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 11th edition, McGraw Hill Education, 2018
2. Cay.S.Horstmann and Gary Cornell, "Core Java 2, Vol 1, Fundamentals", 11th edition, Pearson Education, 2020

REFERENCES:

1. J.Nino and F.A. Hosch , "An Introduction to Programming and OO Design using Java", 1st edition, John wiley & Sons,2018
2. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd edition, Pearson, 2015
3. E Balagurusamy, "Programming with Java",6th edition, McGraw Hill Education,2019

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EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SEMESTER IV

		Category: PCC				
U21EE403	TRANSMISSION AND DISTRIBUTION	L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- U21EE301: Electromagnetic Theory

COURSE OBJECTIVES:

- To provide a comprehensive understanding of the structure and operation of electrical supply systems, Indian power grids, and the role of deregulation and DISCOMs
- To impart in-depth knowledge of tne electrical performance of overhead transmission lines, including corona effects, surge impedance loading, and the Ferranti effect
- To develop competence in the electrical and mechanical design of overhead lines, covering sag–tension calculations, string efficiency, cable heating, power factor improvement, and fault identification

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply the concept of electric power supply and distribution system structure to explain and solve basic power distribution problems under standard operating conditions (Apply)

CO2: Implement standard mathematical models to calculate overhead transmission line parameters such as resistance, inductance, and capacitance for given conductor configurations (Apply)

CO3: Analyze the performance of short and medium transmission lines by evaluating voltage regulation, efficiency, and phasor relationships under specified loading conditions (Analyze)

CO4: Use mechanical design principles to compute sag and tension of overhead transmission lines considering wind, ice, and temperature variations (Apply)

CO5: Examine different types of insulators and underground cables to select suitable components for given power system applications (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO2	3	3	2	-	1	-	-	-	-	1	-	-	-	3
CO3	3	3	2	1	1	-	-	-	-	1	-	-	-	3
CO4	3	3	2	2	1	-	-	-	-	1	-	-	-	3
CO5	2	2	1	-	1	-	1	-	-	1	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I ELECTRICAL SUPPLY SYSTEM 6

Structure of power system – Operating level voltages – Generation, transmission and distribution – AC and DC distributors – indian grids – Electricity de-regulation – DISCOMs

UNIT II ELECTRICAL DESIGN OF OVERHEAD LINES 6

Parameters of single and three phase transmission lines with single and double circuits – Resistance, Inductance and Capacitance of solid, stranded and bundled conductors – Symmetrical and unsymmetrical spacing – Skin and proximity effect

UNIT III PERFORMANCE OF TRANSMISSION LINES 6

Performance of transmission lines – Short line and medium line – Equivalent circuits, Phasor diagram, voltage regulation and transmission efficiency – Surge impedance loading, Ferranti effect

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UNIT IV MECHANICAL DESIGN OF OVERHEAD LINES 6

Line supports – Dampers – Spacers – Types of towers, tower spotting and conductor types – Corona – Critical voltages – Stress and sag calculation – Effects of wind and ice loading

UNIT V INSULATORS AND CABLES 6

Types of insulators – String efficiency – Construction of cables – Power factor and heating of cables – DC cables – Fault identification

LIST OF EXPERIMENTS (Indicative)

1. AC and DC distribution calculations – Different topology
2. Compute inductance and capacitance of a three phase transmission line parameters
3. Modeling of short and medium transmission line
4. Calculation of sag in overhead transmission line
5. Calculation of potential distribution over string insulator

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 60 Periods

TEXT BOOKS:

1. Kothari D.P. and Nagarath I.J., "Power System Engineering", 3rd edition, McGraw-Hill Publishing Company Ltd., New Delhi, 2019
2. Mehta V.K. and Rohit Mehta, "Principles of Power System", 6th edition, S.Chand, New Delhi, 2014

REFERENCES:

1. Gupta B.R., "Power System Analysis and Design", 7th revised edition, S. Chand, New Delhi, 2014
2. Gupta J.B., "Transmission and Distribution", 10th edition, S.K. Kataria & Sons, New Delhi, 2015
3. Singh S.N., "Electric Power Generation, Transmission and Distribution" 2nd edition, PHI Learning, Pvt., Ltd., 2011

EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER IV

U21SSG01	**SOFT SKILLS – I** (Common to all programmes)	**Category: HSMC**				
		L	**T**	**P**	**J**	**C**
		0	**0**	**2**	**0**	**1**

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To inculcate potential skills and to work as a team effectively.
- To develop confidence and enhance interpersonal skills.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Enhance decision making and negotiation skills (Analyze)

CO2: Maintain open, effective, and Professional Communication (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	1	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I VERBAL COMPETENCE **10**

Verbal Analogy – Spotting Errors – Ordering of Sentences – Cloze Test – Effective Listening – Reading Comprehension

UNIT II EFFECTIVE COMMUNICATION **10**

Overcoming Communication Barriers – Body Language and its Etiquettes – Contextual Communication – 7C's of Communication – Listening to Documentaries

UNIT III INTERPERSONAL SKILLS **10**

Group Decision Making – Paralanguage – Negotiation Skills – Preparation & Planning, Bargaining & Problem Solving –Self Grooming – SWOT Analysis

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical 30 Periods Project: – Periods

Total: 30 Periods

TEXT BOOKS:

1. Prashant Sharma,"Soft Skills: Personality Development for Life Success",1st edition, BPB Publications,2022
2. Suresh Kumar E, Sreehari P and Savithri J, "Communication Skills and Soft Skills: An Integrated Approach", 1st edition, Dorling Kindersley, 2011.

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REFERENCES:

1. Jeff Butterfield, "Problem Solving and Decision Making", 2nd edition, Course Technology, 2010.
2. Wushow Bill Chou, "Fast-Tracking your Career: Soft Skills for Engineering and IT Professionals", 1st edition, IEEE Press, 2013.

EVALUATION PATTERN:

Continuous Internal Assessments	Marks
Test – I	50
Test – II	50
Total	100

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SEMESTER IV

U21EE404	ELECTRICAL MACHINES LABORATORY – II	Category: PCC				
		L	T	P	J	C
		0	0	4	0	2

PRE–REQUISITES:

- U21EE305: Electrical Machines Laboratory – I

COURSE OBJECTIVES:

- To introduce indirect testing methods and symmetrical component theory for determining voltage regulation and sequence impedances of synchronous machines
- To provide understanding of the performance characteristics and losses of synchronous and induction machines through experimental testing under different operating conditions
- To impart knowledge of modern simulation tools and experimental techniques for evaluating and validating the performance of AC machines using equivalent circuit parameters and performance characteristics

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Determine voltage regulation of three-phase alternators using EMF, MMF, and slip test methods with acceptable experimental accuracy (Apply)
CO2: Compute sequence impedances of alternators using symmetrical component theory with correct parameter estimation (Apply)
CO3: Analyze synchronous motor performance using V-curves and inverted V-curves under varying excitation (Analyze)
CO4: Analyze performance and losses of single-phase and three-phase induction motors using direct and indirect tests (Analyze)
CO5: Use simulation tools to study and validate AC machine performance through experimental correlation (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	-	-	-	2	1	-	1	-	2
CO2	3	2	1	2	2	-	-	-	1	1	-	1	-	2
CO3	3	3	2	2	2	-	-	-	2	1	-	1	-	2
CO4	3	3	2	2	2	1	1	-	2	1	-	1	-	2
CO5	3	2	1	2	3	1	1	-	1	2	-	2	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

LIST OF EXPERIMENTS

1. Regulation of three phase alternator by EMF and MMF method
2. Regulation of three phase alternator by slip test
3. V and Inverted V curve of three phase synchronous Motor
4. Load test on three-phase induction motor
5. No load and blocked rotor test on three-phase induction motor
6. Separation of No-load losses of three-phase induction motor
7. Load test on single-phase induction motor
8. No load and blocked rotor test on single-phase induction motor

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9. Parallel operation of alternators

10. Simulation on performance characteristics of AC machines

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Project: – Periods

Total: 60 Periods

EVALUATION PATTERN:

Continuous Internal Assessments		**End Semester Examinations**
Evaluation of LaboratoryObservation, Record **(Rubrics Based Assessments)**	Test	
75	25	
100		100
60		40
Total: 100		

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SEMESTER IV

		Category: PCC				
U21EE405	**CONTROL SYSTEMS LABORATORY**	**L**	**T**	**P**	**J**	**C**
		0	**0**	**4**	**2**	**3**

PRE–REQUISITES:

- U21EE302: Electrical Machines – I, U21EE401: Electrical Machines – II

COURSE OBJECTIVES:

- To provide fundamental understanding of mathematical modeling of electrical and electro-mechanical systems
- To introduce systematic methods for analyzing system performance using time domain and frequency domain techniques
- To present the principles of stability analysis and controller/compensator design for improving dynamic system performance

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Develop mathematical models and obtain transfer functions of electrical and electromechanical systems (Apply)

CO2: Evaluate the system performance using time domain analysis techniques (Analyze)

CO3: Analyze system characteristics using frequency domain methods such as Bode plot and Root Locus (Analyze)

CO4: Examine the stability of linear time-invariant systems using appropriate stability criteria (Analyze)

CO5: Design suitable controllers and compensators to achieve desired performance specifications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	1	2	2	2	1	1	2	-
CO2	3	3	2	2	2	1	1	2	2	2	1	1	2	-
CO3	3	3	2	2	2	1	1	2	2	2	1	1	2	-
CO4	3	3	2	2	2	1	1	2	2	2	1	1	2	-
CO5	3	2	1	1	2	1	1	2	2	2	1	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

LIST OF EXPERIMENTS

1. Determination of transfer function parameters of armature controlled DC motor
2. Determination of transfer function parameters of field controlled DC motor
3. Determination of transfer function parameters of DC generator
4. Determination of transfer function parameters of an AC servomotor
5. DC and AC position control systems
6. Simulation of first order and second order systems – Time domain analysis
7. Stability analysis (Bode plot and Root locus) of linear time invariant system

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8. Design of lag compensator and lead compensator for the given system
9. Effect of P, PI, PID Controller
10. Simulation of closed loop temperature control system

Project:

Controller / Compensator design for real world applications using simulation tools.

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: 30 Periods

Total: 60 Periods

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (Practical) (100 Marks)		**Assessment II (Project) (100 Marks)**			
Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test	Review I	Review II	Review III	**Practical Examinations (Examinations will be conducted for 100 Marks)**
75	25	15	25	60	
25		25			50
50					50
Total: 100					

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SEMESTER V

U21EE501	POWER SYSTEM ANALYSIS	Category: PCC				
		L	T	P	J	C
		2	1	0	0	3

PRE–REQUISITES:

- U21EE403: Transmission and Distribution

COURSE OBJECTIVES:

- To introduce the per-unit system and network modeling techniques for power system representation using single-line, impedance, and bus matrix models
- To provide understanding of power system operation under normal and fault conditions through load flow and fault analysis methods
- To impart knowledge of transient stability analysis to assess power system performance under disturbances

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Implement per-unit concepts and network modeling techniques to construct single-line and impedance diagrams and to formulate Y-bus and Z-bus matrices for practical power system networks (Apply)

CO2: Examine power system operating conditions through load flow studies using numerical methods to determine bus voltages and real and reactive power flows (Analyze)

CO3: Employ symmetrical fault analysis methods using Thevenin's theorem and simulation tools to compute fault currents under balanced fault conditions (Apply)

CO4: Investigate unbalanced fault conditions using symmetrical components, sequence networks, and Z-bus matrices to evaluate fault currents in SLG, LL, and DLG faults (Analyze)

CO5: Apply swing equation and equal area criterion to determine transient stability of power system (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	-	-	-	-	-	3
CO2	3	3	2	2	2	-	-	-	-	-	1	-	-	3
CO3	3	2	2	2	3	-	-	-	-	-	-	1	-	3
CO4	3	3	2	2	1	1	1	-	-	-	-	-	-	3
CO5	3	2	2	2	1	-	-	-	-	-	-	-	-	3
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

SYLLABUS:

UNIT I MODELING OF POWER SYSTEMS **6 + 3**

Need for system planning and operational studies – Power system components – per unit quantities – p.u. impedance and reactance diagram – Primitive parameters – Construction of Y-bus and Z-bus using inspection method – Case studies

UNIT II POWER FLOW ANALYSIS **6 + 3**

Classification of buses – Development of power flow model – Newton-Raphson and Gauss-Seidel load flow methods – Q-limit check for voltage-controlled buses

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UNIT III SYMMETRICAL FAULT ANALYSIS **6 + 3**

Importance of short circuit analysis – Assumptions in fault analysis – Analysis using Thevenin's theorem – Analysis using simulation tools

UNIT IV UNSYMMETRICAL FAULT ANALYSIS **6 + 3**

Symmetrical components – Sequence impedances – Sequence networks analysis of single line to ground, line to line and double line to ground faults using Thevenin's theorem and Z-bus matrix – Analysis using simulation tools

UNIT V STABILITY ANALYSIS **6 + 3**

Classification of power system stability – Swing equation – Swing curve – Power angle equation – Equal area criterion – Critical clearing angle and time – Classical step-by-step solution of swing equation

Contact Periods:

Lecture: 30 Periods Tutorial: 15 Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Nagarath I.J and Kothari D.P., "Modern Power System Analysis", 4th edition, Tata McGraw-Hill Education, 2011
2. John J. Grainger and Stevenson Jr. W.D., "Power System Analysis", 6th reprint, McGraw-Hill Education, 2010

REFERENCES:

1. Hadi Saadat, "Power System Analysis", 21st reprint, Tata McGraw-Hill Education, 2010
2. Kundur P., "Power System Stability and Control", 10th reprint, Tata McGraw-Hill Education, 2010
3. Murty P.S.R., "Power System Analysis", 2nd edition, BSP Books Pvt. Ltd, Elsevier, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER V

U21EE502	POWER ELECTRONICS AND DRIVES	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- U21EE303: Analog Electronics and applications, U21EE401 - Electrical Machines – II

COURSE OBJECTIVES:

- To provide the knowledge of power semiconductor devices and converter circuits
- To present the power conversion techniques and control methods used in drives
- To introduce the performance analysis of DC and AC drive systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Examine the characteristics and switching behavior of power semiconductor devices in converter applications. (Analyze)

CO2: Investigate the performance of AC–DC and DC–DC converters under various operating conditions (Analyze)

CO3: Analyze the performance of inverters and AC–AC converters using different control strategies (Analyze)

CO4: Examine the performance of converter-fed DC drives under different operating modes (Analyze)

CO5: Design and select suitable control schemes for AC drives to meet industrial performance requirements (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	2	-	-	-	-	-	-	1	3	3
CO2	3	3	2	-	2	-	1	-	-	-	-	1	3	3
CO3	3	3	2	-	2	-	1	-	-	-	-	1	3	3
CO4	3	3	2	-	2	-	-	-	-	-	-	1	3	3
CO5	3	2	2	-	2	-	1	-	1	1	-	1	3	3
Correlation levels:		1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)				

SYLLABUS:

UNIT I POWER SEMI-CONDUCTOR DEVICES 9

Semiconductor devices: SCR, TRIAC, BJT, MOSFET, IGBT – Construction and characteristics – GaN-SiC devices – Triggering – Commutation circuits – Snubber circuit

UNIT II PHASE-CONTROLLED CONVERTERS AND DC TO DC CONVERTERS 9

Single phase and three phase half and fully controlled converters – Dual converters – Choppers – Control strategy – Four quadrant operation – Buck-Boost converter – Resonant Converters

UNIT III INVERTERS AND AC TO AC CONVERTERS 9

Single phase and three phase voltage source inverters (120° and 180° mode) – PWM techniques – Current source inverter – Multilevel inverters – Phase shifting transformer – Single phase AC voltage controllers and cycloconverters

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UNIT IV DC DRIVES 9

Electric drives – Equations governing motor load dynamics – Selection of motor – Single and three phase converter fed separately excited DC motor drive – Four quadrant operation of drives

UNIT V AC DRIVES 9

Stator voltage control – V/f control – Rotor resistance control – Static Scherbius drive – Self-control of synchronous motor – V/F drives – Applications

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Rashid M.H., "Power Electronics: Circuits, Devices and Applications", 4th edition, Pearson Education, New Delhi, 2017
2. Gopal K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 2018
3. Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2015

REFERENCES:

1. Singh M.D. and Khanchandani K.B., "Power Electronics", 2nd edition, McGraw Hill India, 2013
2. Bimbhra P.S., "Power Electronics", 6th reprint edition, Khanna Publishers, 2018
3. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System", Elsevier, 2012
4. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis), 2013

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER V

U21EE503	MICROPROCESSOR, MICROCONTROLLER AND APPLICATIONS	Category: PCC				
		L	T	P	J	C
		2	0	2	0	3

PRE–REQUISITES:

- U21EE303 – Analog Electronics and Applications

COURSE OBJECTIVES:

- To provide a comprehensive understanding of the architecture, instruction set, timing characteristics and interrupt structure of microprocessors and microcontrollers
- To develop proficiency in assembly language programming techniques using microprocessors and microcontrollers for solving engineering problems
- To impart in-depth knowledge of processor–peripheral interfacing schemes for real-time and industrial applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the architecture, memory organization, interrupts, and timing diagrams of the 8085 microprocessor to assess system performance (Analyze)

CO2: Apply 8085 assembly language programming techniques to solve given problem statements (Apply)

CO3: Deduce interfacing solutions between 8085 microprocessor and peripheral devices such as ADC, DAC, timers, and I/O controllers (Analyze)

CO4: Examine the internal architecture, memory organization, and functional blocks of the 8051 microcontroller for embedded applications (Analyze)

CO5: Implement real-time applications using the 8051 microcontroller and KEIL development environment (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	1	-	-	-	1	2	1	-	1	2	-
CO2	3	2	3	-	1	-	-	1	2	1	-	1	2	-
CO3	3	3	3	2	2	-	-	1	2	1	-	1	3	-
CO4	3	2	-	1	-	-	-	1	2	1	-	1	2	-
CO5	3	3	3	2	2	-	-	1	2	1	-	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I 8085 PROCESSOR 6

Evolution – Architecture of 8085 – Pin details – I/O and memory mapping – Interrupts – Machine cycles and Timing diagrams

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UNIT II PROGRAMMING WITH 8085 PROCESSOR 6

Addressing modes – Instruction format – Instruction set – Assembly Language Programs – Applications

UNIT III PERIPHERAL INTERFACING OF 8085 MICROPROCESSOR 6

Architecture, Pin configuration and interfacing of ICs: 8255, 8259, 8254, 8279, A/D and D/A converters with 8085 microprocessor

UNIT IV 8051 MICROCONTROLLER 6

Architecture of 8051 – Pin details – Memory Organization – I/O Ports – Timers – Serial Port – Interrupts – Timing diagrams

UNIT V PROGRAMMING WITH 8051 CONTROLLER 6

Addressing modes – Instruction set – Assembly Language Programming – Interfacing of Relay and Sensors – KEIL IDE

LIST OF EXPERIMENTS (Indicative)

1. Assembly Language Programs using 8085
2. ADC and DAC interfacing with 8085
3. Assembly Language Programs using 8051
4. Stepper Motor Control using 8051
5. Assembly Language Programs – KEIL IDE

Contact Periods:

Lecture: 30 Periods Tutorial: – Periods Practical: 15 Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Ramesh S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085", 6th edition, Penram International Publishing, Prentice Hall of India, New Delhi, 2011
2. Muhammed Ali Mazidi, Janice Gillispie Mazidi and Rolin D. Mckinlay, "The 8051 Microcontroller and Embedded Systems", 2nd edition, Pearson Education India, New Delhi, 2011

REFERENCES:

1. Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", 2nd edition, Tata McGraw Hill, New Delhi, 2010
2. Subrata Ghoshal, "8051 Microcontroller: Internals, Instructions, Programming and Interfacing", 2nd edition, Pearson Education India, New Delhi, 2014
3. Kenneth J Ayala, "The 8051 Microcontroller Architecture Programming and Application ", 3rd edition, Penram International Publishers

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EVALUATION PATTERN:

Continuous Internal Assessments				End Semester Examinations	
Assessment I (Theory) (100 Marks)		Assessment II (Practical) (100 Marks)		Theory Examinations (Examinations will be conducted for 100 Marks)	Practical Examinations (Examinations will be conducted for 100 Marks)
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test		
40	60	75	25		
25		25		25	25
50				50	
Total: 100					

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER V

U21SSG02	SOFT SKILLS – II (Common to all programmes)	Category: HSMC				
		L	T	P	J	C
		0	0	2	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the importance of communication and enhance self confidence
- To acquire employability skills

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Actively participate in Group Discussion (Analyze)
CO2: Enhance interview skills and make effective Presentation (Apply)

CO-PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	-	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	-	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I PRESENTATION SKILLS **10**

Presentation Techniques – Time Management Techniques – Body language – Managerial Skills – Making Effective Presentation

UNIT II GROUP DISCUSSION AND PUBLIC SPEAKING **10**

Introduction to Group Discussion – Understanding Group Dynamics – Group Discussion Strategies– Activities to Improve GD Skills – Public Speaking Techniques – Public Speaking Activiti

UNIT III INTERVIEW SKILLS **10**

Listening to Interviews – Preparation for the Interview – Interview Techniques and Etiquettes – Handling Stress Interview – Mock Interview – Online Interview Techniques

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: – Periods

Total: 30 Periods

TEXT BOOKS:

1. Prashant Sharma, "Soft Skills: Personality Development for Life Success", BPB Publications,1st edition,2022.
2. Leader Interpersonal and Influence Skills: The Soft Skills of Leadership." Routledge Publications, 2014.

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REFERENCES:

1. Ghosh B N, "Managing Soft Skills for Personality Development", 1st edition, Tata McGraw-Hill, 2012
2. Nitin Bhatnagar and Mamta Bhatnagar, "Effective Communication and Soft Skills Strategies for Success", 1st edition, Pearson Education, 2012.

EVALUATION PATTERN:

Continuous Internal Assessments	Marks
Test – I	50
Test – II	50
Total	100

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SEMESTER V

		Category: PCC				
U21EE504	POWER ELECTRONICS AND DRIVES LABORATORY	L	T	P	J	C
		0	0	4	2	3

PRE-REQUISITES:

- U21EE303: Analog Electronics and applications

COURSE OBJECTIVES:

- To familiarize students with the characteristics and operation of power semiconductor devices and converters
- To provide understanding of the performance of converter-fed DC, AC, and special motor drives
- To impart knowledge of converter-fed drive topologies and their simulation for practical applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the static and dynamic characteristics of power semiconductor devices (Analyze)

CO2: Examine the operation and performance of power converter circuits (Analyze)

CO3: Investigate the performance of converter-fed DC and AC drives (Analyze)

CO4: Examine the performance of converter-fed SRM and BLDC motor drives (Analyze)

CO5: Design and compare converter-fed drive topologies using simulation tools (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	-	1	3	3
CO2	3	3	2	2	2	-	-	-	-	-	-	1	3	3
CO3	3	3	2	2	2	-	-	-	-	-	-	1	3	3
CO4	3	3	2	2	3	-	-	-	-	-	-	1	3	3
CO5	3	2	2	2	3	-	-	-	-	-	-	1	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

LIST OF EXPERIMENTS

1. Characteristics of SCR, TRIAC, MOSFET and IGBT
2. Single phase and three phase-controlled rectifiers
3. DC-DC converters
4. DC-AC converters
5. AC voltage controllers and cycloconverters
6. DSP based control of induction motor drives
7. DSP based control of switched reluctance and DC motor drives

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Project:

Simulation of Power Electronic Circuits using MATLAB Simulink

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: 30 Periods

Total: 60 Periods

EVALUATION PATTERN:

<table>
<tr><th colspan="5">Continuous Internal Assessments</th><th>End Semester Examinations</th></tr>
<tr><td colspan="2">Assessment I
(Practical)
(100 Marks)</td><td colspan="3">Assessment II
(Project)
(100 Marks)</td><td rowspan="2">Practical Examinations
(Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>Evaluation of Laboratory Observation, Record
(Rubrics Based Assessments)</td><td>Test</td><td>Review I</td><td>Review II</td><td>Review III</td></tr>
<tr><td>75</td><td>25</td><td>15</td><td>25</td><td>60</td><td></td></tr>
<tr><td colspan="2">25</td><td colspan="3">25</td><td>50</td></tr>
<tr><td colspan="5">50</td><td>50</td></tr>
<tr><td colspan="6">Total: 100</td></tr>
</table>

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SEMESTER V

U21EE505	POWER ENGINEERING LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	4	0	2

PRE-REQUISITES:

- U21EE403: Transmission and distribution, U21EE501: Power System Analysis

COURSE OBJECTIVES:

- To introduce transmission line theory and computational methods for determining line parameters and developing equivalent models using simulation tools
- To provide understanding of network modeling and analysis techniques for forming bus admittance and impedance matrices in practical power system networks
- To impart knowledge of power system performance analysis through load flow, fault, and stability studies using analytical and digital simulation methods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply transmission line theory to calculate transmission line parameters using standard computational methods (Apply)
CO2: Deploy power system modeling techniques to develop equivalent models of transmission lines using simulation tools (Apply)
CO3: Implement network analysis methods to form Y-bus and Z-bus matrices for power system networks (Apply)
CO4: Investigate power system operating conditions using load flow methods to determine bus voltages, active power, and reactive power (Analyze)
CO5: Examinee power system behavior under symmetrical and unsymmetrical faults and evaluate system response using analytical and simulation methods (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	1	2	2	-	1	-	3
CO2	3	2	1	1	1	-	-	1	2	2	-	1	-	3
CO3	3	2	1	1	1	-	-	1	2	2	-	1	-	3
CO4	3	3	2	1	1	-	-	1	2	2	-	1	-	3
CO5	3	3	2	1	1	-	-	1	2	2	-	1	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

LIST OF EXPERIMENTS

1. Calculation of transmission line parameters
2. Modelling of short and medium transmission lines
3. Formation of Y-bus by the method of inspection
4. Formation of Z-bus by bus building algorithm
5. Load flow analysis by Gauss-Seidel method
6. Load flow analysis by Newton Raphson method
7. Symmetric and unsymmetrical fault analysis
8. Stability analysis of single machine infinite bus system

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Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 60 Periods Project: – Periods

Total: 60 Periods

EVALUATION PATTERN:

Continuous Internal Assessments		**End Semester Examinations**
Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test	
75	25	
100		100
60		40
100		

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SEMESTER VI

U21EE601	PROTECTION AND SWITCHGEAR	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- U21EE403: Transmission and Distribution

COURSE OBJECTIVES:

- To establish a clear conceptual understanding of the characteristics and functions of protective devices in electrical systems
- To develop comprehensive insight into the role of relays and circuit breakers in safeguarding electrical apparatus
- To cultivate the ability to analyze and select appropriate relays and circuit breakers for reliable system protection

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply the principles of protective schemes and IEC standards to select suitable protection methods for power system fault conditions (Apply)
CO2: Utilize the operating principles of protective relays to select suitable relay types for fault situations (Apply)
CO3: Select suitable protection methods for alternators, transformers, bus bars, transmission lines, and motors using the protection schemes (Apply)
CO4: Examine arc phenomena and insulation coordination requirements to determine appropriate circuit breaking and insulation levels (Analyze)
CO5: Compare and analyze the different types of circuit breakers and fuses (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	1	-	-	-	1	-	3
CO2	3	3	2	1	-	-	-	-	-	-	-	1	-	3
CO3	3	3	2	1	-	-	-	-	-	-	-	1	-	3
CO4	3	3	2	2	-	-	-	-	-	-	-	1	-	3
CO5	3	3	2	2	-	1	1	-	-	-	-	1	-	3
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

SYLLABUS:

UNIT I PROTECTION SCHEMES AND STANDARDS 9

Principles and need for protective schemes – Nature, causes and types of faults – Zones of protection – Primary and backup protection – Essential qualities of protection – Classification of protection schemes – Introduction to IEC standards for earthing (TT, TN, IT) – IEC standards for MCB and MCCB

UNIT II PROTECTIVE RELAYS 9

Requirement of relays – Universal relay – Torque equation – Electromagnetic relays: Over current, Directional, Differential, Distance, Negative sequence and Frequency relays – Earth fault relays – Static and Numerical relays

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UNIT III APPARATUS AND LINE PROTECTION 9

Alternator, Transformer, Bus bar, Transmission line and Motor protection schemes – Static protection of EHV lines

UNIT IV THEORY OF CIRCUIT INTERRUPTION AND INSULATION COORDINATION 9

Principles of arc extinction – Arc control devices – DC and AC Circuit breaking – Recovery voltage and restriking voltage – Current chopping – Capacitance current breaking – Arc suppression coil – Insulation coordination – Determination of line insulation – Insulation levels of substation

UNIT V CIRCUIT BREAKERS 9

Circuit breakers : Oil, Air break, Air blast, Sulphur hexafluoride, Vacuum – Fuses – Types – Selection – Discrimination – HVDC breakers – Rating – Testing of circuit breakers

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Sunil S. Rao, "Switchgear and Protection", 13th edition, Khanna Publishers, New Delhi, 2014
2. Anderson P.M., "Power System Protection", 1st edition, A John Wiley and Sons Inc., Publication, 2014

REFERENCES:

1. Badri Ram and Vishwakarma B.H., "Power System Protection and Switchgear", 2nd edition, New Age International Pvt. Ltd., 2011
2. Paithankar Y.G. and Bhide S.R., "Fundamentals of power system protection", 2nd edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010
3. Wadhwa C.L., "Electrical Power Systems", 6th edition, New Age International Pvt. Ltd., 2010
4. https://archive.nptel.ac.in/courses/108/107/108107167/

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course

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SEMESTER VI

		Category: PCC				
U21EE602	EMBEDDED SYSTEM DESIGN	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- U21EE503: Microprocessor, Microcontroller and Applications

COURSE OBJECTIVES:

- To establish strong foundational concepts in embedded system architecture and ARM processor organization
- To develop in-depth understanding of bus communication protocols and data exchange mechanisms in embedded systems
- To foster the ability to design and implement embedded system solutions for real-time applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Select suitable processors and memory devices for a given embedded application with appropriate justification (Apply)

CO2: Examine embedded communication protocols such as RS-232, RS-422, RS-485, CAN, SPI, I2C, and LIN for a given system requirement with correct protocol selection (Analyze)

CO3: Apply RTOS concepts including tasks, interrupts, scheduling algorithms and inter-task communication mechanisms for a real-time embedded system scenario (Apply)

CO4: Deploy ARM7 architecture and instruction set concepts to configure and implement on-chip peripherals such as timers and PWM units for a given embedded application (Apply)

CO5: Analyze embedded control solutions for domestic and industrial applications by developing logical and functional system models (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO4	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO5	3	3	2	2	-	1	1	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Characteristics of embedded system - Structural units - Selection of processor and memory devices - DMA - Timer and counting devices - Watchdog timer - Real time clock - In circuit emulator - Target hardware debugging

UNIT II EMBEDDED NETWORKING 9

I/O devices – Ports and buses – Serial bus communication protocols – RS 232 standard – RS 422 and RS 485 – CAN bus – Serial peripheral interface – I²C bus – LIN bus.

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UNIT III EMBEDDED NETWORKING 9

Task, Process and threads – Interrupt routine in RTOS – Multiprocessing and multitasking – Pre-emptive and Non-primitive scheduling algorithm – Task communication – Shared memory – Message passing – Inter process communication – Semaphores

UNIT IV ARM PROCESSOR AND PERIPHERALS 9

ARM Architecture – Block diagram of ARM 7 – Instruction set – Stacks and subroutine – Peripherals – Timer unit – Pulse Width Modulation unit – UART

UNIT V APPLICATIONS 9

Washing machine – Automotive: Anti-locking brake system – Smart card system – ATM machine – Elevator control

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Rajkamal, "Embedded System - Architecture, Programming and Design", 2nd edition, McGraw Hill, 2013
2. James K. Peckol, "Embedded System Design", 2nd edition, John Wiley and Sons, 2010

REFERENCES:

1. Sriram J., Iyer V. and Pankaj Gupta: "Embedded Real-time Systems Programming", 1st edition, Tata McGraw-Hill, New Delhi, 2017
2. David E.Simon, "An Embedded Software Primer", 17th edition, Pearson Education India, New Delhi, 2014
3. Elicia White, "Making Embedded Systems", 3rd edition, O Reilly Series SPD, 2012
4. https://archive.nptel.ac.in/courses/108/102/108102045/

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="3">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (100 Marks)</th><th colspan="2">Assessment II (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td></td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td>200</td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER VI

U21AMG02	MACHINE LEARNING (For EE Department)	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- NIL

COURSE OBJECTIVES:

- To develop a conceptual understanding of machine learning models, learning paradigms, and data characteristics relevant to engineering applications
- To cultivate proficiency in applying and evaluating regression, classification, clustering, and data transformation techniques for solving electrical engineering problems
- To establish analytical competence in deep learning models and their performance evaluation for selected real-world applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze different types of data and learning paradigms to select suitable machine learning approaches. (Analyze)

CO2: Investigate linear models and association rule mining techniques for engineering datasets (Analyze)

CO3: Apply classification algorithms to solve electrical fault classification problems (Apply)

CO4: Deploy clustering and data transformation techniques for electricity usage analysis. (Apply)

CO5: Analyze deep learning models for selected applications such as lane and vehicle detection (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	-	-	-	-	-	-	1	2	-
CO2	3	3	2	2	1	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO4	3	2	1	1	1	-	-	-	-	-	-	1	3	-
CO5	3	3	2	2	1	-	-	-	-	-	-	1	3	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)					3: Substantial (High)						

SYLLABUS:

UNIT I INTRODUCTION TO MACHINE LEARNING 9

Machine Learning Overview – Machine Learning Model Lifecycle – Machine Learning Tools – Supervised vs Unsupervised Learning – Classification – Regression – Evaluating Machine Learning Models

UNIT II LINEAR MODELS AND ASSOCIATION RULE 9

Linear basis function models – Bayesian linear regression – Association rule mining – Market basket analysis – Case studies: Electricity consumption, weather forecasting

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UNIT III DATA CLASSIFICATION 9

Perceptron algorithm – Linear maximal margin classifier – Linear soft margin classifier – Non-linear classifier – Regression by SVM – Variants of SVM techniques – Decision tree – Classification – Measures of impurity – ID3, C4.5, CART – ID3, C4.5 – Case study: Fault classifier

UNIT IV DATA CLUSTERING AND TRANSFORMATION 9

Unsupervised learning – Clustering Methods – K-Means Clustering – EM algorithm – Data transformation – Entropy based method for attribute discretization – PCA for attribute reduction – Case study: Clustering electricity usage

UNIT V DEEP LEARNING 9

Introduction – Neuron models – Networks: Single and multilevel Perceptron, Radial bias function – Back propagation algorithm – Case studies: Lane detection, Vehicle detection

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", 4th Edition, Prentice Hall India, 2020.
2. Kevin P. Murphy, "Probabilistic Machine Learning: An Introduction", 1st Edition, MIT Press, 2022.
3. Stephen Marsland, "Machine Learning- An Algorithmic Perspective", 2nd Edition, CRC Press, 2015.

REFERENCES:

1. Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", 1st Edition, Cambridge University Press, 2015.
2. John Mueller and Luca Massaron, "Machine Learning for Dummies", 2nd Edition, John Wiley & Sons, 2021.
3. Gopal M, "Applied Machine Learning", 1st Edition, Tata McGraw Hill LLC, 2019.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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SEMESTER VI

U21SSG03	SOFT SKILLS – III (Common to all programmes)	Category: HSMC				
		L	T	P	J	C
		0	0	2	0	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To improve language adeptness and to enhance fluency in language.
- To Gain emotional intelligence and to manage stress.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1 Write reports and make reasoning and assertions (Apply)
CO2: Overcome stress and attain work-life balance (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	1	3	-	-	-	-
CO2	-	-	-	-	-	-	-	1	-	3	-	2	-	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

SYLLABUS:

UNIT I LANGUAGE ADEPTNESS **10**

Sentence Completion – Report Writing – Logical Reasoning – Cause and Effect – Assertion and Reasoning – Digital Profiling – Creative Resume

UNIT II STRESS MANAGEMENT **10**

Factors Causing Stress – Positive and Negative Stress – Effects of Stress – Stress Overcoming Techniques – Context Based Tasks

UNIT III EMOTIONAL INTELLIGENCE **10**

Leadership effectiveness – Self-awareness – Self-management – Self-motivation – Empathy and Social Skills

Contact Periods:

Lecture: – Periods Tutorial: –Periods Practical: 30 Periods Project – Periods
Total 30 Periods

TEXT BOOKS:

1. Daniel Goleman, "Emotional Intelligence: Why it Can Matter More Than IQ", 1st edition, Bloomsbury, 2009.
2. Alan Barker, "Improve Your Communication Skills : Present with Confidence; Write with Style; Learn Skills of Persuasion",1st edition, Kogan Page, 2010.

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REFERENCES:

1. Jeremy Stranks, "Stress at Work: Management and Prevention", 1st edition, Butterworth- Heinemann, 2005.
2. Edward J Watson, "Emotional Intelligence: A Practical Guide on How to Control Your Emotions and Achieve Lifelong Social Success", 1st edition, Amazon Digital Services LLC, 2016.

EVALUATION PATTERN:

Continuous Internal Assessments	Marks
Test – I	50
Test – II	50
Total	100

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SEMESTER VI

U21EE603	EMBEDDED SYSTEM DESIGN LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	4	2	3

PRE-REQUISITES:

- U21EE503: Microprocessor, Microcontroller and Applications

COURSE OBJECTIVES:

- To develop the ability to design and implement assembly language programs using the ARM instruction set
- To provide knowledge on interfacing peripheral devices with the ARM board
- To impart knowledge on the configuration of the ARM board and establish data communication with a PC

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Implement ARM instruction set concepts to develop and execute assembly language programs (Apply)
CO2: Develop and implement the program written in ARM assembly language instructions (Apply)
CO3: Examine embedded communication protocols such as RS-232, RS-422, RS-485, CAN, SPI, I2C, and LIN for a given system requirement (Analyze)
CO4: Utilize ARM7 architecture and instruction set concepts to configure and implement on-chip peripherals such as timers and PWM units for a given embedded application (Apply)
CO5: Implement and test applications on the STM32 evaluation board using relevant development tools (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	1	1	1	2	2	2	1	2	-
CO2	3	3	2	2	3	1	1	1	2	2	2	1	2	-
CO3	3	3	3	3	3	1	1	1	3	3	3	1	2	-
CO4	3	3	2	2	3	1	1	1	2	2	2	1	2	-
CO5	3	3	2	2	3	1	1	1	2	2	2	1	2	-
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)					3: Substantial (High)				

LIST OF EXPERIMENTS

1. Installation of software for embedded development, troubleshooting issues, installing packages
2. STM32 GPIO peripheral programming
   a. LEDs, Buttons
   b. Using GPIO interrupts to respond to user button press
3. Configuration of clock system to generate different peripheral and system frequencys
4. Configuration of UART in polling method to send data from STM32 MCU to PC

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5. Interface audio sensor to STM32 board using ADC
6. Design of a coherent sensor signal sampling methodology to implement a data logger

Project:

Implementation of Embedded processor/controller for real time application

Contact Period:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: 30 Periods

Total: 60 Periods

EVALUATION PATTERN:

<table>
<tr><th colspan="5">Continuous Internal Assessments</th><th>End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (Practical) (100 Marks)</th><th colspan="3">Assessment II (Project) (100 Marks)</th><td rowspan="2">Practical Examinations
(Examinations will be conducted for 100 Marks)</td></tr>
<tr><td>Evaluation of Laboratory Observation, Record
(Rubrics Based Assessments)</td><td>Test</td><td>Review I</td><td>Review II</td><td>Review III</td></tr>
<tr><td>75</td><td>25</td><td>15</td><td>25</td><td>60</td><td></td></tr>
<tr><td colspan="2">25</td><td colspan="3">25</td><td>50</td></tr>
<tr><td colspan="5">50</td><td>50</td></tr>
<tr><td colspan="6">Total: 100</td></tr>
</table>

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SEMESTER VI

U21AMG03	MACHINE LEARNING LABORATORY (For EE Department)	Category: PCC				
		L	T	P	J	C
		0	0	2	0	1

PRE–REQUISITES:

- U21CSG02 : Python Programming

COURSE OBJECTIVES:

- To develop proficiency in applying and analyzing machine learning algorithms using programming tools for supervised and unsupervised learning problems
- To build competence in developing and evaluating machine learning models using real-world datasets relevant to electrical engineering applications
- To enhance analytical ability in interpreting experimental results to assess the performance of machine learning techniques

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply decision tree and regression tree algorithms to solve problems using given datasets (Apply)
CO2: Deploy classification and clustering techniques such as Naïve Bayes and K-means for data modeling tasks (Apply)
CO3: Analyze supervised learning algorithms to model and interpret engineering datasets (Analyze)
CO4: Examine unsupervised learning algorithms for pattern discovery and data interpretation (Analyze)
CO5: Implement machine learning techniques to develop solutions for selected electrical engineering applications (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	-	-	-	-	-	-	1	2	-
CO2	3	3	2	2	2	-	-	-	-	-	-	1	2	-
CO3	3	3	2	2	2	-	-	-	-	-	-	1	2	-
CO4	3	3	2	2	2	-	-	-	-	-	-	1	2	-
CO5	3	3	2	2	2	-	-	-	-	-	-	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

LIST OF EXPERIMENTS

1. Working with default and user defined datasets (.xls and .csv)
2. Implement SVM algorithm using given datasets (.xls and .csv)
3. Data and Text clustering using K-means algorithm
4. Naïve Bayesian classifier for a sample training data set stored as a .CSV file.
5. Back propagation algorithm and test the same using appropriate data sets.
6. Object Detection using machine learning algorithm.
7. Clustering of electricity consumer using K-means.

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project – Periods Total 30 Periods

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REFERENCES:

1. Oliver Theobald, "Machine Learning for Absolute Beginners", 3rd Edition, 2021.
2. Sebastian Raschka. "Python Machine Learning" 2nd Edition, Packt Publishing, 2015.

EVALUATION PATTERN:

Continuous Internal Assessments		End Semester Examinations
Evaluation of Laboratory Observation, Record **(Rubrics Based Assessments)**	Test	
75	25	
100		100
60		40
100		

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SEMESTER VII

U21EE701	PRINCIPLES OF MANAGEMENT	Category: HSMC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop a clear understanding of management principles and the roles and responsibilities of managers
- To build conceptual clarity on the nature and purpose of planning and decision-making processes in organizations
- To establish foundational knowledge of human resource management and motivational theories for effective organizational performance

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the role of managers and relate it to international business strategies (Analyze)
CO2: Apply planning and decision-making techniques in organizational management scenarios (Apply)
CO3: Investigate the role of human resource management in improving organizational effectiveness (Analyze)
CO4: Examine the motivation theories and relate them to leadership and innovation practices (Analyze)
CO5: Implement controlling techniques for cost control in operations management (Apply)

CO-PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	2	2	1	1	2	1	-	-
CO2	-	-	-	-	-	2	2	2	1	1	2	1	-	-
CO3	-	-	-	-	-	2	2	2	1	1	2	1	-	-
CO4	-	-	-	-	-	2	2	2	1	1	2	1	-	-
CO5	-	-	-	-	-	2	2	2	1	1	2	1	-	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Introduction to management – Manager Vs Entrepreneur – Kinds of managers – Managerial roles and skills – Evolution of management: Taylor Principles, Fayol, Elton Mayo – Scientific, human relations, system and contingency approaches – Types of business organization – Sole proprietorship – Public and private sector enterprises – Current trends and issues in management.

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UNIT II PLANNING 9

Definition – Benefits and pitfalls of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic management – Planning tools and techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Intra nd inter organizational process – Types – Line and staff authority – Departmentalization – Delegation of authority – Human Resource Management (HRM) – Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – Motivation theories, motivational techniques – Job satisfaction – Job enrichment – Leadership – Types and theories of leadership – Fiedler's contingency theory, path goal theory– Normative decision theory – Leadership styles – Communication – Process of communication – Barrier in communication – Effective communication.

UNIT V CONTROLLING 9

Innovation and learning perspective of control – Audit – Budgetary and cost control techniques – Use of computers and IT in management control – Productivity problems and management – Control and performance – Direct and preventive control – Challenges in control.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Stephen P. Robbins and Mary Coulter, 'Management', 14th edition, Pearson Education, 2017
2. Harold Koontz, Heinz Welhrich and Ramachandra Aryasri, 2nd edition, 'Principles of Management', McGraw-Hill Education Pvt. Ltd, 2015

REFERENCES:

1. J.K.Mitra, 'Principles of Management', 1st edition, Oxford University Press, 2017
2. Stephen A. Robbins, David A. Decenzo and Mary Coulter, 'Fundamentals of Management', 7th edition, Pearson Education,2011
3. P.C.Tripathi and P.N.Reddy, 'Principles of Management', 6th edition, McGraw-Hill Education Pvt. Ltd, 2017
4. James A F. Stoner,Edward Freeman and Gilbert, 'Management',8th edition, Prentice Hall of India Pvt. Ltd,2011

EVALUATION PATTERN:

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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SEMESTER VII

U21EE702	ELECTRICAL APPLICATION LABORATORY	Category: PCC				
		L	T	P	J	C
		0	0	2	2	2

PRE–REQUISITES:

- U21EE501: Power System Analysis, U21EE502: Power Electronics and Drives

COURSE OBJECTIVES:

- To establish foundational knowledge of electric drives and power systems for understanding their operation and applications
- To develop analytical competence in evaluating the performance of renewable energy sources
- To enable the application of internet technologies for solving real-world engineering problems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Develop the electric drive model using MATLAB software (Apply)

CO2: Integrate the drive with dSPACE controller for speed control application (Apply)

CO3: Deploy the drive for speed control applications using FPGA/PLC (Apply)

CO4: Analyze and interpret the performance parameters of wind and solar PV systems (Analyze)

CO5: Model the real-world problems using internet technology (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	3	-	-	1	2	1	-	1	-	2
CO2	3	3	2	2	3	-	-	1	2	1	-	1	-	2
CO3	3	2	1	1	2	-	-	1	2	1	-	1	-	2
CO4	3	3	2	2	3	-	-	1	2	1	-	1	-	2
CO5	3	2	1	1	3	-	-	1	2	1	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

List of Experiments

1. Model of electric drive systems using MATLAB software
2. Control of variable speed drive using dSPACE controller
3. V/Hz control of electric drive system using PLC
4. Speed control of BLDC motor drive using dSPIC / FPGA Controller
5. Performance assessment of micro wind energy generator
6. Performance assessment of 1 kWp solar PV system
7. Monitoring and control of sensor data via Cloud

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Project:

Modelling / Simulation of Electrical Drives and Applications of Renewable Energy System

Contact Periods:

Lecture: – Periods Tutorial: – Periods Practical: 30 Periods Project: 30 Periods

Total: 60 Periods

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (Practical) (100 Marks)		Assessment II (Project) (100 Marks)			Practical Examinations (Examinations will be conducted for 100 Marks)
Evaluation of Laboratory Observation, Record (Rubrics Based Assessments)	Test	Review I	Review II	Review III	
75	25	15	25	60	
25		25			50
50					50
Total: 100					

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SEMESTER VII

U21EE703	PROJECT WORK PHASE - I	Category: EEC				
		L	T	P	J	C
		0	0	0	4	2

PRE–REQUISITES:

Nil

COURSE OBJECTIVES:

- To develop the ability to identify and solve the specific problem in the field of electrical and electronics engineering
- To develop collaborative work and communication skills
- To acquire skills to utilize the modern tools effectively for report preparation

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify, formulate, design, interpret, analyze and provide solutions to complex problem by applying knowledge gained on basics of science and engineering (Apply)

CO2: Demonstrate a technical skill of their selected project topics by exploring suitable engineering and IT tools (Apply)

CO3: Build the team work to solve problems with ethics and commitment towards sustainable development (Apply)

CO4: Use the modern tools for report preparation and communicate orally in review and viva voce (Apply)

CO5: Acquire the technology advancements in the selected topics and engage in lifelong learning (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO2	-	-	-	2	2	-	-	-	-	-	-	-	2	2
CO3	-	-	-	-	-	2	2	2	2	2	2	2	2	2
CO4	-	-	-	-	2	-	-	-	-	3	2	2	2	2
CO5	-	-	-	-	2	-	-	-	-	-	-	2	2	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

STRATEGY

To identify a project topic of interest in consultation with supervisor. The progress of the project work is evaluated based on a reviews and the review committee may be constituted by the Head of the Department. A project report is required at the end of the semester.

Contact Periods:

Lecture: - Periods Tutorial: - Periods Practical: - Periods Project 60 Periods

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Total 60 Periods

EVALUATION PATTERN:

Internal Assessments (60 Marks)			End Semester Examinations (40 Marks)			
Review I	Review II	Review III	Project Report		Viva - Voce	
			Supervisor	External	Internal	External
10	20	30	10	10	10	10
60			40			
Total			100			

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SEMESTER VIII

U21EE801	PROJECT WORK PHASE - II	Category: EEC				
		L	T	P	J	C
		0	0	0	20	10

PRE–REQUISITES:

Nil

COURSE OBJECTIVES:

- To develop the ability to identify and solve the specific problem in the field of electrical and electronics engineering
- To develop collaborative work and communication skills
- To acquire skills to utilize the modern tools effectively for report preparation

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify, formulate, design, interpret, analyze and provide solutions to complex problems by applying the knowledge gained on the basics of science and engineering (Apply)

CO2: Demonstrate the technical skills of their selected project topics by exploring suitable engineering and IT tools (Apply)

CO3: Build the team work to solve problems with ethics and commitment towards sustainable development (Apply)

CO4: Use the modern tools for report preparation and communicate orally in review and viva voce (Apply)

CO5: Adapt to technology advancements in the selected topics and engage in lifelong learning (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO2	-	-	-	3	3	-	-	-	-	-	-	-	3	3
CO3	-	-	-	-	-	2	2	3	3	3	2	2	3	3
CO4	-	-	-	-	3	-	-	-	-	3	2	3	3	3
CO5	-	-	-	-	3	-	-	-	-	-	-	3	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

STRATEGY

To identify a project topic of interest in consultation with supervisor. The progress of the project work is evaluated based on a reviews and the review committee may be constituted by the Head of the Department. A project report is required at the end of the semester.

Contact Periods:

Lecture: - Periods Tutorial: – Periods Practical: – Periods Project 300 Periods

Total 300 Periods

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EVALUATION PATTERN:

Internal Assessments (60 Marks)			End Semester Examinations (40 Marks)			
Review I	Review II	Review III	Project Report		Viva - Voce	
			Supervisor	External	Internal	External
10	20	30	10	10	10	10
60			40			
Total			100			

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U21EEP01	POWER SYSTEM OPERATION AND CONTROL	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop analytical understanding of load dispatch, load forecasting, and economic operation of power systems for optimal generation scheduling
- To build competence in load frequency control and reactive power control techniques for maintaining system voltage and frequency stability
- To enable understanding of computer-based monitoring, control, and energy management systems for secure and reliable power system operation

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply load dispatch and load forecasting methods for optimal power system operation (Apply)
CO2: Analyze load frequency control of single-area and multi-area power systems (Analyze)
CO3: Implement reactive power control techniques to regulate voltage in power systems (Apply)
CO4: Examine economic operation of power systems using optimal scheduling methods (Analyze)
CO5: Investigate computer-based monitoring and control of power systems using SCADA and energy management systems (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	-	-	-	-	-	-	1	-	3
CO2	3	3	1	1	2	-	-	-	-	-	-	1	-	3
CO3	3	3	1	1	2	-	-	-	-	-	-	1	-	3
CO4	3	3	2	1	1	-	-	-	-	-	1	1	-	3
CO5	2	3	2	1	3	1	1	-	-	-	1	1	-	3
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

SYLLABUS:

UNIT I ECONOMIC ASPECTS 9

Power scenario in Indian grid – National and regional load dispatching centers – Requirements of good power system – Necessity of voltage and frequency regulation – System load variation – Load curves – Load forecasting – Economic load dispatch – Regulation of two generators in parallel

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UNIT II LOAD FREQUENCY CONTROL 9

Speed governing mechanism and modeling of thermal and hydro systems – Speed load characteristics – Parallel operation of generators – Load frequency control of single area and multi-area system – Simulation of single area and multi-area system

UNIT III REACTIVE POWER CONTROL 9

Generation and absorption of reactive power – Basics of reactive power control – Automatic voltage regulator – Static and dynamic analysis of AVR loop – Methods of reactive power control – Necessity of voltage control – Methods of voltage control – Simulation of AVR system

UNIT IV ECONOMIC OPERATION OF POWER SYSTEMS 9

Input and output characteristics of thermal plant – Incremental cost curve – Optimal operation of thermal units without and with transmission losses – Unit commitment (UC) problem – Constraints on UC problem – Solution of UC problem using priority list

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Need of computer control – Energy control centers and its functions – Phasor measurement unit – Data acquisition and controls – System hardware configurations – SCADA – Energy management system and its functions – Various operating states – State estimation problem

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Olle I. Elgerd, "Electric Energy Systems Theory – An Introduction", 34th reprint, McGraw Hill Education Pvt. Ltd., New Delhi, 2010
2. Abhijit Chakrabarti and Sunita Halder, "Power System Analysis Operation and Control",3rd edition, PHI learning Pvt. Ltd., New Delhi, 2010

REFERENCES:

1. Wadhwa C.L., "Electrical Power Systems", 7th edition, New Academic Science Limited, 2016
2. Allen J. Wood and Bruce F. Wollen berg, "Power Generation, Operation and Control", 3rd edition, John Wiley & Sons, Inc., 2013
3. Kundur P., "Power System Stability and Control", 10th reprint, McGraw Hill Education Pvt. Ltd., New Delhi, 2010

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="3">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (100 Marks)</th><th colspan="2">Assessment II (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td></td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td>200</td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21EEP02	HIGH VOLTAGE ENGINEERING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop conceptual understanding of electric field distribution and breakdown mechanisms in dielectric materials
- To introduce high voltage and high current generation and measurement techniques
- To build competence in testing and simulation methods for evaluating the performance of high voltage equipment

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze electric field distribution and breakdown mechanisms in dielectric materials (Analyze)

CO2: Design methods to generate high voltage and high current for testing applications (Apply)

CO3: Implement measurement techniques for high voltage and high current systems (Apply)

CO4: Investigate testing methods and standards for high voltage equipment (Analyze)

CO5: Apply simulation tools to design and evaluate insulators and bushings (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	1	-	-	-	-	-	-	1	-	2
CO2	3	2	1	1	2	-	-	-	-	-	-	1	-	2
CO3	3	2	1	1	2	-	-	-	-	-	-	1	-	2
CO4	3	3	2	-	2	1	1	-	-	-	-	1	-	2
CO5	3	2	1	2	2	-	-	-	-	-	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I ELECTRIC BREAKDOWN IN DIELECTRICS **9**

Uniform and non-uniform electric fields – Breakdown mechanism in gaseous, vacuum, liquid, solids and composite dielectrics

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UNIT II GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of high DC and AC voltages – Generation of impulse voltages and impulse currents – Tripping and control of impulse generators

UNIT III MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9

Measurement of high DC and AC voltages – High DC and AC currents – High impulse voltages and impulse currents

UNIT IV HIGH VOLTAGE TESTING 9

Definitions and terms – IEEE and IEC standards - Partial discharge measurement – Testing of insulators, bushings, circuit breakers, transformers and surge diverters

UNIT V SIMULATION OF HIGH VOLTAGE APPARATUS 9

Finite Element Analysis (FEA): Basis of FEA, procedure, elements, boundary conditions – Simulation environment: Modelling procedure, pre and post processing – Design of insulators and bushings

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Naidu M.S. and Kamaraju V., "High Voltage Engineering", 6th edition, Tata McGraw Hill Ltd., 2020
2. Ravindra Arora, Wolfgang Mosch, "High Voltage and Electrical Insulation Engineering", 2nd edition, Jon & Wiley Son Limited, 2022

REFERENCES:

1. Farouk A.M. Rizk, Giao N. Trinh, "High Voltage Engineering", CRC Press, 2018
2. Sivaji Chakravorti, "Electric Field Analysis", CRC Press, 2017
3. "José Roberto Cardoso", Electromagnetics Through the Finite Element Method - A Simplified Approach Using Maxwell's Equations, CRC Press, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET

U21EEP03	MICROGRID	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To present the architecture and operational characteristics of microgrids.
- To introduce control strategies and power electronic interface techniques used in microgrid operation.
- To emphasize the principles of communication, protection, and energy management in microgrids.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze microgrid architecture and operational characteristics (Analyze)

CO2: Apply power electronic interfaces in microgrid applications (Apply)

CO3: Implement converter and inverter control techniques in microgrid systems (Apply)

CO4: Investigate communication protocols used in microgrid operation (Analyze)

CO5: Examine microgrid operation and protection under grid-connected and islanded modes (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	-	-	-	1	-	2
CO2	3	2	1	-	1	-	-	-	-	-	-	1	-	2
CO3	3	2	1	-	2	-	-	-	-	-	-	1	-	2
CO4	3	3	2	1	2	-	-	-	-	-	-	1	-	2
CO5	3	3	2	1	2	-	-	-	-	-	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I MICROGRID STRUCTURE 9

Typical structure and configuration – Significance – Sources – Types: AC, DC and hybrid microgrid – Technical implications and social fall out – Market models and business cases for microgrid

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UNIT II MICROGRID SOURCES AND POWER ELECTRONIC INTERFACES 9

Review of microgrid sources – Basic characteristics and selection – Power electronics interface – Design for microgrid – DC and AC sources – Protection and co-ordination – Power quality issues and solutions

UNIT III CONTROL AND DESIGN OF POWER ELECTRONIC INTERFACES 9

Microgrid control architecture – Control strategies: Centralized and decentralized control – Multi-agent system-based control – Power relations and power control – Control of DC-DC converters and inverter – Microgrid challenges – Energy management in microgrid

UNIT IV COMMUNICATION INFRASTRUCTURE 9

Requirement of communication system in microgrid – Communication protocols and standards – Selection of communication protocols for microgrid – Event triggered system and Time triggered system – Unicast and multicast communication – Impact of time latencies on operation

UNIT V OPERATION AND PROTECTION OF MICROGRID 9

Grid connected and islanding mode of operation – Challenges for microgrid protection – Adaptive protection – Fault current source for effective protection in islanded operation – Fault current limitation in microgrids

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Nikos Hatziargyriou, "Microgrids: Architectures and Control", Wiley-IEEE Press, 2013
2. Sharkh S.M., Abu-Sara M.A., Orfanoudakis G.I. and Hussain B., "Power Electronic Converters for Microgrids", Wiley – IEEE Press, 2014

REFERENCES:

1. Naser Mahdavi Tabatabaei, Ersan Kabalci, Nicu Bizon, "Microgrid Architectures, Control and Protection Method", Springer, 2020
2. Magdi S. Mahmoud, "Microgrid Advanced Control Methods and Renewable Energy System Integration", Elsevier, 2017
3. Li Fusheng, Li Ruisheng, Zhou Fengquan, "Microgrid Technology and Engineering Application", Elsevier, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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		Category: PEC				
U21EEP04	COMPUTER AIDED POWER SYSTEM ANALYSIS	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce computational techniques for power flow and fault analysis in power systems.
- To present computer-based methods for analyzing power system stability and security.
- To emphasize sparse matrix and numerical techniques used in large-scale power system analysis.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply the algorithms to solve power flow problems (Apply)

CO2: Model the sparse matrix techniques for power system analysis (Apply)

CO3: Categorize symmetrical and unsymmetrical faults using computational methods (Analyze)

CO4: Investigate the contingency and security of power systems (Analyze)

CO5: Examine the stability of power systems using computational techniques (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	3	-	-	-	-	-	-	2	-	2
CO2	3	3	2	1	3	-	-	-	-	-	-	2	-	2
CO3	3	3	2	1	3	-	-	-	-	-	-	2	-	2
CO4	3	3	2	-	3	-	-	-	-	-	-	2	-	2
CO5	3	3	2	-	3	-	-	-	-	-	-	2	-	2
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

SYLLABUS:

UNIT I POWER FLOW STUDIES **9**

Modeling of power system components – Power flow equations – Formation of Y bus matrix – Power flow solution algorithms: Newton Raphson, Fast decoupled and DC load flow analysis – Sequential and simultaneous solution algorithms – Newton Raphson load flow study using MATLAB

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UNIT II SPARSE MATRICES 9

Sparse matrix techniques for large scale power systems – Sparsity directed optimal ordering schemes – Solution algorithms – LU factorization, bi-factorization and iterative methods

UNIT III FAULT ANALYSIS 9

Symmetrical and asymmetrical faults – Z bus formulation with mutual coupling – Short circuit analysis of large power systems using Z bus – Analysis of open circuit faults – Computer method for fault analysis using Z bus and sequence components

UNIT IV STABILITY ANALYSIS 9

Classification of power system stability – Classical model of synchronous machines and excitation system – Transient stability analysis of multi-machine systems – Eigen analysis of dynamical systems – Small signal stability analysis using digital simulator

UNIT V SECURITY ANALYSIS 9

Basic concepts – Static security analysis at control centers – Contingency analysis – Contingency selection – Cyber security initiatives in India

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. George Kusic, "Computer-Aided Power Systems Analysis", 2nd edition, CRC Press, 2009
2. Kothari D.P. and Nagrath I.J., "Power System Engineering", 3rd edition, Tata McGraw-Hill Education, 2019

REFERENCES:

1. Ranjana Sodhi, "Simulation and Analysis of Modern Power Systems", McGraw Hill Limited, 2021
2. Arrillaga J. and Arnold C.P., "Computer Analysis of Power Systems", John Wiley, 2016
3. Uma Rao K., "Computer Techniques and Models in Power Systems", I.K. International Publishing House Pvt. Limited, 2008

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21EEP05	POWER QUALITY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop a comprehensive understanding of power quality disturbances and their underlying causes in electrical power systems
- To present advanced mitigation techniques for improving and maintaining power quality in modern power networks
- To emphasize the principles and methodologies of power quality monitoring and measurement in electrical systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze power quality disturbances and standards (Analyze)

CO2: Model mitigation techniques for voltage sags and interruptions (Apply)

CO3: Apply protection methods against over voltages (Apply)

CO4: Investigate harmonic effects in power systems (Analyze)

CO5: Implement power quality measurement and monitoring techniques (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	2
CO2	2	2	1	1	1	-	-	-	-	-	-	1	-	2
CO3	2	1	1	1	1	-	-	-	-	-	-	1	-	2
CO4	2	1	-	-	-	-	-	-	-	-	-	1	-	2
CO5	2	1	1	1	1	-	-	-	-	-	-	1	-	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I POWER QUALITY AND ITS STANDARDS 9

General classes of power quality problems: Concepts of transients, short duration and long duration voltage variations, voltage imbalance, waveform distortions, frequency variations and voltage fluctuations – Power quality standards: IEEE, IEC, CBEMA and ITI curves

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

Sources of sag and interruptions – Estimating voltage sag performance – Analysis and calculation of various fault conditions – Mitigation of voltage sags – Active series compensators – Static transfer and fast transfer switches – Voltage sag study using simulation

UNIT III OVER VOLTAGES AND ITS MITIGATIONS 9

Sources of over voltages – Capacitor switching – Lightning – Mitigation of voltage swells – Surge

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arresters – Power conditioners – Lightning protection – Line arresters – Protection of transformers and cables – Ferro-resonance – Switching transients – Voltage swell study using simulation

UNIT IV HARMONICS AND ITS EFFECTS 9

Harmonic distortion – Voltage and current distortions – Power system quantities under non - sinusoidal conditions – Harmonic indices – Harmonic sources from commercial and industrial loads – System response characteristics – Effect of harmonics – Devices for controlling harmonic distortion

UNIT V POWER QUALITY MEASURING INSTRUMENTS 9

Flicker meters, disturbance analyzer, spectrum and harmonic analyzer, data chart recorders and smart power quality monitors – Basics of computer analysis tools – Intelligent system for power quality monitoring – Case study

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and H. Wayne Beaty, "Electrical Power Systems Quality", 3rd edition, Tata McGraw Hill, 2012
2. Bhim Singh, Ambrish Chandra and Kamal Al-Haddad, "Power Quality Problems and Mitigations Techniques", 2nd edition, John Wiley, 2015

REFERENCES:

1. Math H.J.Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", IEEE Press, 2011
2. Arrillaga.J., Watson.N.R. and Chen.S., "Power System Quality Assessment", 3rd edition, John Wiley and Sons Ltd., 2011
3. Beaty H. Wayne, McGranaghan and Mark, "Electrical Power Systems Quality", 3rd edition, 2012
4. https://archive.nptel.ac.in/courses/108/102/108102179/

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21EEP06	POWER SYSTEM SECURITY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop an understanding of the factors affecting power system security
- To present the concepts of state estimation, security assessment, and enhancement in power systems
- To emphasize security assessment techniques for improving power system reliability

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze power system security and reliability factors (Analyze)

CO2: Apply state estimation techniques for system monitoring (Apply)

CO3: Examine contingency and security assessment techniques (Analyze)

CO4: Implement security enhancement and optimization techniques (Apply)

CO5: Investigate advanced security assessment using modern techniques (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	2
CO2	3	1	1	-	-	-	-	-	-	-	-	1	-	2
CO3	3	2	2	1	-	-	-	-	-	-	-	1	-	2
CO4	3	2	2	1	-	-	-	-	-	-	-	1	-	2
CO5	3	2	2	1	-	-	-	-	-	-	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I BASICS OF POWER SYSTEM SECURITY 9

Factors affecting power system security – Decomposition and multilevel approach – State estimation – System monitoring using SCADA – Security assessment and security enhancement

UNIT II POWER SYSTEM STATE ESTIMATION 9

Maximum likelihood weighted least-square estimation – State estimation – Detection and identification of bad measurements – Estimation of quantities – Network observability and pseudo measurements

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UNIT III SECURITY ASSESSMENT 9

Detection of network problems – Network equivalent for external system – Network sensitivity methods – Calculation of network sensitivity factors – Fast contingency algorithms – Contingency ranking – Dynamic security indices – PMU based voltage security assessment

UNIT IV SECURITY ENHANCEMENT 9

Correcting the generator dispatch by sensitivity methods – Compensated factors – Security constrained optimization – Preventive – Emergency and restorative control through NLP and LP methods

UNIT V SECURITY TECHNIQUES 9

Voltage security assessment – Transient security assessment methods – Comparison – Case study – Power system security assessment using neural networks and machine learning techniques – SCADA

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Kothari D.P. and Nagrath I.J., "Power System Engineering", 3rd edition, Tata McGraw-Hill Education, 2019
2. Wood, A.J. and Woolenberg, "Power Generation Operation for Security", John Wiley and Sons, 2010

REFERENCES:

1. Allen J. Wood, Bruce F. Wollenberg and Gerald B. Sheble, "Power Generation, Operation and Control", 3rd edition, John Wiley and Sons, 2013
2. Venkatesh P, Manikandan B.V. and Charles Raja S., "Electrical Power Systems: Analysis, Security and Deregulation", PHI learning Pvt. Ltd., 2012
3. Leonard L. Grigsby, "Power System Stability and Control", 3rd edition, CRC Press, 2012

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET LEARN BEYOND

U21EEP07	EHVAC TRANSMISSION	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To present the characteristics and performance aspects of EHVAC transmission systems
- To examine the effects of corona, electric fields, and magnetic fields in high-voltage transmission lines
- To highlight the principles of voltage control and system performance limits in power transmission networks

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze EHVAC transmission system characteristics (Analyze)

CO2: Analyze corona effects in EHV transmission systems (Analyze)

CO3: Analyze electric and magnetic field effects of transmission lines (Analyze)

CO4: Apply voltage control techniques in EHV systems (Apply)

CO5: Analyze steady-state and transient performance limits (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	-	-	2
CO2	3	3	2	1	-	-	-	-	-	-	-	1	-	2
CO3	3	3	2	1	-	-	-	-	-	-	-	1	-	2
CO4	3	2	1	-	-	-	-	-	-	-	-	1	-	2
CO5	3	3	2	1	-	-	-	-	-	-	-	1	-	2
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

SYLLABUS:

UNIT I EHVAC TRANSMISSION SYSTEM 9

Role of EHVAC transmission – Average values of line parameters – Power handling capacity and line loss – Costs of transmission lines and equipment – Resistance of conductors – Properties of bundled conductors – Inductance of EHV line configurations – EHV AC transmission lines in India

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UNIT II CORONA EFFECTS AND RADIO INTERFERENCES 9

Power loss and corona loss – Attenuation of travelling waves due to corona loss – Generation and characteristics of audible noise – Measurement and meter of audible noise – Corona pulses – Limits for radio interference fields – Measurement of RI, RIV, and excitation function

UNIT III ELECTROSTATIC AND MAGNETIC FIELD EFFECTS 9

Electric shock and threshold currents – Calculation of electrostatic field of AC lines – Effect of high electrostatic field – Meters and measurement of electrostatic field – Magnetic field effects in three-phase and six-phase line - IEEE standard for safety levels for human exposure

UNIT IV POWER-FREQUENCY VOLTAGE CONTROL 9

Power-frequency problems – No load voltage conditions and charging currents – Voltage control – Shunt and series compensation – Static VAR compensation

UNIT V STEADY STATE AND TRANSIENT LIMITS 9

Scheme of EHV lines based on steady state and transient limits – Scheme of line insulation – EHV cables and their characteristics – Surge performance of cable systems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Begamudre R.D., "Extra High Voltage AC Transmission Engineering", New Age International Private Limited, 2011
2. Sanjay Kumar Sharma, "EHV-AC, HVDC Transmission and Distribution Engineering", S.K. Kataria & Sons, 2013

REFERENCES:

1. Subir Ray, "An Introduction to High Voltage Engineering", Prentice Hall of India Private Limited, 2013
2. RD Begamudre, "Extra High Voltage AC Transmission Engineering", New Academic Science Limited, 4th edition, 2011
3. Narain G. Hingorani and Laszlo Gyugyi, "Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems", John Willey and Sons, 2000

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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LEARN BEYOND

U21EEP08	SMART GRID TECHNOLOGIES	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop the ability to analyze smart grid architecture and its key components
- To build competence in applying computational and optimization techniques in smart grid analysis
- To foster analytical skills for evaluating renewable energy integration and smart grid operation

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze smart grid architecture and challenges (Analyze)

CO2: Investigate communication and measurement technologies (Analyze)

CO3: Apply optimization techniques for smart grid operation (Apply)

CO4: Examine power electronic converters and energy storage systems (Analyze)

CO5: Model techniques to integrate renewable energy in smart grids (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	1	-	2
CO2	3	3	2	1	-	-	-	-	-	-	-	1	-	2
CO3	3	3	2	1	2	-	-	-	-	-	-	1	-	2
CO4	3	3	2	1	-	-	-	-	-	-	-	1	-	2
CO5	3	3	2	1	-	-	-	-	-	-	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I SMART POWER GRID 9

Grid challenges – Evolution – Characteristics and benefits of smart grid – Vision and roadmap for India – Examples of smart grid projects in India, US and Europe effort – Comparison of microgrid and smart grid – Cyber controlled smart power grids - Consumer versus prosumer

UNIT II COMMUNICATION AND MEASUREMENT 9

Functions of smart grid components – Communication and measurement – Monitoring, PMU and smart meters – Demand side integration – Synchrophasor measurement – IEEE Standards, Multi agent systems technology

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UNIT III COMPUTATIONAL TOOLS 9

Decision support tools – Optimization techniques – Heuristic optimization – Evolutionary computational techniques – Adaptive Dynamic Programming (ADP) techniques – Load flow for smart grid design – Hybridizing optimization techniques

UNIT IV POWER ELECTRONICS AND ENERGY STORAGE SYSTEMS 9

Current source and voltage source converters – Shunt and series compensators with energy storage – Energy storage technologies: Batteries, flow battery, fuel cell, flywheels, superconducting magnetic energy storage systems, super capacitors and energy storage for wind power

UNIT V CASE STUDIES AND TESTBEDS 9

Demonstration projects – Advanced metering – Microgrid with renewable energy – ADP for optimal network reconfiguration in distribution automation – Case study of renewable energy integration – Testbeds and benchmark systems – Challenges and benefits of smart transmission

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Salman K. Salman, "Introduction to the Smart Grid Concepts, Technologies and Evolution", The Institution of Engineering and Technology, 2017
2. James Momoh, "Smart Grid - Fundamentals of Design and Analysis", IEEE Press, John Wiley and Sons, 2012

REFERENCES:

1. Takuro Sato, Daniel M. Kammen, Bin Duan, Muhammad Tariq, Zhenyu Zhou, Jun Wu and Solomon Abebe Asfaw, "Smart Grid Standards - Specifications, Requirements, and Technologies", John Willey and Sons, 2015
2. Stuart Borlase, "Smart Grids Advanced Technologies and Solutions", CRC Press, 2nd Edition, 2018
3. Ali Keyhani, "Design of Smart Power Grid Renewable Energy Systems", John Willey and Sons, 3rd Edition, 2019

EVALUATION PATTERN:*

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET

		Category: PEC				
L21EEP09	ADVANCED SEMICONDUCTOR DEVICES	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To develop the ability to compare the structure, operation, and characteristics of advanced power semiconductor devices
- To build analytical competence in evaluating the steady-state and switching behavior of current-controlled and voltage-controlled silicon devices
- To cultivate design skills for developing suitable gate driving, protection, and thermal management circuits for reliable operation of power semiconductor devices

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Choose appropriate power semiconductor devices for specific power electronic applications based on electrical ratings, switching characteristics, and SOA(Apply)
CO2: Examine the static and dynamic characteristics of current-controlled devices (BJT, Thyristor, GTO) under various operating conditions (Analyze)
CO3: Compare the performance of voltage-controlled devices (MOSFET, IGBT, IGCT) for different power electronic application (Analyze)
CO4: Develop suitable gate driving circuits and protection schemes for safe and efficient device operation (Apply)
CO5: Determine appropriate thermal management systems including heat sink selection and cooling techniques based on power loss calculations (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	3	-
CO2	3	3	2	2	1	-	-	-	-	-	-	1	3	-
CO3	3	3	2	2	-	-	-	-	-	-	-	1	3	-
CO4	3	2	1	1	1	-	-	-	-	-	-	1	3	-
CO5	3	2	1	1	-	-	1	-	-	-	-	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I POWER SEMICONDUCTOR DEVICES 9

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Power diodes - Types, steady state and switching characteristics – rating. Silicon Carbide: Features, Demonstration and Physical Properties - Unipolar and Bipolar Diodes- GaN Technology Overview.

UNIT II CURRENT CONTROLLED DEVICES 9

Power BJT's – Construction, static and switching characteristics, Negative temperature coefficient and second breakdown; Thyristors: Construction, working, static and transient characteristics, types, series and parallel operation – comparison of BJT and Thyristor – GTO – Construction, static and switching characteristics – Applications - GaN Transistor -Electrical Characteristics

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UNIT III VOLTAGE CONTROLLED DEVICES 9

Principle of voltage controlled devices – Power MOSFETs, IGBTs and IGCT – construction, operation, types, static and switching characteristics– Intelligent power modules- study of modules like APTGT100TL170G, MSCSM70TAM05TPAG. Integrated gate commutated thyristor (IGCT) – Applications

UNIT IV DEVICE SELECTION, DRIVING AND PROTECTING CIRCUITS 9

Device selection strategy – On-state and switching losses – EMI due to switching. Necessity of isolation, pulse transformer, optocoupler – Gate drive integrated circuit: Study of Driver IC – SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubber circuit

UNIT V THERMAL PROTECTION 9

Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapors – phase cooling; Guidance for heat sink selection – heat sink types and design – Mounting types –Thermal resistance and impedance – Electrical analogy of thermal components – Switching loss calculation for power device

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", Pearson, 4th edition, 10th Impression 2021.
2. Ned Mohan, T.M.Undeland and W.P.Robbins, "Power Electronics: converters, Application and design", 3rd edition Wiley, 2007

REFERENCES:

1. Sunenobu Kimoto and James A. Cooper, Fundamentals of Silicon Carbide Technology: Growth, Characterization, Devices, and Applications, 1st edition., 2014 John Wiley & Sons Singapore Pvt Ltd.
2. Alex Lidow, Johan Strydom, Michael de Rooij, David Reusch, GaN Transistors for Efficient Power Conversion, 2nd edition, Wiley, 2015
3. Biswanath Paul, Power Electronics, Universities Press 2019

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET
LEARN BEYOND

U21EEP10	SMPS AND UPS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To understand the concepts of switching regulators and SMPS converters.
- To understand the concepts of resonant converters and PWM techniques for inverter circuits
- To acquire knowledge on UPS and filters

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Examine the steady-state behavior and state-space models of DC–DC converters such as Buck, Boost, Buck–Boost, and Cuk converters (Analyze)

CO2 Compare the operation and control of switched mode power converters including flyback, forward, push-pull, and bridge converters (Analyze)

CO3: Apply resonant switching techniques (ZVS, ZCS) in the design of resonant converters and DC-link inverters (Apply)

CO4: Make use of PWM techniques such as SPWM and SVPWM for single-phase and three-phase DC–AC converters and multilevel inverters (Apply)

CO5: Investigate the operation of UPS systems and various power filters used for power quality improvement (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	1	3	-
CO2	3	3	2	2	1	-	-	-	-	-	-	1	3	-
CO3	3	2	1	1	1	-	-	-	-	-	-	1	3	-
CO4	3	2	1	1	2	-	-	-	-	-	-	1	3	-
CO5	3	2	1	1	-	1	1	-	-	-	-	1	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I DC-DC CONVERTERS 9

Principles of step down and step up converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters

UNIT II SWITCHED MODE POWER CONVERTERS 9

Analysis of fly back, forward, push pull, Luo, half bridge and full bridge converters - Control circuits and PWM techniques

UNIT III RESONANT CONVERTERS 9

Resonant switch- Load resonant converters - ZVS, Clamped voltage topologies – DC link inverters with Zero Voltage Switching – ZCS – Series and parallel Resonant inverters - Applications

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UNIT IV DC-AC CONVERTERS 9

Single phase and three phase inverters, Voltage control – Sine PWM, SVPWM and PSPWM techniques – Harmonic elimination techniques - Multilevel inverters - Types: Diode clamped, Flying capacitor and Cascaded – Applications

UNIT V UPS AND FILTERS 9

Power line disturbances - Power conditioners – UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Simon Ang, Alejandro Oliva," Power-Switching Converters", 3rd edition, CRC Press, 2010
2. Kjeld Thorborg, "Power Electronics – In theory and Practice", Overseas Press, 1st Indian edition, 2005

REFERENCES:

1. Erickson, Robert W, "Fundamentals of Power Electronics", Springer, 2nd edition, 2010
2. M.H. Rashid, "Power Electronics circuits, devices and applications" 3rd edition, Prentice Hall of India, New Delhi, 2007
3. P.S.Bimbra, "Power Electronics", Khanna Publishers, 11th edition, 2003
4. https://archive.nptel.ac.in/courses/108/108/108108036/

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET
LEARN BEYOND

		Category: PEC				
U21EEP11	ELECTRICAL MACHINE DESIGN	L	T	P	J	C
		3	0	0	0	3

PRE--REQUISITES:

- NIL

COURSE OBJECTIVES:

- To develop the ability to estimate the main dimensions and winding parameters of DC machines and transformers
- To build competence in evaluating the stator and rotor design of induction and synchronous machines based on performance requirements
- To foster the capability to interpret design solutions for special electrical machines

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Determine the DC machines main dimensions, armature parameters, and predicting operating characteristics from design data (Apply)

CO2: Examine single-phase and three-phase transformers including core, windings, cooling, and performance parameters (Analyze)

CO3: Analyze stator and rotor parameters of induction motors and estimate their operating characteristics (Analyze)

CO4: Compare the salient pole and turbo alternators based on output equations and performance constraints (Analyze)

CO5: Choose special electrical machines such as BLDC, PMSM, and SRM for specific application requirements (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	1	1	-	-	-	-	1	2	-
CO2	3	3	3	3	-	1	1	-	-	-	-	1	2	-
CO3	3	3	2	2	-	1	1	-	-	-	-	1	2	-
CO4	3	3	2	2	-	1	1	-	-	-	-	1	2	-
CO5	3	3	3	3	-	1	1	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I DESIGN OF DC MACHINES 9

Construction - Output Equations – Main dimensions – Choice of specific loadings – Selection of number of poles – Design of armature – Design of commutator and brushes – Evaluation of operating characteristics from design data

UNIT II DESIGN OF TRANSFORMERS 9

Types of transformer - KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of no load current – Temperature rise in transformers – Design of tank and cooling tubes of transformers

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UNIT III DESIGN OF INDUCTION MACHINES 9

Construction - Output equation – Main dimensions – Design of squirrel cage rotor and wound rotor – Magnetic leakage calculations – Operating characteristics: Magnetizing current - Short circuit current – Circle diagram

UNIT IV DESIGN OF SYNCHRONOUS MACHINES 9

Output equations – Choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor – Design of damper winding – Determination of full load field MMF – Design of field winding – Design of turbo alternators

UNIT V DESIGN OF SPECIAL MACHINES 9

Constructional features: BLDC & PMBLDC motors, PMSM and SRM – Output equation – Main Dimensions – Design of BLDC and permanent magnet brushless DC motor – Design of switched reluctance motor – Design of permanent magnet synchronous motor - Application based control designing and simulation

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Sawhney A.K., "A Course in Electrical Machine Design", Dhanpat Rai & Sons, New Delhi, 1984
2. Deshpande M.V., "Design and Testing of Electrical Machine Design" Wheeler Publications, 2010
3. Sen S.K., "Principles of Electrical Machine Designs with Computer Programmes", Oxford and IBH Publishing Co.Pvt.Ltd, New Delhi, 1987

REFERENCES:

1. M.G.Say, "Performance and Design of Alternating Current Machines" 3rd edition, CBS Publishers, 2002
2. A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
3. R.K.Agarwal " Principles of Electrical Machine Design" Esskay Publications, Delhi, 2002.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET

U21EEP12	HVDC TRANSMISSION	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- NIL

COURSE OBJECTIVES:

- To develop the ability to identify the principles, configurations, and applications of HVDC transmission systems
- To build analytical competence in examining the operation, control strategies, and converter technologies used in HVDC systems
- To foster understanding of reactive power management, harmonic mitigation techniques, and power flow in HVDC networks

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Identify the principles, configurations, and applications of DC and HVDC transmission systems including MTDC networks (Apply)

CO2: Examine the operation and performance of line-commutated and voltage source converter (VSC) based HVDC converters (Analyze)

CO3: Distinguish control strategies of HVDC systems including firing angle control, current control, extinction angle control, and VSC control schemes (Analyze)

CO4: Analyze the design considerations for reactive power compensation and harmonic filtering in HVDC systems (Analyze)

CO5: Utilize power flow analysis techniques to HVDC systems under steady-state operating conditions (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO2	3	3	2	2	1	-	-	-	-	-	-	1	2	-
CO3	3	3	2	2	1	-	-	-	-	-	-	1	2	-
CO4	3	3	2	2	1	-	1	-	-	-	-	1	2	-
CO5	3	2	1	1	-	-	1	-	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

SYLLABUS:

UNIT I DC POWER TRANSMISSION TECHNOLOGY 9

Comparison of AC and DC transmission – DC transmission – Applications and Description – Planning for HVDC transmission – Modern trends in HVDC technology – Types and applications of Multi Terminal DC (MTDC) systems.

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UNIT II HVDC CONVERTERS 9

Line commutated converter – Analysis of Graetz circuit with and without overlap – Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of 12 pulse converters – Analysis of VSC topologies and firing schemes.

UNIT III CONTROL OF HVDC SYSTEMS 9

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

UNIT IV REACTIVE POWER AND HARMONIC CONTROL 9

Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters.

UNIT V POWER FLOW ANALYSIS 9

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – Case study.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. K. R. Padiyar, "HVDC Power Transmission System", New Academic Science Limited, New Delhi, 2nd edition, 2017
2. S. Kamakshaiah and V. Kamaraju, "HVDC Transmission", McGraw-Hill Education Private Limited, 2nd edition, 2020

REFERENCES:

1. Dragan Jovcic, "High Voltage Direct Current Transmission: Converters, Systems and DC Grids", John Wiley and Sons, 2nd edition, 2019
2. Chan-Ki Kim, Vijay K. Sood, "HVDC Transmission: Power Conversion Application in Power Systems", John Wiley and Sons, 2009

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

. *Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET

U21EEP13	ADVANCED ELECTRIC MOTORS AND CONTROL	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- NIL

COURSE OBJECTIVES:

- To provide knowledge of special electrical machines and their operating principles
- To present control methods used in special machine drives
- To introduce application and selection aspects of special motor drives

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Examine the operation and performance of synchronous reluctance motors (Analyze)

CO2: Analyze the characteristics and control of permanent magnet synchronous motors (Analyze)

CO3: Design the control circuits for switched reluctance motors (Apply)

CO4: Investigate the performance of BLDC motors with reference to efficiency standards (Analyze)

CO5: Analyze the topology and control methods of axial flux machines (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	1	-	-	-	-	-	-	1	3	-
CO2	3	3	2	-	2	-	-	-	-	-	-	1	3	-
CO3	3	2	2	-	2	-	-	-	-	-	-	1	3	-
CO4	3	3	2	-	2	-	-	-	-	-	-	1	3	-
CO5	3	3	2	-	2	-	-	-	-	-	-	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I SYNCHRONOUS RELUCTANCE MOTOR 9

Constructional features – Principle of operation – Characteristics – Open loop and closed loop control – Microprocessor based control – Sensor less control – Applications

UNIT II PERMANENT MAGNET SYNCHRONOUS MOTOR 9

Construction – Principle of operation – EMF, power input and torque expressions – Power controllers – Torque speed characteristics – Self-control – Vector control – Current control schemes – Sensor less control

UNIT III SWITCHED RELUCTANCE MOTOR 9

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Constructional features – Modes of excitation – Torque prediction – Characteristics – Steady state performance prediction – Power controllers – Control of SRM drive – Sensor less operation of SRM

UNIT IV BLDC MOTOR 9

PMBLDC: Constructional features – Types – Principle of operation – Drive schemes – Converter topologies – Characteristics

UNIT V AXIAL FLUX MOTOR AND ENERGY EFFICIENCY STANDARD 9

Axial Flux motor – types of axial flux motor – Principle of operation – AFPM control method – Characteristics of PM materials – Control of trapezoidal AFPM – Solid state converter – Standard motor efficiency – Efficiency evaluation technique – Motor efficiency labelling

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Vedam Subramanyam, "Electric Drives - Concepts and Applications", 2nd edition, McGraw Hill, 2010
2. Jacek F. Gieras Rong-Jie Wang Maarten J. Kamper., "Axial Flux Permanent Magnet Brushless Machines",2nd edition, Springer, 2008

REFERENCES:

1. Diane Lobsiger ., "Electrical Control for Machines" 7th edition Cengage Learning, 2015
2. Ned Mohan, "Advanced Electric Drives: Analysis, Control and Modeling using MATLAB / Simulink", Wiley, 2014
3. https://en.nanotec.com/knowledge-base/stepper-motor-animation

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET
LEARN BEYOND

U21EEP14	FLEXIBLE AC TRANSMISSION SYSTEMS	Category: PE				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

- To provide knowledge of reactive power control and power flow management in transmission systems.
- To present the operating principles of SVC, TCSC and STATCOM devices
- To introduce advanced FACTS controllers for improving power system stability and performance

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze power flow control mechanisms in transmission systems (Analyze)

CO2: Model the performance and application of static VAR compensators (Apply)

CO3: Examine the operation and impact of thyristor controlled series capacitors (Analyze)

CO4: Investigate the working and stability improvement using STATCOM devices (Analyze)

CO5: Design advanced FACTS controllers for enhancing power system stability (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	-	-	-	-	-	-	1	3	2
CO2	3	2	2	2	2	-	-	-	-	-	-	1	3	2
CO3	3	2	1	1	1	-	-	-	-	-	-	1	3	2
CO4	3	2	1	2	2	-	-	-	-	-	-	1	3	2
CO5	3	2	1	2	2	-	-	-	-	-	-	1	3	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I INTRODUCTION 9

Real and reactive power control in electrical power transmission lines – Load and system compensation – Uncompensated transmission line – Shunt and series compensation.

UNIT II STATIC VAR COMPESATOR (SVC) AND APPLICATIONS 9

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator – Modelling of SVC for power flow and fast transient stability

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UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS 9

Operation of TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for power flow and stability studies – Applications: Improvement of the system stability limit – Enhancement of system damping.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics – Applications: Steady state power transfer – Enhancement of transient stability – Prevention of voltage instability – SSSC – Operation of SSSC – Control of power flow - Dynamic voltage restorer (DVR).

UNIT V ADVANCED FACTS CONTROLLERS 9

Interline DVR (IDVR) – Unified Power flow controller (UPFC) – Interline power flow controller (IPFC) – Unified power quality conditioner (UPQC).

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Joe H. Chow, Juan J. Sanchez-Gasca, "Power System Modeling, Computation, and Control", Jon Wiley & Sons Ltd., 2020.
2. K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 3rd edition, 2021

REFERENCES:

1. V.K.Sood, HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004 , Kluwer Academic Publishers, 2004.
2. Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, "Flexible AC Transmission System: Modelling and Control" Springer, 2012.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET
LEARN BEYOND

U21EEP15	ANALYSIS OF INVERTERS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- NIL

COURSE OBJECTIVES:

- To provide knowledge of single phase and three phase inverter topology
- To present modulation and control techniques used in inverter systems
- To introduce modern inverter configurations and application oriented design aspects

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1 Analyze the operation and performance of single phase bridge inverters (Analyze)

CO2 Examine various modulation techniques used in three phase inverters (Analyze)

CO3 Select suitable current source inverters for specific applications (Apply)

CO4 Design appropriate multilevel inverter configurations for different load conditions (Apply)

CO5 Investigate the performance characteristics of resonant inverters for high frequency applications (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	1	1	-	-	-	-	1	3	-
CO2	3	3	2	1	-	1	1	-	-	-	-	1	3	-
CO3	3	3	3	2	-	1	1	-	-	-	-	1	3	-
CO4	3	2	2	1	-	1	1	-	-	-	-	1	3	-
CO5	3	3	2	2	-	1	1	-	-	-	-	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I SINGLE PHASE INVERTERS 9

Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – Harmonic elimination techniques – Forced commutated Thyristor inverters

UNIT II THREE PHASE VOLTAGE SOURCE INVERTERS 9

180 degree and 120 degree mode inverters with star and delta connected loads – Voltage control of three phase inverters: single pulse, multi pulse, sinusoidal, space vector modulation techniques

UNIT III CURRENT SOURCE INVERTERS 9

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Operation of six-step thyristor inverter – Operating modes – Load commutated inverters – Auto sequential current source inverter (ASCI) – Current pulsations – Comparison of current source and voltage source inverters

UNIT IV MULTILEVEL INVERTERS 9

Multilevel concept – Diode clamped – Flying capacitor – Cascade type multilevel inverters - Comparison of multilevel inverters - Application of multilevel inverters

UNIT V RESONANT INVERTERS 9

Series and parallel resonant inverters - Voltage control of resonant inverters – Class E resonant inverter – Resonant DC link inverters

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, 3rd edition, New Delhi, 2004
2. Jai P. Agrawal, "Power Electronics Systems", Pearson Education, Second Edition, 2002

REFERENCES:

1. Reissland, M.U, "Electrical Measurements: Fundamentals, Concepts, Applications" 1st edition, New Age International (P) Ltd., 2010
2. Bimal K.Bose "Modern Power Electronics and AC Drives", Pearson Education, 2nd edition, 2003
3. P.S.Bimbra, "Power Electronics", Khanna Publishers, 11th edition, 2003
4. https://nptel.ac.in/courses/108102157

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="2">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (100 Marks)</th><th colspan="2">Assessment II (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Project / MCQ</td><td>Written Test</td><td></td><td></td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td>200</td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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LEARN BEYOND

U2IEEP16	SIMULATION OF POWER CONVERTERS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- NIL

COURSE OBJECTIVES:

- To develop the ability to model and simulate electrical circuits and power electronic devices using MATLAB/Simulink and Simscape environments
- To build competence in analyzing the operation and performance of power electronic converters through simulation techniques
- To foster the capability to evaluate switching strategies and control methods for improving converter performance

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply MATLAB/Simulink tools to model and simulate electrical circuits and power electronic devices (Apply)
CO2: Examine the performance of single-phase and three-phase AC–DC converters with different loads using simulation techniques (Analyze)
CO3: Make use of PWM generation and simulation techniques to study the operation and harmonic performance of DC–AC inverters (Apply)
CO4: Investigate the operating characteristics of DC–DC converters such as Buck, Boost, Buck-Boost, SEPIC, and Luo converters under CCM and DCM conditions (Analyze)
CO5: Implement simulation methods to study the operation of AC–AC converters including voltage regulators and cycloconverters using appropriate control techniques (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	3	-	-	1	-	-	-	1	3	-
CO2	3	2	1	-	2	-	-	1	-	-	-	1	3	-
CO3	3	2	2	-	2	-	-	1	-	-	-	1	3	-
CO4	3	2	1	-	2	-	-	1	-	-	-	1	3	-
CO5	3	2	2	-	2	-	-	1	-	-	-	1	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I INTERACTIVE MODELLING 9

Introduction – M-File function – Debugging M-Files – Simulink library browser – Simscape – Circuit elements – DC and AC analysis – Steady state analysis of a linear circuit – Example: RLC, Diode, SCR, MOSFET, IGBT

UNIT II AC TO DC CONVERTER 9

Simulation : single and three phase full wave bridge rectifier using Diode and SCR – R and RLE load analysis – Switching technique using FLC

UNIT III DC TO AC CONVERTER 9

Simulation, Voltage analysis, THD analysis : Three phase 180 degree mode and 120 degree mode Inverter – PWM generation using M.File – Soft switching techniques

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UNIT IV DC TO DC CONVERTER 9

Simulation – Buck converter analysis in CCM and DCM – Boost converter analysis in CCM and DCM – Buck Boost converter analysis in CCM and DCM – SEPIC converter – Luo converter – Switching techniques using soft computing

UNIT V AC TO AC CONVERTER 9

Simulation of three phase three wire AC voltage regulator with star and delta connected load –Single phase and three cyclo converter – Simulation of FLC based cyclo converter

Contact Periods:

Lecture: 45 Periods Tutorial: - Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Narayanaswamy P R Iyer, "Power Electronic converters interactive modelling using Simulink", CRC Press, 2018.
2. L.Ashok kumar, A.kalaiarasi, Y.Uma Maheswari, "Power Electronics with MATLAB", Cambridge University Press, 2018.

REFERENCES:

1. Muhammad H. Rashid, "Power Electronics Devices, Circuits and Applications", 4th edition, Peasrson, 2017.
2. https://in.mathworks.com/solutions/power-electronics-control.html

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

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KPRIET

U21EEP17	BATTERY MANAGEMENT SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To establish a strong foundation in battery technologies and energy storage principles
- To develop comprehensive understanding of battery management system architecture, sensing, and protection techniques
- To enable the application of modeling, estimation, and design concepts in battery management systems for electric vehicle applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Calculate battery voltage, capacity, energy and power for given configurations accurately (Apply)

CO2: Determine BMS functional requirements including sensing, protection and thermal management for applications (Apply)

CO3: Implement SOC and SOH estimation techniques using voltage-based and model-based methods effectively (Apply)

CO4: Simulate equivalent-circuit battery models and vehicle range under defined operating parameters (Apply)

CO5: Design battery management systems considering balancing strategies, load variations and life constraints (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO2	3	2	2	1	-	-	-	-	-	-	-	1	2	-
CO3	3	2	1	2	1	-	-	-	-	-	-	1	2	-
CO4	3	2	2	2	3	-	-	-	-	-	-	1	2	-
CO5	3	2	2	2	1	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I BASIC CONCEPTS OF BMS 9

Introduction to Battery Management System – Cells & amp – Batteries – Nominal voltage and capacity – C rate – Energy and power – Cells in series – Cells in parallel – Electrochemical and lithium-ion cells – Flow Battery – Rechargeable cell

UNIT II BATTERY MANAGEMENT SYSTEM 9

BMS functionality – Sensing unit – High-voltage contactor control – Isolation sensing and thermal control – Protection and interface – Energy and power estimation

UNIT III SENSING AND CONTROL OF BATTERY MANAGEMENT SYSTEM 9

Battery state of charge estimation (SOC) – Voltage-based method – Model-based state estimation – Battery Health Estimation – Lithium-ion aging: Negative electrode – Positive electrode – Cell balancing – Causes of imbalance – Circuits for balancing

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UNIT IV MODELLING AND SIMULATION 9

Equivalent-circuit models (ECMs) – Physics-based models (PBMs) – Empirical modelling approach – Physics-based modelling approach – Vehicle range calculations – Simulation of battery packs

UNIT V DESIGN PRINCIPLES OF BMS 9

Design principles – Effect of distance – Load and force on battery life – Energy balancing with multi-battery system

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Sebastein E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamental, Theory and Design", 1st edition, CRC Publication, 2005
2. Shedon S. Williamson, "Energy Management Strategies for Electric and Plugin Hybrid Electric Vehicles", 1st edition, Springer, 2013

REFERENCES:

1. Plett, Gregory L. Battery management systems, Volume I: Battery modeling. Artech House, 2015.
2. Plett, Gregory L. Battery management systems, Volume II: Equivalent-circuit methods. Artech House, 2015.
3. Davide Andrea," Battery Management Systems for Large Lithium-ion Battery Packs" Artech House, 2010

EVALUATION PATTERN:

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KPRIET
LEARN BEYOND

U21EEP18	ELECTRIC VEHICLES AND DYNAMICS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To establish core concepts of vehicle mechanics and performance characteristics in electric vehicles
- To develop in-depth knowledge of drivetrain components and dynamic behavior of vehicles
- To foster analytical capability in applying vehicle motion and control principles for electric vehicle studies

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Compute vehicle performance parameters for given operating conditions accurately (Apply)

CO2: Determine tractive force and power requirements for standard drive cycles (Apply)

CO3: Select suitable drivetrain components for specified vehicle requirements (Apply)

CO4: Analyze vehicle dynamic performance under defined motion conditions (Analyze)

CO5: Implement cruise control strategies for defined operating scenarios (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO3	3	2	2	1	-	-	-	-	-	-	-	1	2	-
CO4	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO5	3	2	2	1	-	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I CONVENTIONAL VEHICLES 9

Overview – Basics of vehicle performance – Vehicle power source characterization – Transmission characteristics and mathematical models

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UNIT II MECHANICS OF ELECTRIC VEHICLES 9

Fundamentals of vehicle mechanics – Tractive force, power and energy requirements for standard drive cycles of HEVs – Motor torque, Power rating and battery capacity – Power train components and sizing, gears, clutches, transmission and brakes

UNIT III ELECTRIC VEHICLE DRIVE TRAIN 9

Transmission configuration – Components: gears, clutch, brakes, regenerative braking, motor sizing Basic concept of electric traction – Various drive train topologies – Power flow control – Fuel efficiency analysis

UNIT IV DYNAMIC PERFORMANCE OF VEHICLE 9

Dynamic axle loads – Equations of motion – Vehicle performance – Power limited and traction limited acceleration – Braking performance – Brake proportioning – Braking efficiency

UNIT V ADAPTIVE CRUISE CONTROL 9

Introduction – Control architecture – String stability – Autonomous control with constant spacing and time- gap policy – Transitional trajectories – Cruise control – Upper and lower-level cruise control

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Iqbal Hussain, "Electric and Hybrid Vehicles-Design Fundamentals", 2nd edition, CRC Press, 2011
2. Mehrdad Ehsani, Yimin Gao and Ali Emadi, "Modern Electric, Hybrid and Fuel Cell Vehicles: Fundamentals" 5th edition, Prentice Hall India, 2010

REFERENCES:

1. Rajesh Rajamani., "Vehicle Dynamics and Control", 2nd edition, Springer, 2012
2. Davide Andrea, "Battery Management Systems for Large Lithium - Ion Battery Packs", Artech House, 2010
3. Hui Zhang, Dongpu Cao and Haiping Du, "Modeling, Dynamics and Control of Electrified Vehicles", Elsevier Science, 2017

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="3">End Semester Examinations</th></tr>
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LEARN BEYOND

U21EEP19	EV STANDARDS AND TESTING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop awareness of national and international standards governing electric vehicles and charging systems
- To gain comprehensive knowledge of safety regulations, testing procedures, and certification requirements for EV components and systems
- To enable the application of compliance and testing methodologies to assess electric vehicle performance, safety, and regulatory conformity

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply EV standards to evaluate vehicle compliance for given specifications (Apply)

CO2: Determine battery and charging standards for specified electric vehicle applications (Apply)

CO3: Implement regulatory requirements in electric vehicle system evaluation (Apply)

CO4: Conduct electric vehicle testing procedures under defined test conditions (Apply)

CO5: Apply government policies to assess EV deployment feasibility (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	-	-	2	2	-
CO2	3	2	1	1	-	-	-	1	-	-	-	2	2	-
CO3	3	2	2	1	-	-	-	-	-	-	-	2	2	-
CO4	3	2	1	2	-	-	-	-	-	-	-	2	2	-
CO5	3	2	1	1	-	-	-	1	-	-	-	2	2	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

SYLLABUS:

UNIT I EV STANDARDS **9**

Electric power train vehicles – Construction and functional safety requirements – Measurement of electrical energy consumption – Measurement of range – Measurement of net power and maximum 30-minute power – Central Motor Vehicle Rules (CMVR) type approval for electric power train vehicles

UNIT II BATTERY TRACTION AND CHARGING STANDARDS **9**

Battery operated vehicles – Safety requirements of traction batteries – Charger standards – Electric vehicle conductive AC and DC charging system – Public EV charging standards – Charging for high voltage EVs – Home charging standards

UNIT III EV REGULATIONS **9**

EV ecosystem – Vehicle safety standard : AIS 038 – Battery safety standard : AIS 408 – M & N category standard : AIS 038 – L category standard : AIS156

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UNIT IV VEHICLE TESTING 9

Energy consumption by engine cooling fan, air conditioning and brake compressors – Hydraulic pumps power consumption, ABS energy consumption – Test route selection – Vehicle speed test – Cargo, weight and driver selection – Tested data, findings and calculations – Test on rough terrain – Pot hole with laden and unladen conditions

UNIT V GOVERNMENT POLICIES 9

National Electric Mobility Mission Plan 2020 (NEMMP2020) – Faster Adoption and Manufacture of Hybrid and Electric Vehicles – FAME, Niti Aayog Report on Transforming Mobility

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. John G. Hayes and G. Abas Goodarzi, "Electric Power Train: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles", Wiley, 2018
2. Course W.H. and Anglin D.L., "Automotive Mechanics", TMG publishing company, 2017

REFERENCES:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd edition, CRC press, 2010
2. Automotive Handbook, Bosch - Website: www.mainindia.com/Draft, AIS standards.asp
3. DHI Centre of Excellence for E-Mobility, Standards - Website: https://emobility.araiindia.com/standards.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
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Total				40	60
				100	

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U21EEP20	HYBRID ELECTRIC VEHICLES	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To establish foundational concepts of hybrid electric vehicle fundamentals, architectures, and classifications
- To gain in-depth knowledge of hybrid propulsion systems, energy storage devices, and power flow control strategies
- To foster analytical and design competence in modeling, performance evaluation, and energy management of hybrid electric vehicle systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Calculate hybrid vehicle performance parameters for given operating conditions (Apply)

CO2: Determine suitable hybrid architectures for specified vehicle requirements (Apply)

CO3: Implement power flow control strategies under defined driving conditions (Apply)
CO4: Simulate hybrid vehicle energy models using specified drive cycles (Apply)
CO5: Design energy management strategies for given hybrid system constraints (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO4	3	2	1	2	3	-	-	-	-	-	-	1	2	-
CO5	3	2	3	1	-	-	-	-	-	-	-	1	2	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

SYLLABUS:

UNIT I FUNDAMENTALS OF VEHICLES 9

Vehicle movement – Vehicle resistance – Dynamic equation – Power train tractive effort and vehicle speed -- Characteristics: vehicle power plant and transmission – Vehicle performance

UNIT II ARCHITECTURES HYBRID ELECTRIC VEHICLE 9

Classification of HEV – Concept of hybrid electric drive trains – Architectures of HEV's drive train – Operation pattern – Control strategies

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UNIT III ELECTRIC PROPULSION SYSTEM 9

Induction Motor: Voltage/frequency control, field-oriented control – Permanent Magnet Brushless DC Motor: Sensor less techniques – Sensor controlled techniques – Switched Reluctance Motor drive: Sensor less Control

UNIT IV HEV MODELLING 9

Modelling for energy analysis – Vehicle level energy analysis: equations of motions, vehicle energy balance, driving cycles – Power train components

UNIT V TEST FOR HYBRID ELECTRIC VEHICLES 9

Hybrid Electric Vehicle Test (M and N category), Test for Hybrid Electric System Intended for Retro-fitment on Vehicles of M and N Category (GVW < 3500 kg)

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project: – Periods

Total: 45 Periods

TEXT BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Sebastein E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles - Fundamental, Theory and Design", 1st edition, CRC Publication, 2005
2. Chris Mi and Abul Masrur M., "Hybrid Electric Vehicle Principles and Applications with Practical Perspectives", 1st edition, Wiley and Sons, 2018

REFERENCES:

1. Simona Onori, Lorenzo Serrao and Giorgio Rizzoni, "Hybrid Electric Vehicles - Energy Management Strategies", 1st edition, Springer, 2016
2. R. Krishnan, "Electric Motor Drives Modeling, Analysis and Control", 1st edition, Prentice Hall, 2001
3. Narayanaswamy P. and Iyer R., "Power Electronic Converters Interactive Modelling using Simulink", CRC Press, 2018

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
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Total				40	60
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U21EEP21	ELECTRIC VEHICLES IN SMART GRID	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To establish a strong knowledge base in vehicle electrification and the impact of charging strategies on power systems
- To develop understanding of the influence of electric vehicles on power system operation and stability
- To enable the application of frequency control and voltage support services using electric vehicles

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Determine EV charging load impacts on power systems under specified conditions (Apply)
CO2: Calculate EV penetration effects on grid performance for defined demand scenarios (Apply)
CO3: Implement vehicle-to-grid control strategies using given system parameters (Apply)
CO4: Apply communication protocols for EV integration in smart grid environments (Apply)
CO5: Design EV charging infrastructure for specified microgrid conditions (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO2	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	1	-	-	-	-	-	-	-	-	-	2
CO4	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO5	3	2	1	1	-	-	-	-	-	-	-	-	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I IMPACT OF CHARGING SYSTEM 9

EV charging options and infrastructure – Impact of charging strategies – Energy, economic and environmental considerations – Effect of EV charging on generation and load profile – Smart charging technologies – Impact on investment

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UNIT II INFLUENCE OF EVS ON POWER SYSTEM 9

Identification of EV demand – EV penetration level for different scenarios – Classification based on penetration level – EV impacts on system demand: dumb charging, multiple tariff charging, smart charging

UNIT III FREQUENCY CONTROL RESERVES & VOLTAGE SUPPORT FROM EVS 9

Power system ancillary services – Electric vehicles to support wind power integration – Electric vehicle as frequency control reserves and tertiary reserves – Voltage support and electric vehicle integration – Properties of frequency regulation reserves – Control strategies for EVs to support frequency regulation

UNIT IV ICT SOLUTIONS TO SUPPORT EV DEPLOYMENT 9

Architecture and model of smart grid – ICT role in smart grid – Smart metering, information and communication models – Functional and logical models – Technology and solution for smart grid: interoperability – Communication technologies

UNIT V EV CHARGING FACILITY PLANNING 9

Energy generation scheduling – Different power sources – Fluctuant electricity – Centralized charging schemes – Decentralized charging schemes – Energy storage integration into Microgrid – Design of V2G Aggregator

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Sumedha Rajakaruna, Farhad Shahnia, Arindam Ghosh, "Plug In Electric Vehicles in Smart Grids", 2nd edition Springer Nature, 2015.
2. Junwei Lu, Jahangir Hossain, "Vehicle-to-Grid: Linking electric vehicles to the smart grid", Institution of Engineering and Technology, 2015.

REFERENCES:

1. Wanrong Tang , Ying Jun (Angela) Zhang, " Optimal Charging Control of Electric Vehicles in Smart Grids ", Springer Nature, 2017.
2. Crouse W.H, Anglin D.L, "Automotive Transmission and Power Train construction", McGraw Hill, 2000.
3. Harald Naunheimer , Bernd Bertsche , Joachim Ryborz , Wolfgang Novak "Automotive Transmission: Fundamentals, Selection, Design and Application", 2nd Edition, Springer, 2011

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET
LEARN BEYOND

U2' EEP22	AUTOMOTIVE TRANSMISSION	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

Nil

COURSE OBJECTIVES:

- To develop an understanding of the construction and working principles of clutch and gearbox systems
- To gain conceptual knowledge of hydrodynamic and hydrostatic transmission systems
- To enable the application of automotive transmission principles in system analysis and design

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Use the fundamentals of automotive transmission systems to solve engineering problems (Apply)

CO2: Demonstrate the construction and working principles of clutch and gearbox systems in practical applications (Apply)

CO3: mplement the principles of hydrodynamic transmission systems to evaluate performance (Apply)

CO4: Apply the principles of hydrostatic transmission systems to determine the performance characteristics (Apply)

CO5: Utilize automotive transmission principles in electric vehicle applications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	1	2	-
CO2	3	2	3	1	-	-	-	-	-	-	-	1	2	-
CO3	3	2	3	1	-	-	-	-	-	-	-	1	2	-
CO4	3	2	3	1	-	-	-	-	-	-	-	1	2	-
CO5	3	3	3	1	-	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I FUNDAMENTALS OF TRANSMISSION 9

Tractive effort – Resistance to motion of a vehicle – Requirements – Classification – Single, two and four-wheel drive systems – Multi axle drives, chain, shaft and electric drives – Different transmissions in car, and transport vehicles

UNIT II CLUTCH AND GEAR BOX 9

Requirement of Transmission system – Different types of clutches: Principle – construction and operation of friction clutches – Performance of automobile – Tractive effort and acceleration – Determination of gear ratios – Three speed and four speed gear boxes

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UNIT III HYDRODYNAMIC TRANSMISSION 9

Fluid coupling – Principle and constructional details – Torque capacity – Performance characteristics – Reduction of drag torque in fluid coupling – Torque converter – Principle and constructional details – Performance characteristics – Multistage torque converters and polyphase torque converters

UNIT IV HYDROSTATIC TRANSMISSION 9

Principle, types, advantages, limitations – Comparison of hydrostatic drive with hydrodynamic drive – Construction and working of typical Janny hydrostatic drive – Performance Characteristics

UNIT V APPLICATIONS OF AUTOMOTIVE TRANSMISSION 9

Chevrolet turbo glide transmission – Four speed longitudinally mounted automatic transmission – Power glide transmission – Continuously Variable Transmission – Toyota "ECT-i" automatic transmission with intelligent electronic control system – Hydraulic actuation system, Electrified Transmission Technology for HEVs/PHEVs/EVs

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Devaradjane G. and Kumaresan M., "Automobile Engineering", AMK Publishers, 2013
2. Gill P.S., "Automobile Engineering", S K Kataria & Sons, 2014

REFERENCES:

1. Kirk T. Van Gelder, CDX Automotive, "Fundamentals of Automotive Technology: Principles and Practice", Jones & Bartlett Publishers, 2013
2. Chau, K. T., "Electric Vehicle Machines and Drives: Design, Analysis and Application", Wiley-IEEE, 2015
3. Heinz Heisler, "Advance Vehicle Technology", Butterworth-Heinemann, 2002

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET

U21EEP23	ENERGY STORAGE SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To establish foundational concepts of electric vehicle architecture and powertrain components
- To provide in-depth understanding of energy storage system principles in electric vehicles
- To foster the ability to implement IoT paradigms in electric vehicle applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Utilize energy market concepts to study structural issues in the Indian energy sector (Apply)

CO2: Implement performance assessment methods to study different battery storage systems for suitable applications (Apply)

CO3: Execute thermoelectric measurements using appropriate techniques (Apply)

CO4: Employ selection criteria to choose suitable supercapacitors for specific energy storage applications (Apply)

CO5: Demonstrate appropriate methods to compare and choose fuel cells for practical energy applications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	1	3	-
CO2	3	3	2	1	-	-	-	-	-	-	-	1	3	-
CO3	3	3	2	1	-	-	-	-	-	-	-	1	3	-
CO4	3	3	2	1	-	-	-	-	-	-	-	1	3	-
CO5	3	3	2	1	-	-	-	-	-	-	-	1	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I INTRODUCTION TO ENERGY STORAGE 9

Prospect for both traditional and renewable energy sources – Detailed analysis of Indian energy market and future need – Energy, economic growth and the environment – Implications of Kyoto Protocol – Structural change in electricity supply industry

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UNIT II STORAGE SYSTEMS 9

Batteries – Performance – charging and discharging – storage density – energy density and safety issues – classical batteries: Lead Acid – Nickel-Cadmium – Zinc Manganese dioxide and modern batteries – Zinc – Air – Nickel Hydride – Lithium Battery – Fuel cell – Fly wheel

UNIT III THERMOELECTRIC BATTERY 9

Thermoelectric –Eelectron conductor and phonon glass – Classical thermoelectric materials – Probe resistivity measurement – Seebeck coefficient measurement, and thermal conductivity measurement

UNIT IV SUPER CAPACITORS 9

Super capacitors – Types of electrodes and electrolytes – Electrode materials – High surface area activated carbons – Metal oxide – Conductive polymers – Electrolyte – Aqueous – Applications transport vehicles – private vehicles and consumer electronics – energy density – power density and market

UNIT V FUEL CELLS 9

Fuel cells – Direct energy conversion – Maximum intrinsic efficiency of an electrochemical converter, Physical interpretation – Camot efficiency factor in electrochemical energy convertors – Types of fuel cells – Hydrogen oxygen cells – Hydrogen air cell – Aalkaline fuel cell – Phosphoric fuel cell

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Tetsuya Osaka, Madhav Datta, 'Energy Storage Systems in Electronics', Gordon and Breach,2000
2. A.G.Ter-Gazarian, "Energy Storage for Power Systems", Second Edition, The Institution of Engineering and Technology (IET) Publication, UK, 2011.

REFERENCES:

1. D.M. Rowe, 'Thermoelectrics Handbook: Macro to Nano', CRC Press, 2006
2. James M. Eyer, Joseph J. Iannucci and Garth P. Corey ", "Energy Storage Benefits and Market Analysis", Sandia National Laboratories, 2004.
3. Jim Eyer, Garth Corey", Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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		Category: PEC				
U21EEP24	IoT IN EV APPLICATIONS	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To establish foundational concepts of electric vehicle architecture
- To develop understanding of the impact of IoT technologies in electric vehicles
- To foster the ability to implement IoT paradigms in electric vehicle applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Implement IoT concepts in basic engineering applications (Apply)

CO2: Utilize drive-train topologies and propulsion techniques in electric vehicle systems (Apply)

CO3: Solve problems related to vehicle mechanics using fundamental principles (Apply)

CO4: Design hybrid energy storage configurations for electric vehicle applications (Apply)

CO5: Develop IoT-based solutions for electric vehicle applications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO3	3	3	2	1	-	-	-	-	-	-	-	1	2	-
CO4	3	3	2	1	-	-	-	-	-	-	-	1	2	-
CO5	3	3	2	1	-	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I PHYSICAL DESIGN OF IoT 9

IoT System – Characteristics – Logical design – IoT protocols – IoT levels and deployment templates – Need for IoT system management – Network operator requirements – Differences and similarities between M2M and IoT

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UNIT II ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS 9

Evolution of Electric Vehicles – Impact of modern drive trains on energy supplies – Architecture of Electric vehicles and hybrid electric vehicles – Plug-in hybrid electric vehicles – Power train components and sizing, gears, clutches, transmission and brakes

UNIT III MECHANICS OF ELECTRIC VEHICLES 9

Fundamentals of vehicle mechanics – Tractive force, power and energy requirements for standard drive cycles of HEVs – Motor torque, Power rating and battery capacity – Range-extended electric vehicles: classification and configurations, fuel cell electric vehicles, solar electric vehicles, electric bi-cycles and their propulsion systems, vehicle-to-grid, vehicle-to-home concepts

UNIT IV ENERGY STORAGE SYSTEMS 9

Storage requirements – Battery – Fuel cell – Super Capacitor – Power pack management systems – Cell balancing techniques – Flywheel based energy storage and its analysis – Hybridization of different energy storage devices – Compressed air storage systems – Super conducting magnetic storage systems

UNIT V IoT APPLICATIONS 9

Case Study – Autonomous electric vehicles – Connected vehicles – Electric vehicle charging

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, Taylor & Francis Group, 2015
2. Husain I., "Electric and Hybrid Vehicles", Boca Raton, CRC Press, 2010

REFERENCES:

1. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands on Approach", Universities Press, 2015
3. Jack Erjave C. and Jeff Arias, "Alternate Fuel Technology - Electric, Hybrid and Fuel Cell Vehicles", Cengage, 2012

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21EEP25	ARTIFICIAL INTELLIGENCE APPLICATIONS TO POWER SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide a foundational understanding of soft computing principles and their distinction from conventional computational methods
- To build knowledge of Artificial Neural Networks, Fuzzy Logic Systems, and Genetic Algorithms for modeling, optimization, and decision-making applications
- To develop the ability to employ soft computing techniques in addressing power system challenges including load forecasting, voltage stability, and economic load dispatch

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply the basic concepts of Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms to solve engineering problems (Apply)

CO2: Design suitable models for prediction and classification tasks using artificial neural network architectures (Apply)

CO3: Implement fuzzy logic system concepts to develop rule-based decision-making models (Apply)

CO4: Analyze genetic algorithm principles and operators to assess their suitability for real-time optimization problems (Analyze)

CO5: Examine the performance of ANN, Fuzzy Logic and Genetic Algorithms in power system applications (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO4	3	2	2	1	1	-	-	-	-	-	-	1	2	-
CO5	3	2	2	1	1	1	1	-	-	-	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I SOFT COMPUTING TECHNIQUES 9

Definition of AI – Difference between soft computing and hard computing techniques – Expert systems – Brief history of ANN, Fuzzy and GA – Basic concepts of Neural Networks, human brain, model of artificial neuron – Difference between GA and traditional methods

UNIT II NEURAL NETWORKS 9

Neural Network architectures – Single layer and multi-layer feed forward network, recurrent networks – Characteristics of NN, Learning Methods Perceptron – ADALINE networks – Back Propagation Network (BPN) – Nonlinear activation operators – Selection of parameters in BPN

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UNIT III FUZZY LOGIC SYSTEM 9

Comparison between fuzzy and crisp logic, fuzzy sets, membership function, basic fuzzy set – Operations, properties of fuzzy set, fuzzy relations, fuzzy interference system, mamdani, sugeno, fuzzy rule-based system, defuzzification methods – Type 2 fuzzy sets –Interval type 2 fuzzy set

UNIT IV GENETIC ALGORITHM 9

Principles – Encoding – fitness function – Inheritance operators – Types of GA operators: Cross over, Mutation and Reproduction – GA's for constrained and unconstrained optimization.

UNIT V APPLICATION OF AI TO POWER SYSTEM 9

Applications of ANN, Fuzzy logic and GA in power system - load forecasting, Voltage stability – Economic load dispatch.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Rajasekaran S. and VijayalakshmiPai G.A., "Neural Networks, Fuzzy logic and Genetic Algorithms", PHI publication, 2017
2. Kalyanmoy Deb, "Optimization for Engineering Design", PHI publication, 2012

REFERENCES:

1. Kalyanmoy Deb, "Multi-objective Optimization using Evolutionary Algorithms", Wiley Publication, 2010
2. Ross T.J., "Fuzzy logic with Fuzzy Applications", McGraw Hill Inc, 2008
3. Simon Haykins, "Neural Networks: A comprehensive Foundation", Pearson Edition, 2003

EVALUATION PATTERN:

Continuous Internal Assessments				Total Internal Assessments	End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)			
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21EEP26	DATA SCIENCE FOR ELECTRICAL ENGINEERS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop a comprehensive understanding of data science principles and statistical techniques for extracting insights from engineering datasets
- To introduce data mining methodologies and data stream concepts for identifying meaningful patterns in large-scale and dynamic data
- To provide knowledge of data preprocessing, feature selection, and optimization methods to improve the accuracy and efficiency of analytical models

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply fundamental data science and big data analytics techniques to process and interpret large datasets(Apply)
CO2: Deploy statistical techniques for descriptive and inferential data analysis (Apply)
CO3: Examine machine learning techniques for electrical load forecasting and fault classification problems (Analyze)
CO4: Analyze data mining and data stream algorithms for real-time applications (Analyze)
CO5: Employ data science tools using Python to implement analytics and predictive models (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	-	-	-	-	-	-	1	2	-
CO2	3	2	2	1	2	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	2	1	-	-	-	-	-	1	2	-
CO4	3	2	1	1	2	1	-	-	-	-	-	1	2	-
CO5	3	2	1	1	2	-	-	-	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION TO DATA SCIENCE 9

Data Science – Big Data and Data Science – Fundamentals and components – Data scientist – Terminologies used in big data environments – Types of digital data – Classification of digital data – Big data: Evolution, Characteristics, analytics, Classification, challenges facing big data.

UNIT II DESCRIPTIVE ANALYTICS USING STATISTICS 9

Types of data - Mean, median and model – Standard deviation and variants – Probability Density function – Types of data distribution – Percentiles and moments – Correlation and covariance – Conditional probability – Baye's theorem – Univariate, bivariate and multivariate analysis – Dimensionality reduction using principal component analysis.

UNIT III PREDICTIVE MODELING AND MACHINE LEARNING 9

Linear regression – Polynomial regression – Multivariate regression – Multilevel models – Bias/variance trade off – K fold cross validation – Data cleaning and normalization – Cleaning web log data – Feature selection algorithms – Detecting outliers – Introduction to supervised and unsupervised learning – Reinforcement learning – Case studies: Electrical load forecasting, Fault classifier

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UNIT IV MINING DATA STREAMS 9

Stream data model and architecture – Stream computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Real Time Analytics Platform (RTAP) applications – Case studies: Temperature estimation

UNIT V DATA SCIENCE USING PYTHON 9

Essential data science packages: Numpy, Scipy, Jupyter, Statsmodels and Pandas package – Data munging: Data pipeline and Machine learning in Python – Data visualization using Matplotlib – Interactive visualization in Python

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Michael Berthold and David J. Hand, "Intelligent Data Analysis", Springer, 2007
2. Seema Acharya and Subhashini Chellapan, "Big Data Analytics", Wiley, 2015

REFERENCES:

1. Alberto Boschetti and Luca Massaron, "Python Data Science Essentials", 2nd edition, Packt Publications, 2016
2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2014
3. Foster Provost and Tom Fawcet, "Data Science for Business", O'Reilly Publishers, 2013

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="3">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (100 Marks)</th><th colspan="2">Assessment II (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Project / MCQ</td><td>Written Test</td><td></td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td>200</td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21EEP27	FUNDAMENTALS OF AR AND VR	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To impart fundamental knowledge of Augmented Reality (AR) and Virtual Reality (VR) technologies and immersive computing principles
- To provide exposure to system architecture, design methodologies, development platforms, and modeling techniques used in AR/VR environments
- To equip learners with the technical competence required to design and develop interactive AR/VR-based real-time applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply the fundamental concepts of Virtual Reality systems to develop immersive environments (Apply)

CO2: Analyze the architecture and modeling components of VR systems for efficient design and implementation (Analyze)

CO3: Deploy the core concepts of Augmented Reality to design interactive AR environments (Apply)

CO4: Examine computer vision techniques used in AR systems for tracking, registration and real-world interaction (Analyze)

CO5: Employ AR/VR development tools and platforms to implement real-time immersive applications. (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	-	-	-	-	-	-	1	2	-
CO2	3	2	2	2	1	-	-	-	-	-	-	1	2	-
CO3	3	2	2	2	1	-	-	-	-	-	-	1	2	-
CO4	3	2	2	2	1	-	-	-	-	-	-	1	2	-
CO5	3	2	2	2	1	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I OVERVIEW OF VIRTUAL REALITY 9

Introduction – The three I's of virtual reality – Early commercial VR – Five classic components of VR system – Three-Dimensional position trackers – Navigation and Manipulation Interfaces – Gesture Interface. Output Devices: Graphics display – Sound display – Haptic feedback.

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UNIT II COMPUTING ARCHITECTURE AND MODELING 9

PC graphics Architecture – Workstation-based architecture – Distributed VR architecture – Geometric modeling – Kinematic modeling – Physical modeling – Behavior modeling.

UNIT III AGUMENTED REALITY ENVIRONMENT 9

Introduction to augmented reality – History of augmented reality – Multimodal display – Visual perception – Requirements and characteristics – Spatial display model – Visual displays.

UNIT IV TRACKING AND COMPUTER VISION FOR AR 9

Coordinate system – Characteristics of tracking technology – Degrees of freedom – Marker tracking – Multiple camera infrared tracking – Natural feature tracking by detection – Incremental tracking – Simultaneous localization and mapping – Outdoor tracking.

UNIT V APPLICATIONS OF VR AND AR 9

Introduction – VR applications in manufacturing – Military VR application – Engineering – Architecture – Medicine – Entertainment – Science – Training.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Grigore C Burdea, Philippe Coiffet, "Virtual Reality Technology", 2nd Edition, Willey, 2017.
2. Dieter Schmaslstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice" Pearson Education, 2016.
3.

REFERENCES:

1. Alan Craig, William Sherman, Jeffrey Will, "Developing Virtual Reality Applications, Foundations of Effective Design", Morgan Kaufmann, 2009.
2. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, 2013.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET
LEARN BEYOND

U21EEP28	ARTIFICIAL NEURAL NETWORKS AND APPLICATIONS	Category: PCC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide a strong foundation in the principles of single-layer and multi-layer neural networks for engineering applications
- To introduce various specialized neural network architectures and their characteristics
- To familiarize learners with neural network techniques used in developing real-time intelligent systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Apply the concepts of biological and artificial neural networks to model simple intelligent systems (Apply)

CO2: Analyze single-layer and multi-layer neural network architectures to determine their suitability for specific tasks (Analyze)

CO3: Analyze feedforward and feedback neural networks for pattern recognition and control applications (Analyze)

CO4: Employ special neural network models for character recognition problems (Apply)

CO5: Deploy appropriate neural network models for real-time engineering applications (Apply)

CO-PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	-	-	-	-	-	-	1	2	-
CO2	3	2	1	1	2	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	2	-	-	-	-	-	-	1	2	-
CO4	3	2	1	1	2	-	-	-	-	-	-	1	2	-
CO5	3	2	1	1	2	1	-	-	-	-	1	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I FUNDAMENTALS OF NEURAL NETWORKS 9

Introduction – Artificial neural networks – Biological neural networks – Basic building blocks of ANNs – ANN Terminologies – McCulloch-Pits neuron model – Learning rules – Hebb net.

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UNIT II PERCEPTRON AND ASSOCIATIVE MEMORY NETWORKS 9

Single layer perceptron – Multilayer perceptron – Adaline – Madaline – Associative memory networks – Hetero Associate memory neural networks – Auto associative memory networks.

UNIT III FEEDBACK AND FEED FORWARD NETWORKS 9

Discrete Hopfield net – Continuous Hopfield net – Back propagation network – Radial basis function network – Full counter propagation network – Forward counter propagation network – Self organizing feature map.

UNIT IV SPECIAL NETWORKS 9

Probabilistic neural network – Cognitron – Neocognitron – Boltzman machine – Gaussian machine – Support vector machines – Character recognition

UNIT V APPLICATIONS OF NEURAL NETWORKS 9

Bioinformatics – Forecasting – Healthcare – Communication – Robotics – Image processing and compression.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Sivanandam S.N., Sumathi and Deepa S.N., "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw – Hill Education, 2016
2. Rajasekaran S. and Pai G.A.V., "Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis and applications", PHI, New Delhi, 2017

REFERENCES:

1. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson Education India, 2006
2. Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2003.
3. Sivanandam S.N.and Deepa S.N., "Principles of Soft Computing Techniques", Wiley,2018

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET

U21EEP29	FUZZY LOGIC CONTROL	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide a strong foundation in fuzzy set theory and its distinction from classical set theory for handling uncertainty
- To introduce fuzzy logic principles, inference mechanisms and rule-based reasoning for intelligent system development
- To familiarize students with fuzzy-based modeling and control approaches used in electrical engineering applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Examine the concepts of fuzzy sets and classical sets for handling uncertainty in engineering systems (Analyze)
CO2: Differentiate various fuzzy set operations, properties and membership functions (Analyze)
CO3: Investigate fuzzy inference mechanisms and rule-based reasoning systems for intelligent decision making (Analyze)
CO4: Implement fuzzy data analysis techniques for engineering problem solving (Apply)
CO5: Analyze fuzzy logic control methods for electrical engineering applications (Analyze)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	1	-	-	-	-	-	-	1	2	-
CO2	3	3	2	1	1	-	-	-	-	-	-	1	2	-
CO3	3	3	2	1	1	-	-	-	-	-	-	1	2	-
CO4	2	2	2	1	1	-	-	-	-	-	-	1	2	-
CO5	3	3	2	1	2	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I FUZZY SYSTEMS 9

Crisp set – Vagueness – Uncertainty and imprecision – Fuzziness – Basic definitions – Fuzzy set theory – Classical set Vs Fuzzy set – Properties of fuzzy sets – Fuzzy operation – Fuzzy arithmetic – Fuzzy relation – Fuzzy relational equations – Fuzzy Cartesian product and composition

UNIT II FUZZY MODELS AND CONVERSION 9

Introduction to Fuzzy model – Structure of fuzzy logic control – Fuzzification models – Knowledge base – Rule base – Inference engine – Fuzzy to crisp conversion – Lambda cuts for fuzzy sets and relations – Defuzzification methods

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UNIT III FUZZY DATA ANALYSIS 9

Methods for Fuzzy Data Analysis – Algorithmic Approaches – Knowledge based Approaches – Tools for Fuzzy Data Analysis – Applications of FDA

UNIT IV ADVANCED FUZZY LOGIC CONTROL 9

Fuzzy logic controllers –adaptive fuzzy systems – Fuzzy decision making – Multi-objective decision making – Fuzzy classification – Means clustering – Fuzzy pattern recognition – Image processing applications – Syntactic recognition

UNIT V APPLICATION OF FUZZY SYSTEMS 9

Fuzzy logic control: Home heating system – Liquid level control –PID control –Motor control– Energy management – Buck-Boost Converter

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 4th edition, Wiley, 2016
2. H.J. Zimmermann, "Fuzzy Set Theory and its Applications", Springer Netherlands, 2nd Edition, Illustrated, 2014

REFERENCES:

1. Rajasekaran S. and Pai G.A.V., "Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis and applications", PHI, New Delhi, 2017
2. John Yen and Reza Langari, "Fuzzy Logic – Intelligence Control & Information", Pearson Education, New Delhi, 2003
3. Sivanandam S N, Sumathi S, Deepa S N, "Introduction to Fuzzy Logic using MATLAB", Springer-Verlag, Berlin Heidelberg, 2010.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET

U21EEP30	DEEP LEARNING FOR ELECTRICAL ENGINEERING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To foster the capability to analyze deep feed forward networks, convolutional neural networks, recurrent and recursive nets.
- To develop understanding of deep neural network architectures, optimization and regularization techniques.
- To foster the ability to implement the deep neural network models for electrical engineering applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Examine the fundamental principles and components of deep learning techniques (Analyze)

CO2: Develop deep feedforward network models for electrical load forecasting application (Apply)

CO3: Investigate regularization and optimization techniques used in deep neural networks (Analyze)

CO4: Differentiate architectures of various convolutional neural network models for specific applications (Analyze)

CO5: Implement pre-trained deep learning models for solar and wind power forecasting (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	1	-	-	-	-	-	-	1	2	-
CO2	3	3	2	2	1	-	-	-	-	-	1	1	2	-
CO3	3	3	2	2	1	-	-	-	-	-	-	1	2	-
CO4	3	3	2	2	1	-	-	-	-	-	1	1	2	-
CO5	3	3	2	2	1	-	-	-	-	-	1	1	2	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

SYLLABUS:

UNIT I INTRODUCTION 9

Review of concepts from Linear Algebra and Vector Calculus – Learning algorithms: supervised and unsupervised – Capacity, over fitting and under fitting – Hyper parameters and validation sets – Estimators, bias and variance – Maximum likelihood estimation

UNIT II DEEP FEED FORWARD NETWORKS 9

XOR function – Gradient based learning – Hidden units – Architecture design – Back propagation algorithm – Case studies: load forecasting.

UNIT III REGULARIZATION AND OPTIMIZATION FOR DEEP MODELS 9

Norm penalties – Regularization – Dataset augmentation – Noise robustness – Early stopping – Parameter tying and parameter sharing – Bagging and ensemble methods – Dropout – Batch and mini batch algorithms – Basic algorithms

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UNIT IV CONVOLUTIONAL NEURAL NETWORKS 9

Convolution operation – Motivation – Pooling – Convolution and pooling as an infinitely strong prior – Variants of the basic convolution function – Structured outputs – Data type – Unsupervised features- Case studies: AlexNet, ZFNet, VGG, C3D, Google Net

UNIT V RECURRENT AND RECURSIVE NETS 9

Recurrent neural networks – Encoder – decoder sequence to sequence architectures – Deep Recurrent networks – Recursive neural networks – Echo state networks – Leaky units and other strategies for multiple time scales – LSTM – Case studies: forecasting of wind and solar power.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Bengio, Yoshua, Ian J. Goodfellow and Aaron Courville, "Deep Learning", MIT Press, 2015
2. Francois Chollet, "Deep Learning with Python", Manning Publications Co., 2017

REFERENCES:

1. Eugene Charniak, "Introduction to Deep Learning", MIT Press, 2018
2. Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer, 2018
3. Josh Patterson and Adam Gibson, "Deep Learning A Practitioner's Approach", O'Reilly media Inc., 2017

EVALUATION PATTERN:

<table>
<tr><th colspan="4">Continuous Internal Assessments</th><th rowspan="2">Total Internal Assessments</th><th rowspan="3">End Semester Examinations</th></tr>
<tr><th colspan="2">Assessment I (100 Marks)</th><th colspan="2">Assessment II (100 Marks)</th></tr>
<tr><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Mini Project / MCQ</td><td>Written Test</td><td></td></tr>
<tr><td>40</td><td>60</td><td>40</td><td>60</td><td>200</td><td>100</td></tr>
<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
<tr><td colspan="2">100</td></tr>
</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET

U21EEP31	TENSOR FLOW FOR ENGINEERING APPLICATIONS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce the architecture and computational framework of deep learning models using TensorFlow
- To provide knowledge of convolutional and recurrent neural network structures for processing image and sequential data
- To enable the development and deployment of TensorFlow-based deep learning solutions for real-time applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Implement neural network models using TensorFlow to solve engineering problems (Apply)

CO2: Examine the structure and working of convolutional neural networks using TensorFlow (Analyze)

CO3: Develop RNN, LSTM and GRU models for real-time sequence processing applications (Apply)

CO4: Investigate the building blocks of deep learning models using Keras and TFLearn frameworks (Analyze)

CO5: Design and implement CNN and RNN architectures to address real-time problems (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO2	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO4	3	2	1	1	1	-	-	-	-	-	-	1	2	-
CO5	3	2	1	1	1	1	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I IMPLEMENTING NEURAL NETWORKS IN TENSORFLOW 9

Introduction to TensorFlow: Computational graph – Key highlights – Creating a graph – Regression example – Gradient descent – tensor board, modularity – Sharing variables – Managing models over the CPU and GPU – Specifying the logistic regression model in TensorFlow – Logging and training the logistic regression model

UNIT II CONVOLUTIONAL NEURAL NETWORKS 9

Introduction to convolution neural networks – CNN architecture – Convolution operation – Padding and stride – Transfer learning – Fine-tuning – Applications of convolution neural networks

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UNIT III RECURRENT NEURAL NETWORKS 9

Fundamentals of recurrent neural network – Modelling sequencing– Types of RNNs – Long short–term memory – Gated recurrent unit – Recursive neural tensor network theory - recurrent neural network applications

UNIT IV KERAS AND TFLEARN 9

Introduction of Keras – Keras model building blocks – Different compositional layers – Process based use cases' implementations – Introduction of TFlearn – TFlearn model building blocks–Different compositional layers– Cases implementations

UNIT V APPLICATIONS 9

Image classification – Image segmentation and instance segmentation – Object detection – Natural Language Processing – Sentiment analysis and data set – Solar and Wind energy forecasting – Load forecasting, Electric Vehicle charging management

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola. "Dive into Deep Learning", Release 0.15.1, 2020
2. Goodfellow I., Bengio, Y., and Courville, A., "Deep Learning", MIT Press, 2016

REFERENCES:

1. Golub G.H. and Van Loan C.F., "Matrix Computations", JHU Press, 2013
2. Nikhil Buduma and Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next Generation Machine Intelligence Algorithms", O'Reilly Media, 2017
3. Josh Patterson and Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly, 2017

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET
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U21EEP32	FUNDAMENTALS OF NATURAL LANGUAGE PROCESSING	Category: BSC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Python Programming

COURSE OBJECTIVES:

- To provide a strong foundation in the principles of Natural Language Processing, including the use of Context-Free Grammar (CFG) and Probabilistic Context-Free Grammar (PCFG)
- To develop understanding of semantic and pragmatic analysis for meaningful interpretation of natural language
- To enable the implementation of NLP techniques for information retrieval and real-time language processing applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Perform part-of-speech tagging on given text using basic language features. (Apply)
CO2: Examine word-level analysis tasks using NLP components such as tokenization, stemming and parsing. (Analyze)
CO3: Implement rule-based systems to address morphology and syntax processing (Apply)
CO4: Analyze statistical tagging methods for real-time language processing applications. (Analyze)
CO5: Differentiate statistical approaches used in NLP applications and evaluate their suitability (Analyze)

CO-PO MAPPING:

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	3	-	-	-	-	-	-	-	2	-
CO2	3	2	2	2	3	-	-	-	-	-	-	-	2	-
CO3	3	2	2	2	3	-	-	-	-	-	-	-	2	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-	2	-
CO5	3	3	2	2	3	-	-	-	-	-	-	-	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

SYLLABUS:

UNIT I INTRODUCTION 9

Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

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UNIT II WORD LEVEL ANALYSIS 9

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models

UNIT III SYNTACTIC ANALYSIS 9

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK.

UNIT IV SEMANTICS AND PRAGMATICS 9

Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus,

UNIT V DISCOURSE ANALYSIS AND LEXICAL RESOURCES 9

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC)

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

Total 45 Periods

TEXT BOOKS:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Pythonll, First Edition, O_Reilly Media, 2009.

REFERENCES:

1. Tanveer Siddiqui, U.S. Tiwary, —Natural Language Processing and Information Retrievalll, Oxford University Press, 2008.
2. Richard M Reese, —Natural Language Processing with Javall, O_Reilly Media, 2015
3. Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET

U21EEP33	SMART SENSORS AND APPLICATIONS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE--REQUISITES:

- Nil

COURSE OBJECTIVES:

- To facilitate the application of smart sensor principles for measuring and monitoring parameters
- To develop analytical competence in evaluating different types of sensors and their characteristics
- To develop the ability to select and implement appropriate smart sensors for real-time applications

COURSE OUTCOMES:

Upor completion of the course, the student will be able to

CO1: Utilize sensor characteristics and calibration techniques to enhance accuracy and reliability in measurement systems (Apply)

CO2: Identify and implement appropriate sensors to develop and operate real-time measurement systems (Apply)

CO3: Utilize the principles of motion and range sensors to select and integrate suitable sensors in real-time systems (Apply)

CO4: Select and implement suitable sensors for automotive applications to enhance vehicle performance and safety (Apply)

CO5: Examine suitable sensors for energy harvesting applications to enhance system performance (Analyze)

CO–PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO3	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO4	3	2	1	1	-	-	-	-	-	-	-	1	2	-
CO5	3	3	2	2	-	1	1	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I SENSOR CHARACTERISTICS 9

Characteristics – Classification – Calibration of smart sensor – Output signal types – Properties – Dynamic models of sensor elements

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UNIT II OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

LDR – Fiber optic sensors – Pressure sensors – Piezoelectric sensors – Acoustic sensors – Radiation sensors – LASER sensors – MEMS and Nano sensors

UNIT III MOTION AND RANGE SENSORS 9

Motion sensors – Encoders – Optical, Magnetic, Inductive and Capacitive type – Accelerometer – Range sensors – Radar – Flex ray – RF beacons – LIDAR

UNIT IV SENSORS FOR AUTOMOTIVE INDUSTRY 9

Air mass sensors – Wheel speed sensors – Suspension sensors – Impact sensors – Oil sensors – Brake sensors – Battery sensor – Parking sensors – Lane control sensors

UNIT V SENSOR INTERFACE AND APPLICATIONS 9

Battery monitoring sensors – Smart building sensors – Smoke and occupancy sensors – Smart wind sensors – Applications: Vibration and motion energy harvesting – Thermoelectric energy harvesting

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Jon S. Wilson, "Sensor Technology Handbook", 1st edition, Elsevier, 2011
2. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Applications", 3rd edition, Springer, 2015

REFERENCES:

1. Patranabis D., "Sensors and Transducers", 2nd edition, PHI, New Delhi, 2010
2. John G. Webster, "Measurement, Instrumentation and Sensor Handbook", 2nd edition, CRC Press, 2017
3. Richard Zurawski, "Industrial Communication Technology Handbook", 2nd edition, CRC Press, 2015

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I(100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / MiniProject / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET
LEARN BEYOND

		Category: PEC				
U21EEP34	MEMS AND ITS APPLICATIONS	L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide knowledge on the design and modeling of electrostatic sensors and actuators
- To develop understanding of material properties, microstructures, and fabrication methods used in MEMS technology
- To develop the ability to select and implement suitable MEMS sensors in automotive systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Utilize knowledge of microsystem devices to assess their mechanical behavior in practical applications (Apply)

CO2: Employ micro fabrication and micromachining techniques in the development of microsystems (Apply)

CO3: Categorize the working principles of various sensors and actuators to determine their suitability for engineering applications (Analyze)

CO4: Select suitable sensor types and implement appropriate packaging methods based on application requirements (Apply)

CO5: Choose the suitable MEMS devices in automotive applications based on system requirements (Apply)

CO–PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	1	2	-
CO2	2	2	1	1	-	-	-	-	-	-	-	1	2	-
CO3	3	3	2	2	-	-	-	-	-	-	-	1	2	-
CO4	2	2	1	1	-	-	-	-	-	-	-	1	2	-
CO5	2	2	1	1	-	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I MEMS AND MICROFABRICATION 9

Need for miniaturization – MEMS and microsystems – Microsystem products – Micro gears, micro turbines, micro motors, micro – optical devices – Micro fabrication – Microelectronic fabrication process – Silicon based MEMS process – Stress and strain analysis – Flexural beam bending – Torsional deflections – Intrinsic stress

UNIT II MICROMACHINING 9

Photolithography – Ion implantation – Diffusion – Oxidation – Thermal oxidation – Oxidation by chemical vapour deposition – Physical vapour deposition – Sputtering – Etching – Chemical, plasma, LIGA process – Micromachining – Bulk micromachining, surface micromachining, hard and soft micromachining.

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UNIT III SENSING AND ACTUATION 9

Electrostatic sensor – Parallel plate capacitors – Design and fabrication – Interdigitated finger capacitor – Comb drive devices – Micro Grippers – Micro Motors – Thermal sensor – Design and fabrication – Thermocouples – Thermal resistors – Thermal bimorph

UNIT IV MECHANICAL SENSORS AND PACKAGING 9

Mechanical transduction techniques – Piezo resistivity – Piezo electricity – Capacitive, optical, resonant actuation techniques – Pressure sensors – Force and torque sensors – Inertial sensors – Flow sensors – Tactile sensor; Standard IC packaging – Packaging process – MEMS mechanical sensors packing

UNIT V AUTOMOTIVE APPLICATIONS 9

MEMS for passenger safety – Vehicle stability control – Automotive tire pressure monitoring systems – Pressure and flow sensors for engine management system – RF MEMS and its application – MEMS for passenger comfort in vehicles

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Chang Liu, "Foundations of MEMS", 2nd edition, Pearson Education India, 2014
2. Michael Kraft and Neil M. White, "MEMS for Automotive and Aerospace Applications", Woodhead Publishing Limited, Oxford, 2013

REFERENCES:

1. Vinoy K.J., Ananthasuresh G.K. and Rudra Pratap, "Micro and Smart Devices and Systems", Springer India, 2014
2. Stephen Beeby, Graham Ensell, Michael Kraft and Neil White, "MEMS Mechanical Sensors", Artech House, Inc., Boston, London, 2004
3. Thomas M. Adams and Richard A. Layton, "Introductory MEMS: Fabrication and Applications", Springer, 2010

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21EEP35	DISCRETE TIME SIGNAL PROCESSING	Category: PEC			
		L	T	P	C
		3	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop understanding of mathematical operations performed on signals
- To provide knowledge on Z-Transform, DFT, and FFT and their computational procedures
- To impart knowledge of DSP processor computational building blocks and architecture

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Examine different types of signals and systems based on their characteristics and properties (Analyze)

CO2: Implement Z-transform techniques to evaluate discrete-time systems (Apply)

CO3: Utilize DFT and FFT techniques to process and interpret digital signals and systems (Apply)

CO4: Develop FIR and IIR filter for the given specifications (Apply)

CO5: Investigate the functional blocks of a DSP processor and interpret its operation in signal processing applications (Analyze)

CO–PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	1	2	-
CO2	2	2	1	1	-	-	-	-	-	-	-	1	2	-
CO3	2	2	1	1	-	-	-	-	-	-	-	1	2	-
CO4	2	2	1	1	-	-	-	-	-	-	-	1	2	-
CO5	3	3	2	2	-	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I INTRODUCTION 9

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance – Classification of signals: continuous and discrete, energy and power – Mathematical representation of signals – Sampling techniques – Quantization – Quantization error – Nyquist rate – Aliasing effect.

UNIT II DISCRETE TIME SYSTEM ANALYSIS 9

Z-transform and its properties – Inverse z-transforms – Difference equation – Solution by z transform - Stability analysis – Convolution

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UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 9

Discrete Fourier Transform – Properties, magnitude and phase representation – Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure

UNIT IV DESIGN OF DIGITAL FILTERS 9

FIR & IIR filter realization – Parallel & cascade forms – FIR design: Windowing Techniques – Need and choice of windows – Analog filter design – Butterworth and Chebyshev approximations – IIR Filters, digital design using impulse invariant and bilinear transformation – Warping, pre warping.

UNIT V DIGITAL SIGNAL PROCESSORS 9

Introduction – Architecture – Features – Addressing Formats – Introduction to Commercial Digital Signal Processors

Contact Periods:

Lecture:	45 Periods	Tutorial: – Periods	Practical: – Periods	Project	– Periods
				Total	45 Periods

TEXT BOOKS:

1. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.
2. Lonnie C. Ludeman , "Fundamentals of Digital Signal Processing",Wiley,2013

REFERENCES:

1. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014

EVALUATION PATTERN:

Continuous Internal Assessments					End Semester Examinations
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21EEP36	REAL TIME OPERATING SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide comprehensive knowledge of real-time operating system concepts
- To develop understanding of process management and process synchronization mechanisms
- To impart knowledge of real-time kernel architecture and its functionalities

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Compare operating system structures for system-level applications (Analyze)

CO2: Examine tasks, processes, and scheduling mechanisms in operating systems (Analyze)

CO3: Identify various RTOS support models for real-time system design (Apply)

CO4: Investigate the features and operations of a real-time kernel in embedded systems (Analyze)

CO5: Implement RTOS concepts in real-time applications (Apply)

CO–PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	1	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	1	2	-
CO3	3	3	2	2	-	-	-	-	-	-	-	1	2	-
CO4	3	3	2	2	-	-	-	-	-	-	-	1	2	-
CO5	2	2	1	1	-	-	-	-	-	-	-	1	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I REVIEW OF OPERATING SYSTEMS 9

Basic principles – Operating system structures – System calls – Files – Processes – Design and Implementation of processes – Communication between processes

UNIT II OVERVIEW OF RTOS 9

RTOS Task and Task state – Multithreaded preemptive scheduler – Process synchronization– Message queues – Mail boxes -pipes – Critical section – Semaphores – Classical synchronization problem – Deadlocks

UNIT III REALTIME MODELS AND LANGUAGES 9

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling – Interrupt processing – Synchronization

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UNIT IV REALTIME KERNEL 9

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS

UNIT V APPLICATION DEVELOPMENT 9

Discussions on Basics of Linux supportive RTOS – uCOS-C Executive for development of RTOS Application – Case study

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill,2006.
2. Charles Crowley, "Operating Systems-A Design Oriented approach" McGraw Hill,1997.

REFERENCES:

1. Silberschatz,Galvin,Gagne" Operating System Concepts,6th edition,John Wiley,2003.
2. Karim Yaghmour,Building Embedded Linux System",O'reilly Pub,2003.
3. MukeshSighal and N G Shi "Advanced Concepts in Operating System", McGraw Hill,2000.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21EEP37	COMPUTER NETWORKS FOR ELECTRICAL ENGINEERS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop the ability to analyze the layered architecture, protocols, and communication mechanisms used in computer networks
- To build competence in evaluating network performance parameters and protocol behavior across different layers of the network stack
- To foster the capability to apply networking concepts and protocols in electrical engineering applications and allied domains

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the functions and interactions of protocol layers in computer networks (Analyze)

CO2: Examine network performance metrics for different communication techniques (Analyze)

CO3: Investigate network layer protocols including IPv4 and IPv6 for addressing and routing (Analyze)

CO4: Analyze transport layer protocols for reliable and unreliable data transmission (Analyze)

CO5: Examine the working principles of application layer protocols used in networked systems (Analyze)

CO–PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	1	2	-
CO2	3	3	-	1	-	-	-	-	-	-	-	1	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	2	-
CO4	3	3	1	-	-	-	-	-	-	-	-	1	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I PHYSICAL LAYER 9

Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit–switched Networks – Packet Switching.

UNIT II DATA–LINK LAYER AND MEDIA ACCESS 9

Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.

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UNIT III NETWORK LAYER 9

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol

UNIT IV TRANSPORT LAYER 9

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT V APPLICATION LAYER 9

WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Behrouz A. Forouzan, Data Communications and Networking, Fourth Edition TMH, 2017
2. Kalyanmoy Deb, "Optimization for Engineering Design", PHI publication, 2012

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I(100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / MiniProject / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

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U21EEP38	SOFTWARE FOR EMBEDDED SYSTEMS	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop the ability to apply Embedded C programming constructs for developing software in embedded systems
- To build analytical competence in evaluating timing constraints, delays, and interrupt mechanisms in microcontroller-based systems
- To foster the capability to analyze and implement serial communication and peripheral interfacing techniques using Embedded C for real-time applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze data types, control structures, and functions in Embedded C for embedded software development (Analyze)

CO2: Investigate timing constraints such as hardware delays and loop timeouts in real-time embedded systems (Analyze)

CO3: Employ C-based programming techniques for 8051 microcontroller applications (Apply)

CO4: Apply serial communication and interrupt-driven programs for the 8051-microcontroller using Embedded C (Apply)

CO5: Examine peripheral interfacing techniques with 8051 microcontroller using Embedded C (Analyze)

CO–PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1	2	-
CO2	3	3	-	1	1	-	-	-	-	-	-	1	2	-
CO3	3	3	2	-	2	-	-	-	-	-	-	-	2	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-	3	-
CO5	3	3	2	1	2	-	-	-	-	-	-	-	3	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I BASIC C PROGRAMMING 9

Introduction to C programming - Structured program development in C - Data types and operators - C program control - C functions - Introduction to arrays.

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UNIT II EMBEDDED C 9

Object oriented programming with C – Header files for project and port – Meeting Real time constraints: Creating hardware delays – Need for timeout mechanism – Creating loop timeouts – Creating hardware timeouts

UNIT III 8051 PROGRAMMING IN C 9

Data types and time delay in 8051 – I/O programming in 8051 – Logic operations in 8051 – Data conversion program in 8051 – Accessing code ROM space in 8051 – Data serialization using 8051

UNIT IV 8051 SERIAL PORT AND INTERRUPT PROGRAMMING IN C 9

Basics of serial communication – 8051 interface to RS232 – serial port programming in 8051 – 8051 interrupts and programming – Programming for timer configuration

UNIT V 8051 INTERFACING 9

8051: ADC interfacing – DAC interfacing – Sensor interfacing – LCD interfacing – Stepper motor interfacing

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Paul Deitel and Harvey Deitel, "C How to Program", 9th Edition, Pearson Education Limited, 2022, 1st edition.
2. Michael J Pont, "Embedded C", Addison-Wesley, An imprint of Pearson Education, 2002.

REFERENCES:

1. William von Hagen, "The Definitive Guide to GCC", 2nd Edition, Apress Inc., 2006.
2. Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I(100 Marks)		**Assessment II (100 Marks)**		**Total Internal Assessments**	**End Semester Examinations**
*Individual Assignment / Case Study / Seminar / MiniProject / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test		
40	**60**	**40**	**60**	**200**	**100**
Total				**40**	**60**
				100	

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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U21EEP39	IoT SYSTEM DESIGN AND SECURITY	Category: PEC			
		L	T	P	C
		3	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop the ability to analyze the architecture, components, and communication protocols used in Internet of Things (IoT) systems
- To build analytical competence in evaluating IoT communication models, data handling mechanisms, and service discovery techniques for real-time applications
- To foster the capability to assess IoT security issues and implement suitable protection mechanisms for selected IoT-based applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the fundamental concepts, components, and functional blocks of IoT systems (Analyze)
CO2: Examine and compare IoT communication and application layer protocols for different deployment scenarios (Analyze)
CO3: Investigate IoT architectures and deployment models to address real time application requirements (Analyze)
CO4: Analyze IoT communication and service discovery mechanisms such as MQTT and CoAP for IoT (Analyze)
CO5: Examine IoT security challenges and assess IoT-based solutions for selected real-world applications (Analyze)

CO–PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1	2	-
CO2	3	3	-	-	2	-	-	-	-	-	-	1	2	-
CO3	3	3	1	-	2	-	-	-	-	-	-	1	2	-
CO4	3	3	1	1	2	-	-	-	-	-	-	-	3	-
CO5	3	3	2	1	2	-	-	-	-	-	-	-	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I FUNDAMENTALS OF IoT 9

Evolution of IoT – Fog, Edge and Cloud in IoT – Simplified IoT architecture and Core IoT functional stack – Functional blocks of an IoT ecosystem – Sensors, Actuators – Smart Objects and connecting smart objects

UNIT II IoT DATA LINK PROTOCOLS 9

Protocol Standardization for IoT – IEEE802.15.4, IEEE 802.11 AH, LTE–A, M2M and WSN Protocols –SCADA and RFID Protocols – Issues with IoT standardization – Zigbee – network layer – Application Layer Protocols: CoAP and MQTT

UNIT III IoT ARCHITECTURE 9

IoT open–source architecture – OIC architecture and design principles – IoT devices and deployment models – System on Chip – IoTivity: An open source IoT stack overview

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UNIT IV COMMUNICATION AND SERVICE DISCOVERY 9

IoT application development – Application protocols: Communication protocols based on the exchange of messages (MQTT), – Service oriented protocols (COAP) – Data processing for IoT – Organization of data processing for Internet of Things

UNIT V IoT Security and Application 9

IoT Security, System security – Security issues in Zigbee – IoT application: smart and connected cities layered architecture, smart healthcare, smart parking architecture and smart traffic control

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Jamil Y. Khan and Mehmet R. Yuce, "Internet of Things Systems and Application", Jenny Stanford 2019
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017

REFERENCES:

1. Dimitrios Serpanos, Marilyn Wolf, "Internet–of–Things (IoT) Systems: Architectures, Algorithms, Methodologies", Springer International Publication, 2018
2. Alvaro Vives, Marco Zennaro, "Internet of Thing", Taylore & Francis Group, 2018
3. https://www.cse.wustl.edu/~jain/cse570–15/ftp/iot_prot/index.html

EVALUATION PATTERN:

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KPRIET
LEARN BEYOND

U21EEP40	ADVANCED INDUSTRIAL AUTOMATION	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To develop the ability to analyze the architecture, operation, and programming principles of Programmable Logic Controllers (PLCs) used in industrial automation
- To build analytical competence in evaluating I/O modules, data acquisition systems, and industrial communication requirements in automated processes
- To foster the capability to apply and assess SCADA architectures and automation strategies for real-time industrial applications

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze the internal architecture, functional blocks, and operation of Programmable Logic Controllers (Analyze)

CO2: Apply PLC programming concepts and logical instructions for industrial control problems (Apply)

CO3: Examine I/O modules, data acquisition systems and interfacing requirements in industrial automation (Analyze)

CO4: Investigate SCADA architectures and communication requirements for real-time industrial applications (Analyze)

CO5: Implement advanced industrial automation solutions using PLC–SCADA for selected industrial applications (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	1	2	-
CO2	3	3	2	-	2	-	-	-	-	-	-	-	3	-
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CO4	3	2	-	1	1	-	-	-	-	-	-	1	2	-
CO5	3	3	2	1	2	-	-	-	-	-	-	-	3	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)							3: Substantial (High)			

SYLLABUS:

UNIT I PROGRAMMABLE LOGIC CONTROLLERS 9

Evolution – Types – Unitary, modular, small, medium, large – Functional Block diagram – Input/Output (I/O) section, processor, power supply, memory – Central processing unit – Processor software / executive software – Multi tasking – Languages – Ladder language

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UNIT II LOGICAL INSTRUCTIONS AND PROGRAMMING 9

Bit logic instructions – Input and output contact program symbols, numbering system of inputs and outputs, program format – Equivalent ladder diagram of gates, equivalent ladder diagram – Comparison instructions – PLC timers: ON and OFF delay, retentive and non-retentive – Format of timer instruction – PLC Counter – Count up and count down

UNIT III INPUT / OUTPUT MODULES 9

Classification – practical I/O systems and its mapping – I/O expansion - I/O systems – Direct, parallel, serial – Sinking and sourcing – Discrete input module – Rectifier with filter, threshold detection, isolation, logic section, specifications – Analog input module – Types – Analog output module – I/O modules in hazardous locations – Power supply configuration – Case Study: PLC in– Cement and Paper industry

UNIT IV SCADA 9

Generalized architecture – Communication requirements – SCADA system architecture – Monolithic – Distributed – Networked architecture

UNIT V APPLICATIONS OF SCADA 9

SCADA systems in operation and control of interconnected power system – Power system automation, petroleum refining process, sugar and cogeneration plant – Plant wide control – Cloud based automation – Object Linking and Embedding for process control

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Madhuchhanda Mitra and Samarjit Sen Gupta, "PLC and Industrial Automation: An Introduction", 2nd edition, Penram International Publishing (India) Pvt. Ltd., 2017
2. Ronald L. Krutz, "Securing SCADA Systems", 4th edition, John Wiley and Sons, 2015

REFERENCES:

1. Rajesh Mehra and Vikrant Vij, "PLCs & SCADA: Theory and Practice", 1st edition, University Science press, 2011
2. Kunal Chakraborty, Palash De and Indranil Roy, "Industrial Applications of Programmable Logic Controllers and SCADA", Anchor Academic Publishing, 2016
3. Stuart A Boyer, "SCADA: Supervisory Control and Data Acquisition", 4th edition, Inscribe Digital, 2016

EVALUATION PATTERN:

Continuous Internal Assessments					
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				100	

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KPRIET
LEARN BEYOND

U21EEP41	POWER PLANT TECHNOLOGY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide students with knowledge of conventional and renewable power generation methods
- To equip students with skills to analyze measurement and control systems used in power plants
- To enable students to evaluate energy, economic and environmental aspects of power plants

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain solar radiation principles and estimation methods (Understand)

CO2: Apply performance equations of flat plate collectors (Apply)

CO3: Analyze concentrating solar collectors and tracking systems (Analyze)

CO4: Investigate photovoltaic system performance and related technologies (Analyze)

CO5: Calculate the energy in economical way and environmental impact (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO5	3	2	2	-	-	-	1	1	-	-	-	1	-	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I POWER GENERATION METHODS **9**

Brief survey of methods of power generation: hydro, thermal, nuclear, solar, and wind power – importance of instrumentation in power generation – thermal power plants: building blocks, details of boiler processes P&I diagram of boiler – cogeneration

UNIT I MEASUREMENTS IN POWER PLANTS **9**

Electrical measurements: current, voltage, power, frequency, power factor – Nonelectrical parameters: Flow of feed water, fuel, air, steam pressure, and steam temperature – Smoke density measurement – Flue gas oxygen analyzer – Pollution monitoring instruments.

UNIT I I FURNACE CONTROL **9**

Coal handling: Pulverizes – Furnace Draught: natural draught, forced draught, induced draught, power requirements for draught systems – Combustion control: Fuel/Air ratio, combustion efficiency, excess air, parallel and cross limited combustion control

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UNIT IV BOILER CONTROL 9

Boiler metal temperature measurement, pressure measuring devices – Boiler feed water processing and control – Drum level measurement methods – Steam temperature control: main steam and reheat steam temperature control, Superheater control, Deaerator control – interlocks in boiler operation.

UNIT V ENERGY, ECONOMICS, AND ENVIRONMENTAL ISSUESS 9

Power tariff types – Load distribution parameters – Load curve – Comparison of site selection – Capital & Operating cost of different power plants. Pollution control technologies – Waste Disposal of coal and nuclear power plant

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. R.K Hedge, "Power Plant Engineering", Pearson Education India, 2015
2. Krishnaswamy KM, Bala P, Bala MP, "Power Plant Instrumentation," Prentice Hall, 2013

REFERENCES:

1. Jain R.K., Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 2008
2. Harry Taplin, "The control of boilers" ,3rd Edition, River Publishers, 2014

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LEARN BEYOND

U21EEP42	FUEL CELL TECHNOLOGY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE–REQUISITES:

- NI

COURSE OBJECTIVES:

- To introduce students to the principles and working of fuel cells.
- To develop analytical ability in fuel cell modeling and characterization.
- To enable students to evaluate hydrogen-based energy systems.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Explain the fundamentals and types of fuel cells (Understand)

CO2: Make use of electrochemical reaction kinetics in fuel cells (Apply)

CO3: Analyze fuel cell characteristics using modeling techniques (Analyze)

CO4: Examine hydrogen production methods and life-cycle aspects of fuel cell systems (Analyze)

CO5: Apply appropriate hydrogen production methods and life-cycle assessment concepts for fuel cell systems (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO4	3	2	2	1	-	2	2	-	-	-	1	2	-	3
CO5	3	2	3	1	-	2	2	-	-	-	1	2	-	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

SYLLABUS:

UNIT I BASICS OF FUEL CELLS 9

Fuel Cells: History, Design, Principle, and Working – Types - Fuel cell performances- Batteries and fuel cells comparison – Fuel cell thermodynamics

UNIT II FUEL CELL REACTION KINETICS 9

Electrode kinetics and overvoltage – Butler- Volmer: Nernst and Tafel equation – Charge transfer reaction – Electrocatalysis design and activation kinetics – Fuel cell charge and mass transport - Flow field, transport in electrode and electrolyte

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UNIT III FUEL CELL CHARACTERIZATION 9

Fuel cell properties - Fuel cell test station – Testing condition - In situ analysis: CV, EIS and equivalent circuit model, Current interrupt analysis - Ex situ techniques: Porosity, Surface area, Structure, Gas permeability, Chemical analysis

UNIT IV HYDROGEN PRODUCTION METHODS 9

H_2 production from fossil fuel – Source of fuels – Electrolysis – Thermal decomposition – Photochemical and photocatalytic methods – safety issues – Cost of hydrogen production – Life cycle analysis of fuel cell

UNIT V HYDROGEN STORAGE METHODS AND APPLICATIONS 9

Metal hydrides – Metallic alloy hydrides – Carbon nanotubes – Sea as source of deuterium -Fuel processor – Fuel cell Power section in fuel cell stack – Automotive application – Power conditioner – Portable devices

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. John Wiley and Sons., "Fuel cell fundamentals", Willey 2016
2. O'Hayre, R. P., S. Cha, W. Colella, F. B. Prinz, Fuel Cell Fundamentals, Wiley, NY 2006

REFERENCES:

1. Bard, A. J., L. R., Faulkner, Electrochemical Methods, Wiley, N.Y. 2004
2. Basu, S. (Ed) Fuel Cell Science and Technology, Springer, N.Y. 2007

EVALUATION PATTERN:

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KPRIET

U21EEP43	SOLAR ENERGY TECHNOLOGY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce the fundamentals of solar radiation and energy conversion
- To enable students to analyze solar thermal and photovoltaic systems
- To develop ability to evaluate solar energy applications

COURSE OUTCOMES

Upon completion of the course, the student will be able to

CO1: Explain solar radiation principles and estimation methods (Understand)
CO2: Apply performance equations of flat plate collectors (Apply)
CO3: Analyze concentrating solar collectors and tracking systems (Analyze)
CO4: Investigate photovoltaic system performance and related technologies (Analyze)
CO5: Apply solar energy system concepts to real-time engineering applications (Apply)

CO-PO MAPPING:

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CO4	3	3	2	1	-	1	2	-	-	-	1	2	-	3
CO5	3	2	3	1	-	1	2	-	-	-	1	2	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I SOLAR RADIATION 9

Source of radiation – Sun earth relationship – Extra-terrestrial radiation – Atmospheric attenuation - Solar constant – Monthly average daily global radiation and diffuse radiations – Radiation Measurement instruments

UNIT II SOLAR FLAT PLATE COLLECTORS 9

Design considerations – classification – Flat plate collectors – air heating collector's liquid heating - Temperature distributions – Heat removal rate – Useful energy gain – Losses in the collectors – Testing of flat plate collectors.

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UNIT III SOLAR COLLECTORS 9

Solar collectors: Types, Materials, Construction and operation – Cylindrical, Parabolic collector, Compound parabolic collector: orientation and tracking modes – Geometry – Tracking requirements.

UNIT IV PHOTOVOLTAIC SYSTEMS 9

Conversion of Solar energy into Electricity – Photovoltaic Effect, Photovoltaic material – Solar Cell Module – Silicon solar cell and types – Efficiency of solar cells – PV Systems, Photovoltaic applications.

UNIT V APPLICATIONS 9

Solar thermal power plant – Solar desalination – Solar dryer – Solar water heating – Solar air heating – Solar cookers – Solar air conditioning – Solar pumps.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Soteris Kalogirou, "Solar Energy Engineering: Processes and Systems", 2nd Edition, Academic Press, 2013.
2. Duffie JA and Beckman WA, "Solar Engineering of Thermal Processes", 4th Edition, Wiley, 2013
3. Solanki, "Solar Photovoltaics: fundamentals, technologies and applications" 2nd Edition, PHI Learning, 2011

REFERENCES:

1. Sukhatme SP, "Solar Energy", Tata McGraw-Hill Education, 3rd Edition, 2008.
2. Garg HP and Prakash J, "Solar Energy - Fundamentals & Applications", Tata McGrawHill, 2000.

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KPRIET

U21EEP44	BIO ENERGY TECHNOLOGY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- Nil

COURSE OBJECTIVES:

- To create awareness about bio-energy resources and conversion processes
- To enable students to analyze bio-energy technologies.
- To develop capability to evaluate bio-energy systems economically and environmentally

COURSE OUTCOMES

Upon completion of the course, the student will be able to

CO1: Explain bio-energy resources and Indian bio-energy scenario (Understand)
CO2: Apply bio-methanation and combustion principles (Apply)
CO3: Analyze gasification techniques and performance (Analyze)
CO4: Examine pyrolysis and carbonization processes used in bio-energy conversion (Apply)
CO5: Apply bio-energy system concepts to address safety and economic considerations (Apply)

CO-PO MAPPING:

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CO5	3	2	3	1	-	1	2	-	-	-	1	2	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

SYLLABUS:

UNIT I INTRODUCTION 9

Biomass: Current scenario – Types and Characteristics– Conversion mechanisms – Carbon neutrality - Fuel assessment studies

UNIT II BIO METHANATION 9

Microbial systems – Biogas production – Impact of gas production– Effect of additives on biogas yield – Feedstocks - Biogas plants: Types, construction, operation – Biogas appliances: Burner, illumination and power generation – Kinetics and mechanism – Digesters treatment.

UNIT III COMBUSTION 9

Perfect, complete, incomplete – equivalence ratio – fixed Bed, fluid Bed – fuel and ash handling – Briquetting: types of Briquetting – feed requirements and preprocessing

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UNIT IV GASIFICATION 9

Types – comparison – application – performance evaluation – economics – dual fuel engines – Gas Engines – engine characteristics on gas mode – gas cooling and cleaning train.

UNIT V PYROLYSIS AND CARBONIZATION 9

Pyrolysis –Types – process governing parameters – differential thermal analysis – differential scanning calorimetry – Typical yield rates. Effect of carbonization temperature on yield and composition of charcoal- Industrial safety in carbonization

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Mahendra S. Sevada, Pradip D. Narale and Suhir N. Kharpude, "Bioenergy Engineering", 1st edition, CRC Press, 2021
2. Madhumi Mitra and Abhijit Nagchaudhuri, "Practices and Perspectives in Sustainable Bioenergy", 1st edition, Springer, 2020

REFERENCES:

1. Augustine O. Ayeni, Samuel Eshorame Sanni and Solomon U. Oranusi, "Bioenergy and Biochemical Processing Technologies", 1st edition, Springer, 2022
2. Emmanuel D. Rogdakis, Irene P. Koronaki, "Renewable Energy Engineering: Solar, Wind, Biomass, Hydrogen and Geothermal Energy systems", 1st edition, Bentham Books, 2018

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LEARN BEYOND

U21EEP45	WIND ENERGY TECHNOLOGY	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

Nil

COURSE OBJECTIVES:

- To develop the ability to assess wind characteristics and wind energy resource potential
- To build competence in analyzing wind turbine aerodynamics and performance characteristics
- To foster analytical skills for evaluating wind farm operation, control strategies, and economic aspects

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze wind data to estimate energy potential (Analyze)

CO2: Examine aerodynamic theories and measurements to assess wind turbine performance (Analyze)

CO3: Design control, safety, and SCADA systems for wind turbine operation (Apply)

CO4: Investigate wind farm siting, grid integration, and environmental impacts (Analyze)

CO5: Analyze the economic feasibility of wind energy systems using cost and value analysis (Analyze)

CO-PO MAPPING:

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SYLLABUS:

UNIT I WIND CHARACTERISTICS AND RESOURCES **9**

Characteristics of the Wind Resource – Characteristics of the Atmospheric Boundary Layer – Wind Data Analysis and Resource Estimation – Regional Wind Resource Assessment

UNIT II AERODYNAMICS OF WIND TURBINE **9**

Wind Measurement - One-dimensional Momentum Theory and the Betz Limit – Ideal Horizontal Axis Wind Turbine with Wake Rotation – Air foils - Performance - Horizontal and Vertical Axis Wind Turbines

UNIT III MODERN WIND TURBINE CONTROL AND MONITORING SYSTEM **9**

Pitch and Yaw Systems – Protections and Safety Consideration in Wind Turbines – Wind Turbine Monitoring – SCADA - Operation & Maintenance for Product Life Cycle

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UNIT IV WIND FARMS 9

Wind Farms – Site selection – Installation and Operation Issues – Wind farms in electrical grids-environmental concerns - Radio waves interference

UNIT V ECONOMICS ANALYSIS 9

Economic Assessment of Wind Energy Systems – Capital Costs - Operation and Maintenance Costs – Value of Wind Energy – Economic Analysis Methods

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. T Burton, et.al, "Wind Energy Handbook", 3rd Edition, John Wiley and Sons, 2021
2. J.F. Manwell, et.al, "Wind Energy Explained", 3rd Edition, John Wiley and Sons, 2019

REFERENCES:

1. D. A. Spera, "Wind Turbine Technology: Fundamental concepts of Wind Turbine Engineering", 2nd Edition, ASME Press, 2016
2. William W. Peng, "Fundamentals of turbo machinery", John Wiley and Sons, 2016
3. Mukund. R. Patel, "Wind and solar power systems" 2nd Edition, Taylor & Francis, 2006

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<tr><td>*Individual Assignment / Case Study / Seminar / Project / MCQ</td><td>Written Test</td><td>*Individual Assignment / Case Study / Seminar / Project / MCQ</td><td>Written Test</td><td></td></tr>
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<tr><td colspan="4" rowspan="2">Total</td><td>40</td><td>60</td></tr>
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</table>

*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Designer can choose any one / two components based on the nature of the course.

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KPRIET

		Category: PEC				
U21EEP46	ENERGY EFFICIENT BUILDINGS	L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

Nil

COURSE OBJECTIVES:

- To develop the ability to explain green building concepts, sustainable materials, and indoor environmental quality
- To build analytical competence in evaluating climatic factors, thermal comfort, and passive design strategies for energy-efficient buildings
- To foster the capability to assess building energy management practices, energy audits, and monitoring techniques

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze building envelope, materials, and indoor environmental quality for green buildings. (Analyze)

CO2: Design passive heating, cooling, and daylighting systems for energy-efficient buildings (Apply)

CO3: Examine human comfort, sol-air temperature, and ventilation for indoor environmental design (Analyze)

CO4: Investigate climate and microclimate effects on building design (Analyze)

CO5: Develop building energy management, audits, and monitoring tools (Apply)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1	-	1	2	-	-	-	-	1	-	3
CO2	2	3	2	1	-	1	2	-	-	-	-	1	-	3
CO3	2	3	2	1	-	1	2	-	-	-	-	1	-	3
CO4	2	3	2	1	-	1	2	-	-	-	-	1	-	3
CO5	2	3	2	1	-	1	2	-	-	-	-	1	-	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)					

SYLLABUS:

UNIT I GENERAL ASPECTS 9

Building Envelope – Building Materials – Green building standards - Indoor Environment - Components of Indoor Environment. Quality of Indoor Environment.

UNIT I ENERGY CONSCIOUS IN BUILDINGS 9

Heating – Passive Heating – Direct Gain – Indirect Gain – Isolated Gain-Solarium – Cooling: Passive Cooling –Ventilation Cooling – Evaporative Cooling – Nocturnal Radiation Cooling Desiccant Cooling – Earth Coupling - Principles of Daylighting systems.

UNIT I I HUMAN COMFORT 9

Human Comfort –Thermal, Visual, Acoustical and Olfactory comfort – Sol-air temperature and its significance – Ventilation calculation and significance

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UNIT IV CLIMATE ZONES 9

Climatic zones and their characteristics – Factors affecting climate – Implications of climate on building design – Urban climate – Microclimate

UNIT V ENERGY MANAGEMENT SYSTEM 9

Energy Management of Buildings – Energy Audit of Buildings. – Energy management matrix - Tools - Monitoring and targeting.

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXTBOOKS:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.
2. Green Building Hand Book by Tom Woolley and Samkimings, 2009.

REFERENCES:

1. Hand book on Energy Conscious Buildings (http://mnre.gov.in/centers/about-sec-2/handbook-on-energy-conscious-buildings/)
2. J.K. Nayak and J.A. Prajapati, "Handbook on Energy Conscious Buildings, Solar Energy Control", MNES, 2017
3. Energy Conservation Building Codes 2017; Bureau of Energy Efficiency.

EVALUATION PATTERN:

Continuous Internal Assessments					
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments	End Semester Examinations
*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Project / MCQ	Written Test		
40	60	40	60	200	100
Total				40	60
				100	

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LEARN BEYOND

U21EEP47	ELECTRICAL ENERGY UTILIZATION AND COST ESTIMATION	Category: PE				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

Nil

COURSE OBJECTIVES:

- To develop the ability to analyze electric traction systems, load management practices, and energy-efficient utilization of electrical energy
- To build competence in evaluating lighting and electrical systems for efficient power usage
- To foster the capability to design and estimate electrical installations, including wiring practices and cost

COURSE OUTCOMES

Upon completion of the course, the student will be able to

CO1: Analyze traction motor control, braking, and modern electric railway systems (Analyze)

CO2: Investigate load management and tariff methods to improve energy efficiency (Analyze)

CO3: Examine lighting systems and lamp types for efficient illumination design (Analyze)

CO4: Design electrical estimation, costing, and material selection for building installations (Apply)

CO5: Design wiring, protection and load calculations for residential installations (Apply)

CO-PO MAPPING:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO5	3	2	2	1	-	1	1	-	-	-	1	1	2	-
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)			3: Substantial (High)								

SYLLABUS:

UNIT I ELECTRIC TRACTION SYSTEM **9**

Traction motor characteristics – Starting and speed control – Electric braking – Energy recovered using regenerative braking – Power of electric traction – Use of electronic control of traction motor – Track equipment and collection gear – Block diagram of a modern locomotive – Metro-rail system.

UNIT II ECONOMIC ASPECTS OF UTILIZATION **9**

Load curves – Load factors and its improvement – Availability based tariff – Demand side management – Peak clipping – Peak shifting – Valley filling – Use of off-peak energy – Case studies on energy efficiency in thermal and electrical utilities (Quantitative analysis only)

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UNIT III DESIGN OF ILLUMINATION SCHEMES 9

Illumination engineering – Lamp types – Incandescent lamp, fluorescent lamp – Design of illumination systems – Different lighting scheme & their design methods – Flood and street lighting – CFL, OCFL, and LED lighting system

UNIT IV ESTIMATION AND COSTING 9

Estimation and costing – Electrical schedule, catalogues, market survey and source selection, bill of materials – Purchase system – Estimation and costing: electrical installation for residential buildings, commercial buildings and small industries

UNIT V ELECTRICAL INSTALLATION 9

Guidelines for wiring of residential installation and positioning of equipment – Circuit design in light and power circuits – Selection of wires and cables – Load calculations and selection of conductor– Selection of switch rating, protective switchgear ELCB, MCB and wiring accessories – Case studies- House wiring

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. Openshaw Taylor E., "Utilization of Electric Energy in SI Units", reprint, Universities Press, Hyderabad, 2011
2. Wayne J. Del Pico, "Electrical Estimating Methods", 4thedition, John Wiley & Sons, 2015

REFERENCES:

1. Wadhwa C.L., "Generation, Distribution and Utilization of Electrical Energy", 3rd edition, New Academic Science, 2011
2. Rajput R.K., "Utilization of Electrical Power", 2ndedition,Laxmi Publication Pvt. Ltd, 2013
3. Rajiv Shankar, "Energy Auditing in Electrical Utilities", Viva Books, 2014

EVALUATION PATTERN:

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LEARN BEYOND

U2' EEP48	ENERGY MANAGEMENT AND AUDITING	Category: PEC				
		L	T	P	J	C
		3	0	0	0	3

PRE-REQUISITES:

- N I

COURSE OBJECTIVES:

- To develop the ability to explain global and Indian energy resources, consumption patterns, and energy policies
- To build analytical competence in assessing energy management practices, conservation methods, and energy audit procedures
- To foster the capability to evaluate project finance aspects and environmental sustainability in energy systems

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

CO1: Analyze energy resources, consumption patterns, and policy in India and globally (Analyze)

CO2: Apply energy conservation laws, BEE schemes, and national energy policies in practice (Apply)

CO3: Investigate energy management and audit procedures using benchmarking and performance data (Analyze)

CO4: Model project finance, risk, and planning methods for energy projects (Apply)

CO5: Examine energy–environment interactions and global climate policies for sustainable development (Analyze)

CO-PO MAPPING:

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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SYLLABUS:

UNIT I ENERGY SCENARIO 9

Primary and secondary energy – Commercial and non-commercial energy – Global primary energy reserves – Energy consumption – Indian energy scenario – Sector wise energy consumption in India – Energy needs of growing economy – Integrated energy policy – Purchasing power parity

UNIT II ENERGY CONSERVATION ACTS AND POLICIES 9

Energy conservation – Importance – Features of energy conservation act – Schemes of BEE – Electricity acts – Integrated energy policy – National action plan on climate change.

UNIT III ENERGY MANAGEMENT AND ENERGY AUDIT 9

Energy Management – Need for energy audit – Types – Costs – Benchmarking – Energy performance – Instruments and metering for audit – Audit procedures and time intervals – Case study.

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UNIT IV FINANCIAL AND PROJECT MANAGEMENT 9

Financial analysis techniques – Cash flow – Sensitivity and risk analysis – Financing options – ESCOs – Project development cycle – Project planning techniques

UNIT V ENERGY EFFICIENCY AND CLIMATE CHANGE 9

Energy and environment – Global environmental issues – Ozone layer depletion – Global warming and climate change – UNFCCC – IPCC – COP – Kyoto Protocol – Sustainable development

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Project – Periods

Total 45 Periods

TEXT BOOKS:

1. "General Aspects of Energy Management and Energy Audit", 4th edition, Bureau of Energy Efficiency, New Delhi, India, 2015
2. Wayne C. Turner, Steve Doty, "Energy Management Handbook", 6th edition, CRC Press, 2006
3. K V Sharma and P Venkataseshaiah, "Energy Management and Conservation", 1st edition, International Publishing House pvt.ltd,2011.

REFERENCES:

1. Albert Thumann, William J. Younger, "Handbook of Energy Audits", 9th Edition, Taylor & Francis Group, 2013
2. Rajiv Shankar, "Energy Auditing in Electrical Utilities", Viva Books, 2014
3. Rajan, G.G., "Optimizing Energy Efficiencies in Industry", Tata McGraw Hill Publication Company, 2001

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(Autonomous, NAAC "A")

0422 2635600, +91 75488 88444

admission@kpriet.ac.in

Avinashi Road, Arasur, Coimbatore - 641407

kpriet.edu.in /KPRIETonline