B.E (Electrical and Electronics Engineering)

2018 Regulations , Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai
Approved by AICTE , NAAC with 'A^{+}' Grade)
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CONTENTS

VISION OF THE DEPARTMENT

- To offer world-class education, by providing Academic and Professional competence in tune withtechnological and societal aspirations.

MISSION OF THE DEPARTMENT

- To produce globally competent Electrical and Electronics Engineers through continuously evolvingteaching and learning process.
- To promote the knowledge and skills of students, members of faculty and supporting staff throughprofessional training.
- To induce the young minds of engineers to meet the expectations of industry and society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

On successful completion of four year BE degree programme quite a few yearsafter graduation our graduates will

PEO1: Apply, analyze, design and create products and solutions for real-life Electrical and ElectronicsEngineering problems.

PEO2: Function effectively in multidisciplinary teams with technical competency to develop sustainablesolutions for global, environmental and societal needs in an ethical way.

PEO3: Update their domain knowledge to attain continuous career enhancement / to be an entrepreneurand to adapt themselves to life-long learning.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

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

b. **Problem Analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

c. **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.

d. **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.

e. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **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.

h. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **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.

k. **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.

l. **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.

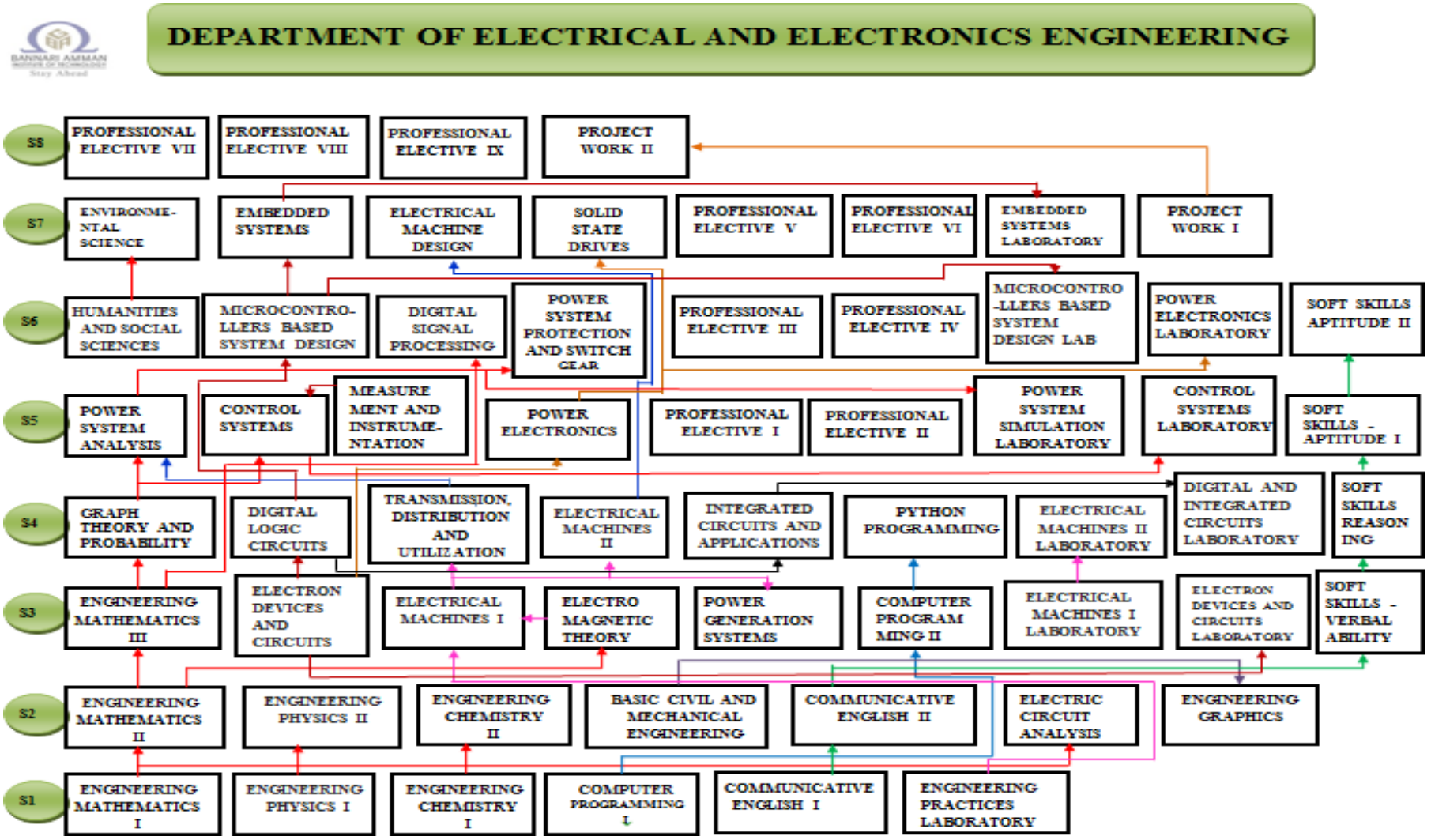
PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

2. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

MAPPING OF PEOs and POs

POs	a	b	c	d	e	f	g	h	i	j	k	l
PEO1	X	X	X	X	X		X	X	X	X		X
PEO2	X		X	X	X	X		X	X	X	X	
PEO3	X	X		X		X	X				X	X


DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
S8
PROFESSIONAL ELECTIVE VII
PROFESSIONAL ELECTIVE VIII
PROFESSIONAL ELECTIVE IX
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S7
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ELECTRICAL MACHINE DESIGN
SOLID STATE DRIVES
PROFESSIONAL ELECTIVE V
PROFESSIONAL ELECTIVE VI
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PROJECT WORK I
S6
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MICROCONTROLLERS BASED SYSTEM DESIGN
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ELECTRICAL MACHINES II
INTEGRATED CIRCUITS AND APPLICATIONS
PYTHON PROGRAMMING
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DIGITAL AND INTEGRATED CIRCUITS LABORATORY
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S3
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ELECTRICAL MACHINES I
ELECTRO MAGNETIC THEORY
POWER GENERATION SYSTEMS
COMPUTER PROGRAMMING II
ELECTRICAL MACHINES I LABORATORY
ELECTRON DEVICES AND CIRCUITS LABORATORY
SOFT SKILLS - VERBAL ABILITY
S2
ENGINEERING MATHEMATICS II
ENGINEERING PHYSICS II
ENGINEERING CHEMISTRY II
BASIC CIVIL AND MECHANICAL ENGINEERING
COMMUNICATIVE ENGLISH II
ELECTRIC CIRCUIT ANALYSIS
ENGINEERING GRAPHICS
S1
ENGINEERING MATHEMATICS I
ENGINEERING PHYSICS I
ENGINEERING CHEMISTRY I
COMPUTER PROGRAMMING
COMMUNICATIVE ENGLISH I
ENGINEERING PRACTICES LABORATORY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Minimum Credits to be Earned: 170

I SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18EE101	ENGINEERING MATHEMATICS I	3	1	0	4	4	50	50	100	BS
18EE102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18EE103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18EE104	COMPUTER PROGRAMMING I	2	0	2	3	5	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
18EE106	ENGINEERING PRACTICES LABORATORY	0	0	4	2	4	100	0	100	ES
Total		**10**	**1**	**12**	**17**	**24**	**400**	**200**	**600**	**-**
II SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18EE201	ENGINEERING MATHEMATICS II	3	1	0	4	4	50	50	100	BS
18EE202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
18EE203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18EE204	BASIC CIVIL AND MECHANICAL ENGINEERING	3	0	0	3	3	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
18EE206	ELECTRIC CIRCUIT ANALYSIS	3	0	2	4	5	50	50	100	ES
18EE207	ENGINEERING GRAPHICS	1	0	4	3	5	100	0	100	ES
Total		**15**	**1**	**12**	**22**	**28**	**450**	**250**	**700**	**-**

III SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18EE301	ENGINEERING MATHEMATICS III	3	1	0	4	4	50	50	100	BS
18EE302	ELECTRON DEVICES ANDCIRCUITS	3	0	0	3	3	50	50	100	PC
18EE303	ELECTRICAL MACHINES I	3	1	0	4	4	50	50	100	PC
18EE304	ELECTROMAGNETIC THEORY	3	1	0	4	4	50	50	100	ES
18EE305	POWER GENERATION SYSTEMS	3	0	0	3	3	50	50	100	PC
18EE306	COMPUTER PROGRAMMING II	3	0	2	4	5	50	50	100	ES
18EE307	ELECTRICAL MACHINES I LABORATORY	0	0	2	1	2	100	0	100	PC
18EE308	ELECTRON DEVICES ANDCIRCUITS LABORATORY	0	0	2	1	2	100	0	100	PC
18GE301	SOFT SKILLS - VERBALABILITY	0	0	2	-	2	100	0	100	EEC
Total		**18**	**3**	**8**	**24**	**29**	**600**	**300**	**900**	**-**

IV SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18EE401	GRAPH THEORY AND PROBABILITY	3	1	0	4	4	50	50	100	BS
18EE402	DIGITAL LOGIC CIRCUITS	3	1	0	4	4	50	50	100	PC
18EE403	TRANSMISSION , DISTRIBUTION AND UTILIZATION	3	0	0	3	3	50	50	100	PC
18EE404	ELECTRICAL MACHINES II	3	1	0	4	4	50	50	100	PC
18EE405	INTEGRATED CIRCUITS AND APPLICATIONS	3	0	0	3	3	50	50	100	PC
18EE406	PYTHON PROGRAMMING	2	0	2	3	4	50	50	100	ES
18EE407	ELECTRICAL MACHINES II LABORATORY	0	0	2	1	2	100	0	100	PC
18EE408	DIGITAL AND INTEGRATED CIRCUITS LABORATORY	0	0	2	1	2	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
18GE401	SOFT SKILLS – BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		**19**	**3**	**8**	**23**	**30**	**700**	**300**	**1000**	**-**

V SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18EE501	POWER SYSTEM ANALYSIS	3	1	0	4	4	50	50	100	PC
18EE502	CONTROL SYSTEMS	3	1	0	4	4	50	50	100	PC
18EE503	MEASUREMENT AND INSTRUMENTATION	3	0	2	4	5	50	50	100	PC
18EE504	POWER ELECTRONICS	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	50	50	100	PE
18EE507	POWER SYSTEM SIMULATION LABORATORY	0	0	2	1	2	100	0	100	PC
18EE508	CONTROL SYSTEMS LABORATORY	0	0	2	1	2	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		**18**	**2**	**8**	**23**	**28**	**600**	**300**	**900**	**-**

VI SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
18HS003	PRINCIPLES OF MANAGEMENT	2	0	0	2	2	50	50	100	HSS
18EE602	MICROCONTROLLERS BASED SYSTEM DESIGN	3	0	0	3	3	50	50	100	PC
18EE603	DIGITAL SIGNAL PROCESSING	3	1	0	4	4	50	50	100	PC
18EE604	POWER SYSTEM PROTECTION AND SWITCH GEAR	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	50	50	100	PE
18EE607	MICROCONTROLLERS BASED SYSTEM DESIGN LAB	0	0	2	1	2	100	0	100	PC
18EE608	POWER ELECTRONICS LABORATORY	0	0	2	1	2	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		**17**	**1**	**6**	**20**	**24**	**600**	**300**	**900**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS002	PROFESSIONAL ETHICS IN ENGINEERING	2	0	0	2	2	50	50	100	HSS
18EE702	EMBEDDED SYSTEMS	3	0	0	3	3	50	50	100	PC
18EE703	ELECTRICAL MACHINE DESIGN	3	1	0	4	4	50	50	100	PC
18EE704	SOLID STATE DRIVES	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	50	50	100	PE
18EE707	EMBEDDED SYSTEMS LABORATORY	0	0	2	1	2	100	0	100	PC
18EE708	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
Total		**17**	**1**	**10**	**23**	**28**	**450**	**350**	**800**	**-**
VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	50	50	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	50	50	100	PE
18EE804	PROJECT WORK II	0	0	18	9	18	50	50	100	EEC
Total		**9**	**0**	**18**	**18**	**27**	**200**	**200**	**400**	**-**

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
PHYSICS ELECTIVES										
18GE0P1	NANOMATERIALS SCIENCE	3	0	0	3	3	50	50	100	BS
18GE0P2	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	50	50	100	BS
18GE0P3	APPLIED LASER SCIENCE	3	0	0	3	3	50	50	100	BS
CHEMISTRY ELECTIVES										
18GE0C1	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	50	50	100	BS
18GE0C2	ENERGY STORING DEVICES	3	0	0	3	3	50	50	100	BS
18GE0C3	POLYMER SCIENCE	3	0	0	3	3	50	50	100	BS
MATHEMATICS ELECTIVES										
18GE0M1	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	50	50	100	BS
18GE0M2	ALGEBRA AND NUMBER THEORY	3	0	0	3	3	50	50	100	BS
18GE0M3	MATHEMATICAL FINANCE AND QUEUEING THEORY	3	0	0	3	3	50	50	100	BS
ENTREPRENEURSHIP ELECTIVES										
18GE0E1	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	50	50	100	PE
18GE0E2	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	50	50	100	PE
DISCIPLINE ELECTIVES										
18EE001	ADVANCED POWER SEMICONDUCTOR DEVICES	3	0	0	3	3	50	50	100	PE
18EE002	SPECIAL ELECTRICAL MACHINES	3	0	0	3	3	50	50	100	PE
18EE003	HIGH VOLTAGE ENGINEERING	3	0	0	3	3	50	50	100	PE

18EE004	POWER SYSTEM CONTROL	3	0	0	3	3	50	50	100	PE
18EE005	POWER QUALITY	3	0	0	3	3	50	50	100	PE
18EE006	ENERGY STORAGE SYSTEMS	3	0	0	3	3	50	50	100	PE
18EE007	POWER PLANT INSTRUMENTATION AND CONTROL	3	0	0	3	3	50	50	100	PE
18EE008	INDUSTRIAL ELECTRONICS	3	0	0	3	3	50	50	100	PE
18EE009	VLSI DESIGN	3	0	0	3	3	50	50	100	PE
18EE010	ARTIFICIAL INTELLIGENCE TECHNIQUES	3	0	0	3	3	50	50	100	PE
18EE011	COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS	3	0	0	3	3	50	50	100	PE
18EE012	BIO MEDICAL INSTRUMENTATION	3	0	0	3	3	50	50	100	PE
18EE013	ADVANCED CONTROL SYSTEMS	3	0	0	3	3	50	50	100	PE
18EE014	ELECTRICAL AND HYBRID VEHICLES	3	0	0	3	3	50	50	100	PE
18EE015	SMART GRID TECHNOLOGIES	3	0	0	3	3	50	50	100	PE
18EE016	FLEXIBLE AC TRANSMISSION SYSTEMS	3	0	0	3	3	50	50	100	PE
18EE017	ILLUMINATION ENGINEERING	3	0	0	3	3	50	50	100	PE
18EE018	ENERGY AUDITING	3	0	0	3	3	50	50	100	PE
18EE019	RENEWABLE ENERGY SOURCES	3	0	0	3	3	50	50	100	PE
18EE020	AUTOMOTIVE ELECTRONICS	3	0	0	3	3	50	50	100	PE
18EE021	COMPUTER NETWORKING	3	0	0	3	3	50	50	100	PE
18EE022	INTERNET OF THINGS	3	0	0	3	3	50	50	100	PE
18EE023	DIGITAL IMAGE PROCESSING	3	0	0	3	3	50	50	100	PE
18EE024	COMMUNICATION ENGINEERING	3	0	0	3	3	50	50	100	PE
18EE025	AUTOMATION AND CONTROL	3	0	0	3	3	50	50	100	PE
18EE026	SIGNALS AND SYSTEMS	3	0	0	3	3	50	50	100	PE
18EE027	POWER SYSTEM DEREGULATION	3	0	0	3	3	50	50	100	PE
18EE028	WIND AND SOLAR ENERGY CONVERSION SYSTEM	3	0	0	3	3	50	50	100	PE
18EE029	INTEGRATION OF SCIENCE AND TECHNOLOGY IN INDUSTRY 4.0	3	0	0	3	3	50	50	100	PE
18EE030	ELECTRIC VEHICLE CHARGING STATION	3	0	0	3	3	50	50	100	PE
18EE031	POWER SYSTEM FOR ELECTRIC VEHICLE	3	0	0	3	3	50	50	100	PE

OPEN ELECTIVES										
18EE0YA	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	3	50	50	100	ES
18EE0YB	ELECTRICAL SAFETY	3	0	0	3	3	50	50	100	ES
18EE0YC	INDUSTRIAL DRIVES AND CONTROL	3	0	0	3	3	50	50	100	ES
ONE CREDIT COURSES										
18EE0XA	EMBEDDED CONTROL OF ELECTRIC DRIVES	0	0	0	1		100	0	100	EEC
18EE0XB	DESIGN OF EMBEDDED SYSTEM FOR DC MOTOR CONTROL	0	0	0	1		100	0	100	EEC
18EE0XC	INDUSTRIAL AUTOMATION	0	0	0	1		100	0	100	EEC
18EE0XD	QUALITY MANAGEMENT SYSTEM	0	0	0	1		100	0	100	EEC
18EE0XE	PRODUCT LIFECYCLE MANAGEMENT	0	0	0	1		100	0	100	EEC
18EE0XF	APPLICATIONS OF SYNCHRONOUS GENERATOR IN INDUSTRIES	0	0	0	1		100	0	100	EEC
18EE0XG	REACTIVE POWER MANAGEMENT AND ENERGY STORAGE DEVICES	0	0	0	1		100	0	100	EEC
18EE0XH	SUBSTATION DESIGN	0	0	0	1		100	0	100	EEC
18EE0XI	DESIGN OF GRID TIED SOLAR PV SYSTEM	0	0	0	1		100	0	100	EEC
18EE0XJ	DESIGN OF INDOOR AND OUTDOOR LIGHTING USING DIALUX	0	0	0	1		100	0	100	EEC
18EE0XK	DESIGN OF POWER CONVERTERS FOR INDUSTRIAL APPLICATION	0	0	0	1		100	0	100	EEC
18EE0XL	LITHIUM BATTERY TECHNOLOGY FOR EV	0	0	0	1		100	0	100	EEC
18EE0XM	POWER PLANT AUTOMATION USING SCADA AND DCS	0	0	0	1		100	0	100	EEC
18EE0XN	POWER SYSTEMS DESIGN AND ANALYSIS USING ETAP	0	0	0	1		100	0	100	EEC
18EE0XO	LOAD FORECASTING IN SOLAR POWER PLANTS	0	0	0	1		100	0	100	EEC
18EE0XP	PCB FABRICATION FOR POWER CONVERTERS	0	0	0	1		100	0	100	EEC

ADDITIONAL ONE CREDIT COURSE										
18GE0XA	ETYMOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XB	GENERAL PSYCHOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XC	NEURO BEHAVIORAL SCIENCE	-	-	-	1	-	100	0	100	EEC
18GE0XD	VISUAL MEDIA AND FILM MAKING	-	-	-	1	-	100	0	100	EEC
18GE0XE	YOGA FOR HUMAN EXCELLENCE	-	-	-	1	-	100	0	100	EEC
18GE0XF	VEDIC MATHEMATICS	-	-	-	1	-	100	0	100	EEC
18GE0XG	HEALTH AND FITNESS	-	-	-	1	-	100	0	100	EEC
18GE0XH	CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING	-	-	-	1	-	100	0	100	EEC
18GE0XI	BLOG WRITING	-	-	-	1	-	100	0	100	EEC
18GE0XJ	INTERPERSONAL SKILLS	-	-	-	1	-	100	0	100	EEC
18GE0XK	COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT	-	-	-	1	-	100	0	100	EEC
18GE0XL	NATIONAL CADET CORPS	-	-	-	1	-	100	0	100	EEC
18GE0XM	NEW AGE INNOVATION AND ENTREPRENEURSHIP	-	-	-	1	-	100	0	100	EEC
18GE0XN	DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES	-	-	-	1	-	100	0	100	EEC
18GE0XO	SOCIAL PSYCHOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XP	FM RADIO BROADCASTING TECHNOLOGY	-	-	-	1	-	100	0	100	EEC

VALUE ADDED COURSES	
18EEV01	ORCAD
18EEV02	HANDS ON TRAINING ON DESIGN OF CONTROLLERS FOR POWERCONVERTERS
18EEV03	IOT BASED SYSTEM DESIGN
18EEV04	ELECTRONIC CIRCUIT DESIGN
18EEV05	COMPUTER AIDED DESIGN AND ANALYSIS OF ELECTRICAL SYSTEM
18EEV06	DESIGN OF POWER CONVERTERS FOR ELECTRICAL MACHINES

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	4	4					28	16	15%	20%
2	ES	5	10	8	3					26	15	15%	20%
3	HSS	2	2				2	2		8	5	5%	10%
4	PC			12	16	17	12	12		69	41	30%	40%
5	PE					6	6	6	9	27	16	10%	15%
6	EEC							3	9	12	7	10%	15%
Total		17	22	24	23	23	20	23	18	170	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

18EE101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and Eigen vectors for different matrices to describe the stability of the linear systems in engineering fields.
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Apply the principles of coordinate systems in the complex plane and characteristics of linear systems by Eigen values and Eigen vectors.
2. Analyse various types of functions and their differentiation techniques involved in engineering fields.
3. Apply different methods of integration to solve the engineering problems.
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-
2	2	2	-	-	-	-	-	-	-	-	-	-	3	-
3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
4	1	2	-	-	-	-	-	-	-	-	-	-	2	-
5	2	2	-	-	-	-	-	-	-	-	-	-	3	-

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices : Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices:

integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, L Hopital s Rule. Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution.

UNIT V **9 Hours**

COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchy s Integral Formula - Classification of Singularities - Cauchy s Residue Theorem.

FOR FURTHER READING

Quadratic forms - Application of conic sections, quadratic surfaces - discrete dynamical systems - Triple integral in polar coordinates-Formation of Bus Admittance Matrices. Applications of mass spring system in ordinary differential equations of higher order.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi, 2016.
3. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995
4. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.
5. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.

18EE102 ENGINEERING PHYSICS I 2 0 2 3

Course Objectives

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Apply the Newton's three laws of motion to solve the real world problems involving elevator, at wood machine and acceleration of objects.
2. Differentiate the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations.
3. Analyse the electric and magnetic elements using the fundamental laws and properties of electricity and magnetism.
4. Justify the characteristics of mirrors, lenses, microscopes and diffraction gratings using the concepts of physical and geometrical optics
5. Conclude the wave and particle nature of matter with special theory of relativity and quantum physics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	2	2	-	-	1	-
2	2	1	-	-	-	-	-	-	2	2	-	-	2	-
3	2	2	-	-	-	-	-	-	2	2	-	-	1	-
4	2	2	-	-	-	-	-	-	2	2	-	-	2	-
5	2	1	-	-	-	-	-	-	2	2	-	-	1	-

UNIT I **6 Hours**

MECHANICS

Newtons laws of motion: Concept of force and its nature - Newtons first law and inertial frames - definition of mass - Newtons second law-gravitational force and weight - Newtons third law. Applications of Newtons laws: particle in equilibrium, particle under net force - weighing a mass in an elevator, the atwood machine and acceleration of two objects connected by a cord

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion - energy of simple harmonic oscillator - spring mass system - time period of simple pendulum, compound pendulum and torsional pendulum - Damped oscillations. Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission - rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges - electric fields - Gauss law and its applications - electric potential - capacitance - energy stored in a capacitor. Concept and source of magnetic fields - Amperes theorem - determination of magnetic field due to different current distributions - Faradays law - self-induction and mutual induction - energy stored in an inductor

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light - laws of reflection and refraction - refractive index and Snells law - dispersion of light - total internal reflection - image formation: concave mirrors - convex mirrors - thin lenses - compound microscope - human eye. Conditions of interference - Youngs double slit experiment - intensity distribution of interference - phase change due to reflection - diffraction-narrow slit diffraction - single slit and two slit - intensity distribution - diffraction grating – applications.

UNIT V **6 Hours**

MODERN PHYSICS

Special theory of relativity - simultaneity and time dilation - twin paradox - length contraction - relativistic mass variation - space time graph. Black body radiation and Planck hypothesis - allowed energy levels - thermal radiation from different objects - photoelectric and Compton effect. Matter waves - de-Broglie hypothesis - wave nature of particles - Davission-Germer experiment

1 **5 Hours**

EXPERIMENT 1

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

2 **5 Hours**

EXPERIMENT 2

Determination of moment of inertia-Torsional pendulum

3 **5 Hours**

EXPERIMENT 3

Determination of wavelength of mercury spectral lines-spectrometer

4 **4 Hours**

EXPERIMENT 4

Determination of refractive index of solid and liquid-travelling microscope

5 **3 Hours**

EXPERIMENT 5

Determination of wavelength of laser-diffraction grating

6 **4 Hours**

EXPERIMENT 6

Determination of frequency of a tuning fork-Meldes apparatus

7 **4 Hours**

EXPERIMENT 7

Thickness of a thin wire using interference of light-Air wedge method

Total: 60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011
3. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017
4. H D Young and R A Freedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016
5. R K Gaur and S L Gupta, Engineering Physics, Dhanpat Rai Publications, 2012.

18EE103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Recall the terminologies of electrochemistry and explain the function of electrode with its electrochemical reactions.
- Infer the construction, cell reactions and working in batteries.
- Classify the conducting property of the material based on resistivity and predict their applications.
- Outline the fundamentals of corrosion, its types and protection methods.
- Outline the purpose of alloying, properties and its application.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply the electrochemical concepts to determine the electrode potential of the given metal.
2. Analyze the cell reactions taking place during charging and discharging of primary and secondary batteries with its applications and disposal methods.
3. Assess the significance of high-resistivity materials in industrial and electronic applications.
4. Analyze the two mechanisms of corrosion to identify effective corrosion protection methods on metallic objects.
5. Analyze the properties of ferrous and non-ferrous alloys in electronics industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	-	-	-	-	-	2	2	-	-	-	2
2	2	1	-	-	-	-	-	-	2	2	-	-	-	-
3	1	2	-	-	-	-	-	-	2	2	-	-	2	-
4	1	1	-	-	-	-	-	-	2	2	-	-	1	-
5	2	2	-	-	-	-	-	-	2	2	-	-	2	-

UNIT I **7 Hours**

BASICS OF ELECTROCHEMISTRY

Electrodes - types of electrodes. Cells - types - applications - redox reactions and its determination.

UNIT II **6 Hours**

BATTERIES

Batteries - construction - types - primary and secondary -modern batteries - cell reactions and applications - disposal of batteries.

UNIT III **6 Hours**

ELECTRICAL CONDUCTING MATERIALS

Electrical conducting materials - classification based on resistivity - significance of low resistivity metals (Cu, Al and Fe) - thermal conductivity of metals - high resistivity materials and their applications (manganin, constantin, nichrome, mercury, and tungsten.

UNIT IV **6 Hours**

CORROSION CONTROL AND PROTECTIVE COATING

Corrosion - types - galvanic series and its applications. Corrosion control methods: Sacrificial anode and impressed current cathodic method- protective coating - electroplating - electroless plating - application in Printed Circuit Board (PCB).

UNIT V **5 Hours**

ALLOYS

Purpose of alloying - properties and classification of alloys - manufacturing of alloys for electrical machineries.

FURTHER READING

Fuel cells: Principle, construction and applications of hydrogen-oxygen fuel cell, solid oxide fuel cell (SOFC) and proton exchange membrane fuel cell.

1 **4 Hours**

EXPERIMENT 1

Determination of standard electrode potential of electrical conducting metal using calomel as reference electrode.

2 **4 Hours**

EXPERIMENT 2

Construct a cell (using scrap metal/ other sources) exhibiting valid output and compare it with the existing commercial batteries based on output.

3 **4 Hours**

EXPERIMENT 3

Evaluation of chemical earthing materials by the given data analyzed by AAS spectroscopy and their output.

4 **5 Hours**

EXPERIMENT 4

Electroplating of copper on a given target object and estimate the amount of copper at anode.

5 **9 Hours**

EXPERIMENT 5

(a) Determination of corrosion percentage of electrical materials by weight loss method.
(b) Correlation between conductivity and corrosion rates in Fe- Carbon- Steels- Cu under different environments (5)

6 **4 Hours**

EXPERIMENT 6

Estimation of Cu content in brass by EDTA method.

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, NewDelhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012.
3. E.McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010.
4. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
5. O.P Khanna, Materials Science and Metallurgy, Dhanpat Rai Publishing Company, New Delhi, 2013.
6. Electrical and Electronic Engineering Materials, SK Bhattacharya, Khanna Publishers, New Delhi.

18EE104 COMPUTER PROGRAMMING I 2 0 2 3

Course Objectives

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching
c. 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,substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. 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.
l. 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.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Implement C programs using operators, type conversion and input-output functions.
2. Apply decision making and looping statements in writing C programs.
3. Develop C programs using the concepts of Arrays and strings.
4. Apply the concepts of functions and pointers in writing C programs.
5. Design applications using structures, unions and files in C.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	-	3	-	-	-	-	2	-	1	3	-
2	2	1	-	2	3	-	-	-	-	2	-	1	3	-
3	1	3	2	-	3	-	-	-	-	2	-	2	3	-
4	1	3	-	2	3	-	-	-	2	2	1	2	3	-
5	1	3	2	-	3	-	-	1	2	2	2	2	3	-

UNIT I **6 Hours**

INTRODUCTORY CONCEPTS

C Primitives: Introduction to C- Planning and writing a C program- Character Set - Keywords and Identifiers - Data Types - Variables and Constants - Compiling and executing the C program Operators and Expressions: Arithmetic - Relational - Logical - Increment and decrement - Conditional - Bitwise - Comma - Sizeof() - Assignment - Shift operator - Precedence and order of evaluation - Type Conversion

UNIT II **6 Hours**

CONTROL STATEMENTS

Decision Making and Branching: simple if statement - if else statement - nesting of if else Statement - Switch Statement.
Decision Making and Looping: while statement - do while statement - for statement Jump Statements: goto - break - continue - return statement

UNIT III **6 Hours**

ARRAYS AND STRINGS

Arrays: Introduction, one dimensional array, two-dimensional arrays and multi dimensional arrays. Strings: Declaring and initializing string variables- Reading and writing strings - String handling functions.

UNIT IV **6 Hours**

FUNCTIONS AND POINTERS

User Defined Functions: Elements of user defined functions - Definition of functions - return values and their types - function calls - categories of function - call by value and call by reference - recursion Pointers: Understanding Pointers - accessing the address of the variable - declaring pointer variables - Initialization of pointer variables - Accessing a variable through its pointer

UNIT V **6 Hours**

STRUCTURES AND FILES

Storage Class Specifiers: Auto - registers - static - extern - typedef Structures and Unions: Introduction - defining a structure - declaring structure variables - accessing structure members - structure initialization -Unions File Management in C: Defining and opening a file - closing a file - Input/output operations on files.

FOR FURTHER READING

Problem solving - Logical thinking - logic - symbolic logic - truth tables - Math puzzles – magic triangles - magic squares - alphabetic puzzles - Cross number puzzles. Creating and manipulating document using word - Mail merge - Creating spread sheet with charts and formula using excel - developing power point presentation with Animations.

1 **3 Hours**

EXPERIMENT 1

Write a C program to perform arithmetic operations on integers and floating point numbers.

2 **3 Hours**

EXPERIMENT 2

Write a C program to implement ternary operator and relational operators.

3 **3 Hours**

EXPERIMENT 3

Write a C program to read the values of A,B,C through the keyboard. Add them and after addition check if it is in the range of 100 to 200 or not. Print separate message for each.

4 **3 Hours**

EXPERIMENT 4

Write a C program to display the roots of a quadratic equation with their types using switch case.

5 **3 Hours**

EXPERIMENT 5

Write a C program to generate the following triangle.

1
1 2 3
1 2 3 4 5
1 2 3 4 5 6 7

6 **3 Hours**

EXPERIMENT 6

Write a C program to get a matrix of order 3x3 and display a matrix of order of 4x4, with the fourth row and column as the sum of rows and columns respectively.

7 **3 Hours**

EXPERIMENT 7

Write a C program to remove the occurrence of "the" word from entered string.

8 **3 Hours**

EXPERIMENT 8

Write a C program to find the factorial of given number.

9 **3 Hours**

EXPERIMENT 9

Design a structure to hold the following details of a student. Read the details of a student and display them in the following format Student

details: rollno, name, branch, year, section, cgpa.

****

NAME:
ROLL NO:
BRANCH:
YEAR:
SECTION:
CGPA:

10 **3 Hours**

EXPERIMENT 10

Create two files test1.txt and test2.txt and write a C program to read the file text1.txt character by character on the screen and paste it at the end of test2.txt.

Total: 60 Hours

Reference(s)

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013
2. Byron Gottfried , Programming with C, Schaum's Outlines, Tata Mcgraw-Hill, 2013
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Kelley A and I. Pohl, A Book on C : Programming in C, Pearson Education, 1998
6. Ashok.N.Kamthane,Programming in C,Pearson education,2013

18EE106 ENGINEERING PRACTICES LABORATORY 0 0 4 2

Course Objectives

- To provide hands on training for dismantling and assembling of starters and transformers.
- To develop the skills for making simple electrical wiring connections using suitable tools.
- To develop the skill for trouble shooting and maintenance of home appliances.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
l. 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.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Construct electrical circuits to demonstrate the current and voltage division rule and measure electrical parameters using multimeters.
2. Demonstrate soldering techniques by assembling and troubleshooting simple Printed Circuit Boards.
3. Apply knowledge of logic gates to demonstrate their truth tables in digital circuits.
4. Construct electrical wiring systems and demonstrate the measurement of earth resistance.
5. Demonstrate the working of repairded home appliances using suitable troubleshooting methods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	2	-	-	2	2	-	2	3	-
2	2	-	-	-	-	2	-	-	2	2	-	2	-	3
3	2	-	-	-	-	2	-	-	2	2	-	2	2	-
4	2	-	-	-	-	2	2	-	2	2	-	2	2	2
5	2	-	-	-	-	2	2	-	2	2	-	2	-	2

1 **6 Hours**

EXPERIMENT 1

Measurement of electrical parameters using multimeters.

2 **6 Hours**

EXPERIMENT 2

Verification of current division for parallel circuit.

3 **6 Hours**

EXPERIMENT 3

Verification of voltage division for series circuit.

4 **6 Hours**

EXPERIMENT 4

Soldering Practice for simple Printed Circuit Board (PCB).

5 **6 Hours**

EXPERIMENT 5

Verification of Logic gates truth table.

6 **6 Hours**

EXPERIMENT 6

Construct electrical wire connections for staircase wiring and godown wiring with MCB.

7 **6 Hours**

EXPERIMENT 7

Trouble shooting and Maintenance of Table Fan/Ceiling Fan.

8 **6 Hours**

EXPERIMENT 8

Trouble shooting and Maintenance of grinder/ mixer grinder.

9 **6 Hours**

EXPERIMENT 9

Trouble shooting and Maintenance of Fluorescent Lamp circuit.

10 **6 Hours**

EXPERIMENT 10

Measurement of earth resistance.

Total: 60 Hours

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans.

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Apply appropriate grammar and vocabulary that aligns with the expectations of the Competitive exam level.
2. Analyze the general meaning of non-routine letters within your work area, and find key details in short reports of a predictable nature.
3. Construct straightforward, routine letters of a factual nature, and select relevant information to make notes on routine matters, such as taking or placing orders.
4. Use simple presentations or demonstrations and demonstrate understanding by summarizing key points
5. Resolve predictable requests from a visitor, outline routine requirements, and offer advice within your job area on simple matters.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	3	3	-	-	1	-
2	-	-	-	-	-	-	-	-	3	3	-	-	1	-
3	-	-	-	-	-	-	-	-	3	3	-	-	1	-
4	-	-	-	-	-	-	-	-	3	3	-	-	1	-
5	-	-	-	-	-	-	-	-	3	3	-	-	1	-

UNIT I **9 Hours**

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making.

1.Goodbye party for Miss Pushpa T S - Nissim Ezekiel2.Our Casuarina Tree - Toru Dutt
3.Palanquin Bearers - Sarojini Naidu4.The Tyger - William Blake
5. Ode on a Grecian Urn - John Keats

Total: 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

18EE201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems

Course Outcomes (COs)

1. Apply the concepts of partial differentiation to evaluate various parameters in signals and systems and characterize maxima and minima of functions for optimization problems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Apply mathematical concepts to construct first-order differential equations derived from real-time phenomena and solve them using appropriate analytical methods.
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
3	2	1	-	-	-	-	-	-	-	-	-	-	2	-
4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
5	2	1	-	-	-	-	-	-	-	-	-	-	1	-

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Greens theorem and Gauss Divergence theorem).

UNIT III **9 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoullis equation, applications.

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

FOR FURTHER READING

Applications to Electrostatic and Fluid Flow. **Total: 60 Hours**

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016.
3. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
4. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
5. Peter V. O Neil , Advanced Engineering Mathematics, Seventh Edition , Cengage Learning India Private Limited, 2012.
6. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.

18EE202 ENGINEERING PHYSICS II 2 0 2 3

Course Objectives

- Understand the fundamentals of crystal, transport properties of semiconductors and magnetic materials
- Differentiate passive and active components
- Compare different display devices and their functions

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Compute the seven types of crystal systems, crystal planes and illustrate unit cell characteristics of SC, BCC, FCC and HCP crystal structures.
2. Conclude the characteristics of semiconducting materials in terms of crystal lattice, charge carriers and energy band diagrams.
3. Differentiate the active and passive components in an electronic circuit and outline the working mechanisms of diodes.
4. Analyse the properties of magnetic materials, domain theory of ferromagnetism and the applications of recording and readout process.
5. Outline the interaction of electromagnetic radiation with matter and working principle of LED, LCD and OLED display devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	2	2	-	-	2	-
2	2	1	-	-	-	-	-	-	2	2	-	-	2	-
3	2	1	-	-	-	-	-	-	2	2	-	-	2	-
4	2	1	-	-	-	-	-	-	2	2	-	-	2	-
5	2	1	-	-	-	-	-	-	2	2	-	-	1	-

UNIT I **6 Hours**

CRYSTAL PHYSICS

Classification of solids - crystal structure - lattice points and space lattic - unit cell and lattice parameters - crystal systems and Bravais lattices - crystallographic planes - Miller indices - interplanar space of lattice planes - anisotropic properties of crystal - unit cell characteristics of SC, BCC, FCC and HCP structures

UNIT II **7 Hours**

SEMICONDUCTING MATERIALS

Band theory of solids - classification of solids - electrical and thermal conductivity - Semiconductors: elemental and compound semiconductor - intrinsic and extrinsic semiconductors - energy band diagram and electrical conduction - variation of Fermi level with temperature and impurity concentration - temperature dependence of carrier concentration in extrinsic semiconductor - Hall effect - determination of Hall coefficient - solar cells.

UNIT III **5 Hours**

PASSIVE AND ACTIVE COMPONENTS

Fundamental definitions - types of resistors,capacitors, inductors and transformers - characteristics of PN junction. Diodes: laser diode - PIN diode - Schottky diode - step recovery diode - tunnel diode - varactor diode - Zener diode

UNIT IV **6 Hours**

MAGNETIC MATERIALS

Basic definitions - origin of magnetic moment - classification of magnetic materials - influence of temperature on magnetic behaviour - domain theory of ferromagnetism - hysteresis of ferromagnetic materials - soft and hard magnetic materials - applications:magnetic recording - giant magneto resistance (GMR) effect

UNIT V **6 Hours**

DISPLAY DEVICES

Electromagnetic radiation - interaction of radiation with solids - classification of optical materials - luminescence - types of luminescence - LED and OLED: principle, construction, working, advantages and disadvantages. LCD: characteristics of liquid crystals - types - phases - twisted nematicdisplay: construction, working, merits and demerits. Comparison of LED, OLED and LCD

1 **5 Hours**

EXPERIMENT 1

Measurement of resistivity of a given material by four probe method

2 **5 Hours**

EXPERIMENT 2

Find the Hall coefficient and carrier concentration of semiconducting material using Hall effect apparatus

3 **5 Hours**

EXPERIMENT 3

Determine the V-I characteristics of a solar cell

4 **5 Hours**

EXPERIMENT 4

Find the band gap value of the given semiconductor diode. Based on the band gap value, identify the given semiconductor

5 **5 Hours**

EXPERIMENT 5

Determine the V-I characteristics of P-N diode and Zener diode

6 **5 Hours**

EXPERIMENT 6

Determine the thermal conductivity of a bad conductor by using Lee's disc method

Total: 60 Hours

Reference(s)

1. Balasubramaniam, R. "Callister""s Materials Science and Engineering". Wiley India Pvt.Ltd., 2014.
2. Kasap, S.O. "Principles of Electronic Materials and Devices". McGraw-Hill Education,2017
3. William D. Callister, Jr. & David G. Rethwisch "Fundamentals of Materials Science and Engineering".John Wiley and Sons Incl.,2008.
4. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Alpha Science International Ltd., 2017
5. Donald A. Neamen. "Semiconductor Physics and Devices", Mc Graw-Hill, 2011
6. Palanisamy P. K."Physics for electronics and information science". Dipti Press Pvt. Ltd., 2018.
7. Papadopoulos, Christo, Solid-State Electronic Devices An Introduction, Springer, NewYork,2014.
8. Raghavan, V. "Materials Science and Engineering: A First course". PHI Learning, 2015.
9. B.L.Theraja, Basic Electronics Solid State, S.Chand& Company Ltd, New Delhi, 2000.

18EE203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Summarize the unique properties of group IV elements and their applications in electronics
- Apply the basic knowledge of conducting polymers for electrical applications
- Infer the materials used in insulation of electrical signals
- Outline the chemistry of materials used in ceramic insulators and resistors
- Illustrate the novel nanofabrication techniques for nano electronic applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
j. 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.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply the knowledge of the structural and chemical properties of Group IV elements and their oxides to evaluate their suitability for fabricate integrated circuits.
2. Analyze the suitability of conducting polymer for optical and storage applications.
3. Compare the advantages of nano-material over conventional material for the fabrication of nano electronic components.
4. Assess the properties of ceramic insulators to determine their suitability for electronic applications.
5. Analyze the morphologyof materials using AFM, SEM, TEM techniques

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	2	-	2	2	2	-	-	1	-
2	2	1	-	-	-	-	-	2	2	-	-	-	2	-
3	2	2	-	-	-	-	1	2	2	-	-	-	3	-
4	2	2	-	-	-	2	-	2	2	-	-	-	-	2
5	2	1	-	-	-	-	1	2	2	2	-	-	1	-

UNIT I **6 Hours**

CHEMISTRY OF SEMICONDUCTORS

Group IV elements - structure and properties - oxides of silicon and germanium - applications in electronics- IC device and VLSI design fabrication.

UNIT II **6 Hours**

POLYMERS AND CONDUCTING POLYMERS

Polymers - conducting polymers - commercial polymers: Synthesis and applications - optical fibres - functions and applications.

UNIT III **5 Hours**

INSULATING MATERIALS

Dielectrics - characteristics and types - insulating materials - resins - thermal insulators.

UNIT IV **7 Hours**

ELECTRONIC CERAMICS

Properties of ceramic insulators - ceramic capacitor materials - ferrite (magnetic) ceramics - ceramic sensors. Application and characterization of ZnO varistors. Resistor materials: Carbon based materials - metal-based materials.

UNIT V **6 Hours**

NANOELECTRONICS

Nanoelectronics - introduction - nanoelectronic architectures: Nanofabrication - nanopatterning of metallic/semiconducting nanostructures, structural characterization (SEM, TEM, AFM).

FOR FURTHER READING

Basics and applications of electromagnetic spectrum - electronic, vibrational and rotational transitions. Principle, instrumentation -block diagram and applications of UV visible and IR spectroscopy.

1 **3 Hours**

EXPERIMENT 1

Determination of silica content in potassium silicate by titration methods

2 **8 Hours**

EXPERIMENT 2

(a) Preparation of conducting polymer by electro deposition method
(b) Identification of functional group in conducting polymer compounds using IR spectroscopy.

3 **4 Hours**

EXPERIMENT 3

Interpretation of dielectric materials using DTA curve analysis

4 **7 Hours**

EXPERIMENT 4

(a) Estimation of Zn in ceramics using EDTA method
(b) Comparison of different types of ceramics used in electrical/electronics by IR spectroscopy

5 **4 Hours**

EXPERIMENT 5

Preparation of CdS nanocrystals using thiourea

6 **4 Hours**

EXPERIMENT 6

Preparation of metal nanoparticles and their characterization

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, DhanpatRai Publishing Company, New Delhi, 2013.
2. R. Gowariker, N. V. Viswanathan, J. Sreedhar, Polymer Science, 1st Edition, New age International Publishers, New Delhi, 2014.
3. Sergio pizzini,Physical chemistry of semiconductor materials and processes, John Wiley & Sons, 2015.
4. T. Pradeep, Nano: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw Hill, 2012.
5. George W. Hanson, Fundamentals of nano electronics, Prentice Hall, 2008.
6. Van Vleck Elements of Materials Science Addison Wesley Publishers, 2010. 7. Rolf. E, Hummel, Electronic Properties of Materials, 4ed. Springer, New York, 2011

18EE204 BASICS OF CIVIL AND MECHANICAL ENGINEERING 3 0 0 3

Course Objectives

- To impart basic knowledge in the field of Civil Engineering.
- To create awareness on green building systems with its energy.
- To impart knowledge on various infrastructural systems.
- To familiarize students with all commonly used mechanical elements.
- To understand the working principles of various Internal Combustion Engines, Refrigeration and air conditioning.
- To impart knowledge on various types of Boilers and turbines.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply the site selection procedure for various building construction.
2. Apply the green building and energy efficiency concept in a building construction.
3. Analyse the infrastructural facility for indoor and outdoor applications.
4. Apply the commonly known mechanical component and assemble the electrical appliances.
5. Analyse the various Internal Combustion Engines and Refrigeration system and select the suitable one for the customer needs.
6. Analyse the various Boilers and turbines for customized application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	-	-	-	-	-	-	1	-
2	3	-	-	-	-	-	2	-	-	-	-	-	1	-
3	3	-	-	-	-	-	2	-	-	-	-	-	2	-
4	2	-	-	-	-	-	-	-	-	-	-	-	-	2
5	2	-	-	-	-	-	-	-	-	-	-	-	-	2
6	2	-	-	-	-	-	-	-	-	-	-	-	1	-

UNIT I **7 Hours**

BASIC REQUIREMENTS OF STRUCTURES

Scope of Civil Engineering- Principles of Planning of buildings: orientation, energy efficiency, utility. Components of building-classification of buildings. Site selection for power plants, wind mill -Site measurements using chain and tape.

UNIT II **7 Hours**

GREEN BUILDINGS

Conventional versus green building delivery systems- LEED building assessment standard - LEED certification process - Building rating system in India and its future - Building energy issues - Building energy design strategies - Building envelope.

UNIT III **7 Hours**

INFRASTRUCTURAL SYSTEMS

Water supply systems- Rain Water Harvesting Trenches. Classification of Highways- Types of bridges- Lighting of infrastructure facilities : indoor & outdoor.

UNIT IV **8 Hours**

MECHANICAL ELEMENTS

Basic Concepts, Bearings - ball bearing, roller bearing, thrust bearing, tapper roller bearing, journal / bush bearing, bearing blocks, one way bearings - Gears - spur, helical, bevel gear, worm gears, rack and pinion. Couplings - rigid coupling - sleeve, flange, clamp couplings. Flexible coupling - Oldham, universal, jaw and fluid couplings. Torque limiter - Belt drives - flat belt, V belt, timing belt drives. Chain drives, rope drives, chain block - Conveyers - roller conveyer, belt conveyer, vertical conveyer, pneumatic conveyer, chain conveyer, screw conveyer - Shafts, keys, spline shafts - Fasteners - screws, bolts, nuts and their specifications in mm and inch scale.

UNIT V **8 Hours**

INTERNAL COMBUSTION ENGINES AND REFRIGERATION

Internal Combustion (IC) Classification, main components, working principle of two and four stroke petrol and diesel engines, differences Refrigeration working principle of vapour compression and absorption system. Introduction to Air conditioning.

UNIT VI **8 Hours**

BOILERS AND TURBINE

Introduction to heat transfer - conduction, convection, radiation. Introduction to Boilers, classification, differences between fire tube and water tube boiler, super critical boiler. Steam turbines - working principle of single stage impulse and reaction turbine, Hydraulic turbine - working principle of Francis turbine, Kaplan turbine and Pelton wheel.

Total: 45 Hours

Reference(s)

1. N. Arunachalam, Bascis of Civil Engineering, Pratheeba Publishers, 2000.
2. M. Bauer, P. Mosle and M. Schwarz, Green Building: Guidebook for Sustainable Architecture, Springer - Verlag Berlin Heidelberg, 2010.
3. Charles. J. Kibert, Sustainable Construction: Green Building Design and Delivery, John Wiley & Sons, Inc., New Jersey, 2008.
4. G. Shanmugam and M. S. Palanichamy, Basic Civil and Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 2014.
5. Traffic Engineering manual -2007. 6. http://www.sasurieengg.com/e-course-material/I-year-E-course-material-II-sem/9.GE6251-BCM.pdf
6. Basant C.M. Agrawal, Basic of Mechanical Engineering, Wiley India Pvt. Ltd., New Delhi 2014.
7. V. B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Publishing CompanyPvt. Ltd., New Delhi, 2010. V. Ganesan, Internal Combustion Engines, Tata McGraw Hill Publishing Company Private limited., New Delhi, 2012.
8. R. K. Bansal, A Textbook of FluidMechanics and Machinery, Laxmi Publications (P) Ltd., New Delhi, Revised Ninth edition, 2014.

18EE206 ELECTRIC CIRCUIT ANALYSIS 3 0 2 4

Course Objectives

- To analyze the electric circuits using basic laws
- To compute electrical parameters like current and voltage using network theorems for AC and DC circuits
- To differentiate single phase and three phase circuits
- To analyze R, L, C components for resonance, coupling and transient response

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. 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.
l. 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.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply the Kirchhoffs laws to the electric circuit to compute the electrical parameters.
2. Apply the network theorems to compute various parameters of electric network.
3. Analyze the three phase circuit with different types of loads to solve real-world electrical systems.
4. Design a tank circuit for given frequency and analyze the coupled circuits for electrical networks.
5. Analyze the transient response of RL, RC and RLC circuit to design the electrical system.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	1	2	-	-	-	2	-	2	1	3	-
2	3	3	-	2	1	-	-	-	-	2	2	1	3	-
3	3	3	-	2	1	-	-	-	2	-	-	1	3	-
4	3	3	2	2	1	-	-	-	-	-	-	1	3	1
5	3	3	-	2	2	-	-	-	-	2	-	1	2	-

UNIT I **10 Hours**

ELECTRIC CIRCUITS

Active and Passive elements - Ohm's law - Kirchhoff's Laws - Resistance in series and parallel -voltage division and current division - Mesh and Nodal analysis - Source Transformation - Generation of alternating emf - RMS value, average value, peak factor and form factor - Analysis of Pure Resistive, Inductive and Capacitive circuits

UNIT II **10 Hours**

NETWORK THEOREMS FOR DC

Analysis of circuits using Thevenin' s theorem, Norton 's theorem, Maximum power transfer theorem and Superposition theorem - Applications.

UNIT III **8 Hours**

THREE PHASE CIRCUITS

Introduction - Analysis of Three phase balanced and unbalanced systems with star and delta connected loads - Phasor diagram - Star-Delta transformation - Measurement of Power and Power factor.

UNIT IV **10 Hours**

RESONANCE AND COUPLED CIRCUITS

Series and parallel resonance - Q factor and bandwidth - Resonant frequency of a tank circuit - Basics of magnetic circuits - Simple and Composite magnetic circuits - Self and Mutual inductances - Coefficient of Coupling - Coupled circuits - Dot convention - Coupled circuits in Series and Parallel.

UNIT V **7 Hours**

TRANSIENTS

Steady state and Transient response - Transient Response of RL, RC and RLC Circuits with step and ramp input - Time Constant Analysis.

FOR FURTHER READING

Super Mesh and Super Node analysis - Reciprocity theorem - Millman' s Theorem - Two port networks.

1 **6 Hours**

EXPERIMENT 1

Experimental verification of Kirchhoff’s voltage and current laws.

2 **6 Hours**

EXPERIMENT 2

Experimental verification of Thevenin’s and Norton Theorem**.**

3 **6 Hours**

EXPERIMENT 3

Study of CRO and measurement of voltage and frequency using function generator.

4 **6 Hours**

EXPERIMENT 4

Experimental determination of power in three phase circuits by two-watt meter method.

5 **6 Hours**

EXPERIMENT 5

Frequency Response of a series R-L-C Circuit

Total: 75 Hours

Reference(s)

1. William H. Hayt, Jack E. Kemmerly, and Steven M. Durbin, Engineering Circuit Analysis, Eighth Edition, Tata McGraw Hill, 2013.
2. Charles K. Alexander, Fundamentals of Electric Circuits, Fifth Edition, Tata McGraw Hill Publishing Co Ltd, 2013.
3. Mahmood Nahvi, Joseph A Edminister, Electric Circuits, Fifth Edition, Tata McGraw Hill Publishing Company Limited, 2017.
4. S P Ghosh, A K Chakraborty, Network Analysis and Synthesis, Tata McGraw Hill Education Private Limited, 2010.
5. Sudhakar and S. P. Shyam Mohan, Circuits and Network Analysis and Synthesis, Fifth Edition, Tata McGraw Hill, 2015.

18EE207 ENGINEERING GRAPHICS 1 0 4 3

Course Objectives

- Provide knowledge on projection of points and lines.
- Impart skill in drawing projection of simple solids.
- Familiarize creation of orthographic views from isometric projections of simple solids and vice versa.
- Build the proficiency to create two dimensional sketches using software.
- Provide the skill to build three dimensional models and its orthographic views using software.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Analyse the projection of points and lines in different quadrants.
2. Construct orthographic projections of simple solids.
3. Create the orthographic and isometric projections of simple solids.
4. Devlop the two dimensional views of engineering components using software.
5. Construct three dimensional models of engineering components and its orthographic views using software.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	-	-	-	-	-	2	-	-	-	1	-
2	2	-	-	-	-	-	-	-	2	-	-	-	2	-
3	2	-	-	-	-	-	-	-	2	-	-	-	1	-
4	2	-	-	-	-	-	-	-	2	-	-	-	3	-
5	2	-	-	-	-	-	-	-	2	-	-	-	3	-

UNIT I **3 Hours**

PROJECTION OF POINTS AND LINES

Practices on lettering, numbering and dimensioning of drawings. Principles of projection, Projection of points in four quadrants, first angle projection of straight lines - parallel, perpendicular and inclined to anyone plane.

UNIT II **3 Hours**

PROJECTION OF SOLIDS

Orthographic projection of simple solids - parallel, perpendicular and inclined to one plane using change of position method.

UNIT III **3 Hours**

ISOMETRIC AND PERSPECTIVE PROJECTION

Conversion of isometric to orthographic projection and vice versa. Perspective projection of simple solids.

UNIT IV **3 Hours**

CREATION OF 2D SKETCHES USING SOFTWARE

Sketch Entities - line, circle, arc, rectangle, slots, polygon, text, snap, and grid. Sketch Tools-fillet, chamfer, offset, convert entities, trim, extend, mirror, move, copy, rotate, scale, stretch, sketch pattern. Geometrical constraints, Dimensioning - smart, horizontal, vertical, ordinate

UNIT V **3 Hours**

PART MODELING AND DRAFTING USING SOFTWARE

Part Modeling - extrude, cut, revolve, creation of planes, fillet, chamfer, shell, rib, pattern, mirror, loft, draft and swept. Drafting - Converting 3D models to orthographic views with dimensions.

1 **12 Hours**

EXPERIMENT 1

Create 2D sketch of different components used in engineering applications.

2 **12 Hours**

EXPERIMENT 2

Create part model of a component from given isometric drawings.

3 **12 Hours**

EXPERIMENT 3

Create part model of a component from given orthographic views.

4 **12 Hours**

EXPERIMENT 4

Create an assembly model of product from detailed parts drawing.

5 **12 Hours**

EXPERIMENT 5

Create stl file from CAD model, transfer file to 3D printer, setup the machine parameters, build and post process the component using Additive Manufacturing Technology.

Total: 75 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International,2005.
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46,2008.
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited, 2008.
5. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.
6. Ian Gibson, David W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010

18EE301 ENGINEERING MATHEMATICS III 3 1 0 4

Course Objectives

- Understand the concepts of Fourier series, Transforms and Boundary Conditions, which will enable them to model and analyze the physical phenomena
- Implement the Fourier analysis, an elegant method in the study of heat flow, fluid mechanics and electromagnetic fields.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Apply the Fourier series concepts to anlyse the harmonics
2. Apply the Fourier transform technique to develop a filter
3. Applys Laplace transform and deduce transfer function
4. Apply the Z-transform to convert a discrete-time signal, which is a sequence of real or complex numbers, into a complex frequency domain representation.
5. Apply basic statistical inference techniques, including confidence intervals, hypothesis testing to science/engineering problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
3	3	3	-	-	-	-	-	-	-	-	-	-	2	-
4	2	2	-	-	-	-	-	-	-	-	-	-	2	-
5	2	2	-	-	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

FOURIER SERIES

Dirichlet's conditions - General Fourier series - Odd and even functions - Half range cosine and sine series - Root mean square value- Harmonic analysis

UNIT II **9 Hours**

FOURIER TRANSFORM

Fourier Integral Theorem- Fourier Transform and Inverse Fourier Transform- Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem - Parseval's Identity

UNIT III **9 Hours**

LAPLACE TRANSFORM

Properties and theorems of Laplace transform - Shifting theorems- Inverse Laplace transforms - Convolution Applications to ordinary differential equations - Applications to linear system analysis.

UNIT IV **9 Hours**

Z -TRANSFORM

Z-Transform - Elementary Properties - Inverse Z-Transform - Convolution Method- Partial fraction method - Solution of Difference Equations using Z-Transform.

UNIT V **9 Hours**

PARTIAL DIFFERENTIAL EQUATION

Introduction to partial differential equations, One-dimensional wave equation, Method of separation of variables, D"Alembert"s solution of the wave equation - Heat equation, Laplace"s equation , Laplace transform method of solution.

Total: 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics,10 Edition, John Wiley, 2015.
2. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 7th Edition, John Wiley, 2014.
3. O'Neil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1997.
4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 4th edition 2011.
5. Greenberg Michael D., Advanced Engineering Mathematics, Prentice-Hall International Inc,2nd Edition 2006.

3 0 0 3

18EE302 ELECTRON DEVICES AND CIRCUITS

Course Objectives

- To understand the construction, operation and characteristics of solid state switching devices.
- To understand the operation of voltage amplifiers
- To analyze the performance of power amplifiers and feedback amplifiers.
- To understand the construction and operation of oscillators and multivibrators.
- To analyze the performance of wave shaping circuits

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the characteristics of semiconductor devices to select suitable device for specific applications.
2. Analyze the principles of BJT in RC-coupled amplifiers and differential amplifiers to evaluate their performance in different electronic circuits.
3. Analyze the performance of power and feedback amplifiers for industrial applications.
4. Apply the Oscillator and Multivibrator circuits for waveform generation.
5. Analyze the rectifiers and voltage regulator for designing power supply.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
2	2	2	2	2	-	-	-	-	-	-	-	-	2	2
3	2	2	1	2	-	-	-	-	-	-	-	-	2	2
4	2	1	1	2	-	-	-	-	-	-	-	-	2	2
5	2	2	1	2	-	-	-	-	-	-	-	-	2	3

UNIT I **8 Hours**

SEMICONDUCTOR DEVICES

Construction, Operation and characteristics of PN Junction Diode, Zener diode, BJT, MOSFET and UJT, Photodiode, Photo Transistor, LED.

UNIT II **8 Hours**

VOLTAGE AMPLIFIERS

Biasing of BJT-RC Coupled Amplifier - Differential amplifier using BJT -Differential and Common mode gain, CMRR

UNIT III **9 Hours**

POWER AND FEEDBACK AMPLIFIERS

Performance analysis of Class A, Class B, Class C and Class D - Basic concepts of feedback amplifiers- Topologies - Effect of negative feedback on input and output resistances, gain stability, distortion, bandwidth.

UNIT IV **10 Hours**

OSCILLATOR AND MULTIVIBRATORS

Oscillators, Barkhausen Criterian, RC phase shift oscillators, Wien Bridge and Hartley oscillators,Colpitts oscillators and UJT based saw tooth oscillator, Astable, Monostable, Bistable Multivibrators - operation.

UNIT V **10 Hours**

POWER SUPPLY AND WAVESHAPING CIRCUITS

Performance analysis Half wave rectifier and full wave rectifier, Filters -Series and Shunt Voltage Regulator - Clippers and Clampers.

Total: 45 Hours

Reference(s)

1. Jacob. Millman, Christos C.Halkias, Electronic Devices and Circuits, 3rd Edition ,Tata McGraw Hill Publishing Limited, New Delhi.
2. David A. Bell, Electronic Devices and Circuits,5th Edition,Oxford University Press,
3. N.P.Deshpande, Electronic Devices and Circuits,1stEdition,Tata McGraw Hill Publishing Limited, New Delhi,2013.
4. Thomas L Floyd, Electronic Devices, Prentice Hall of India, New Delhi,2011.

18EE303 ELECTRICAL MACHINES I 3 1 0 4

Course Objectives

- To understand the production of torque and EMF.
- To understand the construction, operation and characteristics of various types of DC machines.
- To understand the operation and performance of special machines
- To understand the construction, operation and characteristics of transformers
- To estimate the performance of Transformers.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. 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.

m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply the concept of Magnetic circuit in electro-mechanical energy conversion systems.
2. Analyze the characteristics of DC Generators and motors.
3. Analyze the performance of special electrical machines for industrial applications.
4. Analyze the performance of the transformers using equivalent circuit.
5. Estimate the losses and regulation of transformers through suitable testing methods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	-	-	-	-	-	-	-	-	-	-	3	-
2	2	3	-	-	-	-	-	-	-	-	-	-	2	-
3	2	1	-	-	-	-	-	-	-	-	-	-	-	3
4	2	2	-	-	-	-	-	-	-	-	-	-	3	-
5	3	3	-	3	-	-	-	-	-	-	-	-	3	-

UNIT I **8 Hours**

PRINCIPLES OF ENERGY CONVERSION

Faraday's law of electromagnetic induction -singly and doubly excited magnetic field systems -EMF and torque production in rotating machines.

UNIT II **12 Hours**

DC MACHINES

Generator and Motor- Construction - Principle of operation - Types - Characteristics - Armature reaction and commutation - Starting and Speed control -Various testing-Braking -Applications

UNIT III **8 Hours**

SPECIAL MACHINES

Stepper motor, permanent magnet brushless D.C. motor and switched reluctance motors -construction-principle of operation-types- applications

UNIT IV **9 Hours**

TRANSFORMERS

Construction - Principle of operation - Types - Equivalent circuit -Voltage regulation and efficiency - Auto transformer

UNIT V **8 Hours**

TRANSFORMER TESTING

Testing of transformers -Polarity, open circuit, short circuit and Sumpner's test - Three phase transformers connections- Parallel operation

Total: 60 Hours

Reference(s)

1. D. P. Kothari and I. J. Nagrath, Electric Machines, Tata McGraw Hill Publishing Company Ltd, 2017
2. P. S. Bimbhra, Electrical Machinery, Khanna Publishers, Delhi, 2018
3. E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, Electric Machinery, Tata McGraw Hill publishing Company Ltd, New Delhi ,2015
4. Stephen J.Chapman, Electric Machinery Fundamentals, Tata McGraw Hill, New Delhi, 2018.
5. T.Kenjo, Stepping motors and their microprocessor controls, Oxford University press, New Delhi, 2011
6. T.Kenjo and S.Nagamori,Permanent magnet and Brushless DC motors, Clarendon press, London, 2015

18EE304 ELECTROMAGNETIC THEORY 3 1 0 4

Course Objectives

- To understand the application of vector calculus in electromagnetic theory.
- To understand the concept of Coulombs law and Gauss law.
- To calculate magnetic density and magnetic field intensity using Biot-savarat law and amperes law.
- To compute Maxwell's equations using Faraday's Law, Gauss Law and Amperes law.
- To examine Electromagnetic wave propagation in different medium.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply coordinate systems and vector calculus concepts to solve engineering problems.
2. Apply Coulomb's Law and Gauss Law to compute electric potential and electric flux density.
3. Apply Biot-savart Law and Ampere's Law to find Magnetic potential.
4. Apply Faraday's laws, Maxwell's equations, and the Poynting theorem to solve the electromagnetic problems
5. Analyze the parameters of electromagnetic wave propagation in different medium and wave parameters.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	-	-	-	-	-	-	-	-	-	-	2	-
2	3	3	-	-	-	-	-	-	-	-	-	-	2	-
3	3	3	-	-	-	-	-	-	-	-	-	-	2	-
4	3	3	-	-	-	-	-	-	-	-	-	-	3	1
5	3	3	-	-	-	-	-	-	-	-	-	-	3	1

UNIT I **10 Hours**

INTRODUCTION

Different co-ordinate systems: Cartesian coordinates, cylindrical coordinates, spherical coordinates - Vector calculus: Differential length, area and volume, line surface and volume integrals - gradient of a scalar, divergence of a vector and divergence theorem - curl of a vector and Stoke's theorem - Laplacian of a scalar.

UNIT II **10 Hours**

ELECTROSTATICS

Coulomb's Law - Electric field intensity - Field due to point and continuous charges - Gauss's law and it's applications to calculate electric field - Electric scalar potential - Polarization-Boundary conditions-Poisson's and Laplace's equations - Capacitance-energy density.

UNIT III **9 Hours**

MAGNETOSTATICS

Magnetic field intensity - Biot-savart Law - Ampere's Law - Magnetic field due to straight conductors, circular loop, infinite sheet carrying current -Magnetization-Boundary Conditions-Magnetic vector potential.

UNIT IV **8 Hours**

ELECTRODYNAMICFIELDS

Faraday's laws, induced EMF - Static and dynamic EMF, Maxwell's equations (differential and integral forms), Poynting theorem.

UNIT V **8 Hours**

ELECTROMAGNETIC WAVES

Electro Magnetic Wave equations - Wave parameters: velocity, intrinsic impedance, propagation constant - Waves in free space - skin depth.

Total: 60 Hours

Reference(s)

1. William H. Hayt, Jr. John A. Buck, Engineering Electromagnetics, McGraw Hill Higher Education, 8th revised Edition, 2011.
2. K. A. Gangadhar, P.M. Ramanathan, Electromagnetic Field Theory, Khanna Publishers, Sixteenth Edition, 2011.
3. Bhag Sing Guru and Huseyin R. Hiziroglu, Electromagnetic Field Theory Fundamentals, Cambridge University Press, fourth Edition, 2010.
4. A.Joseph. Edminister and Vishnu Priye, Electromagnetics, Special Indian edition, Schaum's Outlines, Tata McGraw Hill, 2009.
5. Sadiku, Elements of Electromagnetics, Third Edition, Oxford University Press, 2010.
6. Kraus and Fleish, Electromagnetics with Applications, McGraw Hill International Editions, Fifth Edition, 2008.

18EE305 POWER GENERATION SYSTEMS 3 0 0 3

Course Objectives

- To understand the various terminologies of power plants
- To understand the layout and working of steam power station
- To understand the layout and working of hydro power station
- To understand the layout and main parts of nuclear power station
- To understand the working of different types of alternative sources of electrical energy

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
f. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. 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.
l. 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.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the performance parameters of power plants and select appropriate power stations.
2. Assess the characteristics of turbo alternators and functions of steamturbines for thermal power plant.
3. Use hydrological data and analyze the functional aspects of hydroelectric power station.
4. Analyze the layout, working and site selection criteria of Nuclear power station
5. Apply the concepts of alternative energy sources for sustainable energy solutions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	2	-	-	-	2	-	2	-
2	3	-	-	-	-	2	2	2	-	-	-	1	2	1
3	3	-	-	-	-	2	2	-	-	-	-	1	2	1
4	3	-	-	-	-	2	2	-	-	-	-	1	2	1
5	3	-	-	-	-	2	3	2	-	-	-	1	2	1

UNIT I **9 Hours**

INTRODUCTION

Connected load, maximum load, maximum demand, demand factor, load factor, diversity factor, plant capacity factor, plant utilization factor, load curve, load duration curve and mass curve. Choice of Power station and units.

UNIT II **9 Hours**

STEAM POWER STATION

Steam station layout, Steam station auxiliaries and working of a steam station, characteristics of turbo alternators, super pressure steam stations and Cogeneration systems.

UNIT III **8 Hours**

HYDRO POWER STATION

Hydrology, Hydrographs, Flow duration curve, Hydroelectric power plants - classification, Layout, auxiliaries and working of a hydro station.

UNIT IV **9 Hours**

NUCLEAR POWER STATIONS

Basics of nuclear energy, Layout and main parts of nuclear power station, types of reactor, site selection criteria for nuclear power plant, safety measures.

UNIT V **10 Hours**

ALTERNATIVE SOURCES OF ENERGY

Solar power generation - Photo-voltaic and solar thermal generation, Wind power generation, Geo Thermal, Biomass, Fuel Cell power systems, micro-hydel power plants, tidal power generation and MHD generation.

FOR FURTHER READING

Types of power station, Types of dam,Types of power reactor, Conversion of solar energy into electric energy.

Total:45 Hours

Reference(s)

1. B.R. Gupta Generation of Electrical Energy, S.Chand Publishers, New Delhi,2015.
2. J.B.Gupta , A Course in Electrical Power, S.K. Kataria & Sons Publishers, New Delhi ,2014.
3. Gate Academy Publication, Electrical Power Generation, Third Edition, DURG, 2016.
4. M.V. Deshpande ,Elements of Electric Power Station Design, Tata McGraw Hill, New Delhi ,2006.
5. Car, T.H., Electric Power Station, Chappman& Hall Publishers, 2006.
6. Soni Gupta Bhatnagar , A Course in Electrical Power, DhanpatRai Publishers, New Delhi ,2009.

18EE306 COMPUTER PROGRAMMING II 3 0 2 4

Course Objectives

- Understand the fundamental concepts of data structure
- Impart the different paradigms in linear and non-linear data structures to problem solutions
- Determine the problems to solve using sorting and searching algorithms

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

l. 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.

m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Compute the time and space complexity of algorithms with asymptotic notations.
2. Develop applications using stack and queue data structures.
3. Implement all the operations of linked list data structures to store and retrieve the given data.
4. Construct a hierarchical data structure to represent the given data using tree data structure.
5. Analyze the efficiency of various searching and sorting techniques using different data structures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	2	3	-	-	1	2	2	-	2	1	-
2	2	3	2	2	3	-	-	1	2	2	-	2	2	-
3	2	3	2	2	3	-	-	1	2	2	-	2	3	-
4	2	3	2	2	3	-	-	1	2	2	-	2	3	-
5	2	2	3	2	3	-	-	1	2	2	-	2	3	-

UNIT I **9 Hours**

INTRODUCTION

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: Insertion, Deletion, Traversal, Analysis of an Algorithm: Asymptotic Notations, Time-Space Trade off, Abstract Data Types (ADTs): List ADT

UNIT II **9 Hours**

STACKS AND QUEUES

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation-corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

UNIT III **9 Hours**

LINKED LIST

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

UNIT IV **10 Hours**

TREES

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with Complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

UNIT V **8 Hours**

SORTING AND HASHING

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

FOR FURTHER READING

Applications of list - Red-Black trees - Splay trees- Bucket hashing - Introduction to NP Completeness

1 **3 Hours**

EXPERIMENT 1

Implement the concepts of Stack, Simple Queue using Arrays

2

EXPERIMENT 2

Implement the concepts of Circular Queue and Priority Queue ADT using Arrays

3 **3 Hours**

EXPERIMENT 3

Implement Singly and Doubly Linked list.

4 **3 Hours**

EXPERIMENT 4

Implement Circular Linked list

5 **3 Hours**

EXPERIMENT 5

Implement Stack and Queue ADT using Linked list

6 **3 Hours**

EXPERIMENT 6

Create program to perform tree traversals and other operations in a Binary Search Tree

7 **3 Hours**

EXPERIMENT 7

Develop applications for Hashing.

8 **3 Hours**

EXPERIMENT 8

Implement Sorting and Searching algorithms based on a given scenario.

9 **3 Hours**

EXPERIMENT 9

Implement Quick sort and Merge sort based on a given scenario

10 **3 Hours**

EXPERIMENT 10

Implement Heap sort based on a given scenario

Total: 75 Hours

Reference(s)

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education,2016.
2. Ellis Horowitz, Sartaj Sahni,Fundamentals of Data Structures, Illustrated Edition, Computer Science Press.
3. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011.
4. R. G. Dromey,How to Solve it by Computer, 2nd Impression, Pearson Education.

18EE307 ELECTRICAL MACHINES I LABORATORY 0 0 2 1

Course Objectives

- To understand the characteristics of DC motor under various loadingconditions.
- To understand the open circuit and load characteristics of DC generator
- To perform the tests to determine the efficiency and regulation of the DC machines and transformers

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. 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.

d. 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.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the performance characteristics of DC motors and generators under defined conditions.
2. Analyze the efficiency and speed control metods of DC shunt motor for industrial applications.
3. Analyze the performance of DC machine by conducting suitable tests.
4. Analyze the operation of stepper motors by implementing specific excitation schemes to achieve precise and controlled movements.
5. Apply various tests to determine and optimize the performance parameters of single-phase transformers.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	2	2	-	-	-	-	2	2	-	-	3	-
2	3	-	3	3	-	-	-	-	2	2	-	-	2	-
3	3	-	3	2	-	-	-	-	2	2	-	-	2	2
4	2	-	3	3	-	-	-	-	2	2	-	-	3	2
5	3	-	-	2	-	-	-	-	2	2	-	-	1	3

1 **3 Hours**

EXPERIMENT 1

Performance Analysis of Permanent Magnet DC motor

2 **3 Hours**

EXPERIMENT 2

Performance Analysis of DC Generator coupled with DC motor

3 **3 Hours**

EXPERIMENT 3

Control of Permanent Magnet DC motor.

4 **3 Hours**

EXPERIMENT 4

Load test on DC shunt motor .

5 **3 Hours**

EXPERIMENT 5

Speed control of DC shunt Motor.

6 **3 Hours**

EXPERIMENT 6

Predetermination of Efficiency of DC machine using Swinburne's Test.

7 **3 Hours**

EXPERIMENT 7

Control of stepper motor for different excitations.

8 **3 Hours**

EXPERIMENT 8

Load test on single phase transformer.

9 **3 Hours**

EXPERIMENT 9

Open circuit and short circuit test on single phase transformer.

10 **3 Hours**

EXPERIMENT 9

Determination of performance parameters of transformer using Sumpner's test.

Total: 30 Hours

18EE308 ELECTRON DEVICES AND CIRCUITS LABORATORY

Course Objectives **0 0 2 1**

- To obtain the VI characteristics of semiconductor devices.
- To construct a regulated DC power supply for various voltage level.
- To obtain the frequency response of amplifiers and oscillator circuits.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the Volt-Ampere characteristics of diodes, current controlled and voltage controlled power switches.
2. Design and implement a gate driver circuit for Power Switches.
3. Design and implement the Power supply circuits using voltage regulators.
4. Design and analyse the performance of amplifiers and oscillators
5. Design and implementation of Monostable and Astable Multivibrator circuits.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	-	-	-	-	-	2	2	-	-	3	-
2	1	2	3	-	-	-	-	-	2	2	-	-	3	2
3	3	2	3	-	-	-	-	-	2	2	-	-	3	2
4	3	2	3	-	-	-	-	-	2	2	-	-	3	2
5	1	2	3	-	-	-	-	-	2	2	-	-	3	3

1 **4 Hours**

EXPERIMENT 1

Volt-Ampere characteristics of PN diode and Zener diode.

2 **4 Hours**

EXPERIMENT 2

Volt-Ampere characteristics of Transistor and MOSFET.

3 **4 Hours**

EXPERIMENT 3

Design of Gate driver circuit for MOSFET

4 **2 Hours**

EXPERIMENT 4

Design of DC Power supply circuit.

5 **2 Hours**

EXPERIMENT 5

Design and verification of series voltage regulator.

6 **2 Hours**

EXPERIMENT 6

Design and implementation of CE amplifier.

7 **2 Hours**

EXPERIMENT 7

Design and implementation of class B push pull amplifier.

8 **4 Hours**

EXPERIMENT 8

Design and implementation of RC Phase shift and Wein bridge oscillator.

9 **4 Hours**

EXPERIMENT 9

Design and implementation of Monostable and Astable Multivibrator circuits.

10 **2 Hours**

EXPERIMENT 10

Design of audio amplifier using any one type of power amplifier.

Total: 30 Hours

18EE401 GRAPH THEORY AND PROBABILITY 3 1 0 4

Course Objectives

- Understand the basic concepts of probability and the distributions with characteristics of one dimensional random variables.
- Analyze the various data by different numerical and statistical sampling techniques.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
l. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Demonstrate and apply the basic probability axioms and concepts in their core areas of random phenomena.
2. Analyze the various data by different numerical techniques.
3. Analyze the various collection of data in science / engineering problems using statistical inference techniques.
4. Apply the stastics process to train the neural networks.
5. Apply the concept of error analysis and finite element analysis techniques in their core area

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	1	2	-
2	3	1	-	-	-	-	-	-	-	-	-	1	3	-
3	1	1	-	-	-	-	-	-	-	-	-	1	1	-
4	1	1	-	-	-	-	-	-	-	-	-	1	1	-
5	2	3	-	-	-	-	-	-	-	-	-	3	2	-

UNIT I **10 Hours**

GRAPH THEORY

Introduction to Graphs-Graph operations- Graph and Matrices-Graph Isomorphism- Connected Graphs-Euler Graphs- Hamilton paths and circuits- planar Graph-Graph colouring-Trees- Shortest path problem.

UNIT II **9 Hours**

NUMERICAL SOLUTIONS OF DIFFERENTIAL EQUATION

Solution of first order ordinary differential equations: Euler and Modified Euler mthods-Fourth order Runge- Kutta method - Solution of partial differential equations: Elliptic equations: Laplace equation and Poisson's equation.

UNIT III **10 Hours**

PROBABILITY THEORY

Probability. Random variables, probability densities and distributions, mean and variance of a distribution. Conditional probability. Bayes theorem. Binomial, Poisson and normal distributions.

UNIT IV **9 Hours**

STATISTICS

Mean: Arithmetic mean ,Geometric mean and Harmonic mean ,Median, Mode, Variance, Standard Deviation, Time series Analysis: Moving average Techniques, Covariance, Correlation and Regression.

UNIT V **7 Hours**

ERROR ANALYSIS

Errors, Truncation and round off errors, measurement errors, Chebyshev's Polynomial and data filtering.

Total: 60 Hours

Reference(s)

1 Greenberg Michael D., Advanced Engineering Mathematics, Prentice-Hall International Inc,2nd Edition 2006.
2 James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 4th Edition 2011.
3 Kreyszig Erwin, Advanced Engineering Mathematics, 10th Edition, John Wiley, 2015.
4 Kenneth H Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, Seventh Edition, Seventh Edition, Mc Graw Hill Education India Private Limited, New Delhi, 2013.
5 Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, McGraw Hill Inc, 4th Edition, 2002.

18EE402 DIGITAL LOGIC CIRCUITS 3 1 0 4

Course Objectives

- To perform the numeric conversions and design of simple logic circuits.
- To understand the concepts of combinational circuits
- To construct synchronous and asynchronous sequential circuits
- To familiarize with programmable logic devices and logic families
- To understand the fundamental concepts of VHDL programming

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

l. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

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Course Outcomes (COs)

1. Apply Boolean algebra and number systems to design the digital circuits.
2. Design and realize the combinational circuits using logic gates for data processing.
3. Analyze the synchronous and asynchronous sequential circuits using basic flip flops.
4. Examine the operation of various Programmable Logic Devices and logic families to develop efficient digital systems.
5. Develop simple programs in VHDL for suitable applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	1	-	-	-	-	-	-	-	2	3	-
2	3	2	3	1	-	-	-	-	-	-	-	2	3	1
3	3	2	3	1	-	-	-	-	-	-	-	2	3	1
4	3	2	3	1	-	-	-	-	-	-	-	2	2	1
5	3	2	-	-	3	-	-	-	-	-	-	2	2	1

UNIT I **10 Hours**

NUMBER SYSTEM AND BOOLEAN ALGEBRA

Review of number system; Types and conversion of codes-BCD, Gray code, Excess 3 code; Error detection and correction codes; Boolean algebra: De-Morgan's theorem, Simplification of functions using K-maps- Quine McCluskey method.

UNIT II **9 Hours**

COMBINATIONAL CIRCUITS

Design of functions using logic gates, Design of Adders, Subtractors, Comparators, Code converters, Encoders, Decoders, Multiplexers and Demultiplexers.

UNIT III **10 Hours**

SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS

Flip flops - SR, JK - MSJK , D and T, Analysis of synchronous and asynchronous sequential circuits, Design of synchronous sequential circuits-Counters, Moore and Melay model; state diagram; state reduction; state assignment.

UNIT IV **7 Hours**

PROGRAMMABLE LOGIC DEVICES AND LOGIC FAMILIES

Programmable Logic Devices: PLA, PAL, Logic families: TTL, ECL,IIL, CMOS.

UNIT V **9 Hours**

INTRODUCTION TO VHDL

Digital design process flow- Entities and Architecture-Concurrent statements-Sequential statements - Behavioral, Dataflow, and structural modeling - simple VHDL codes.

FOR FURTHER READING

Shift registers: shift register operations, SISO, SIPO, PISO and PIPO, Design of asynchronous sequential circuits, Field Programmable Logic Array(FPLA)

Total: 60 Hours

Reference(s)

1. Malvino and Leach, Digital Principles and Applications, Tata McGraw Hill, New Delhi, 7th edition, 2011
2. A.Anand kumar, Fundamentals of digital circuits, 3rd Edition, PHI Learning Pvt Ltd, 2014
3. John M.Yarbrough, Digital Logic, Application & Design, Thomson, 2010.
4. Floyd, Digital Fundamentals, Pearson Education, 10 th edition, 2011.
5. M. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India, 4th edition, 2013
6. A. K. Maini,Digital Electronics: Principles, Devices And Applications, Wiley, 2007.

18EE403 TRANSMISSION , DISTRIBUTION AND UTILIZATION 3 0 0 3

Course Objectives

- To understand the various types of transmission system and develop the mathematical models for line parameters.
- To compute the voltage regulation and efficiency using line parameters.
- To analyze the voltage distribution in insulator strings and grading of cables in transmission lines.
- To understand the different types of distribution system and substations with its layout
- To understand the application of electrical energy in domestic and industrial loads.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and anengineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Evaluate the fundamental parameters of overhead transmission line for transmission line modeling.
2. Apply transmission line equation and phasor diagram to estimate the voltage regulation and efficiency of short, medium, and long transmission lines under various load conditions.
3. Analyze the characteristics of different types of cables and insulators and estimate the string efficiency of insulators.
4. Analyze the layout of primary and secondary AC distribution system for power distribution.
5. Select the suitable electrical heating and welding techniques for industrial application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
1	3	2	-	2	-	2	2	-	-	-	2	-	3	-
2	3	2	-	2	-	-	-	-	-	-	2	-	3	-
3	3	1	-	-	-	-	-	-	-	-	2	-	1	-
4	3	-	-	-	-	2	2	-	-	-	-	-	-	1
5	3	-	-	-	-	2	2	-	-	-	-	-	-	1

UNIT I **10 Hours**

LINE PARAMETERS

Resistance, Inductance and capacitance of single phase and three phase line - Stranded and bundled conductor configurations - Symmetrical and unsymmetrical spacing - Transposition of line conductors - Double circuit lines - Skin and proximity effects.

UNIT II **10 Hours**

PERFORMANCE OF TRANSMISSION LINES

Regulations and Efficiency of Short Lines, Medium transmission lines by nominal T & Ž methods- Long Transmission line by Rigorous Solutions - ABCD Constant - Ferranti Effect - Corona Effect - Corona loss.

UNIT III **8 Hours**

CABLES AND INSULATORS

Cables - Types - Capacitance - Grading of cables - Testing of cables - Insulators - Types and comparison - Voltage distribution in insulator string - String efficiency - Methods of improving string efficiency.

UNIT IV **9 Hours**

DISTRIBUTION SYSTEM

AC distribution - single phase and three phase, 4-wire distribution- System comparison- Primary and Secondary distribution networks - Underground Distribution system - Laying, Terminal equipment - Substation equipment and layouts.

UNIT V **8 Hours**

UTILIZATION OF ELECTRICAL ENERGY

Electric Heating: Advantages and methods of electric heating, resistance heating, induction heating and dielectric heating Electric Welding: resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

Total: 45 Hours

Reference(s)

1. C.L .Wadhwa, Electrical Power Systems, New Age International Edition, New Delhi 2018
2. I.J.Nagrath, D.P.Kothari, Power System Engineering, Tata McGraw Hill Ltd, New Delhi, 2017
3. V. Kamaraju , Electrical Power Distribution Systems, Tata McGraw Hill Ltd, New Delhi, 2017
4. Turan Gonen, Electric Power Distribution system, Engineering, CRC Press 2017
5. H Partap Art and Science of Utilization of Electrical Energy, Dhanpat Rai & Sons 2017
6. E. Openshaw Taylor and V. V. L. Rao, Utilization of Electric Energy, University Press

18EE404 ELECTRICAL MACHINES II 3 1 0 4

Course Objectives

- To understand the construction, working and performance characteristics of alternator.
- To understand the construction and starting methods of Synchronous motor.
- To understand the construction working and performance characteristics of single phase and three phase induction motor.
- To select the appropriate machine from the knowledge of starting and speed control for various applications
- To understand the characteristics of fractional horse power motors.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the performance of alternator using different testing methods.
2. Analyze the characteristics and assess the performance of synchronous motor.
3. Analyze the characteristics and select a three phase induction machines for industrial application.
4. Apply suitable starting and speed control methods for three phase induction motors.
5. Apply the concepts of electric circuit and analyze the performance of fractional horse power motors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
2	2	2	-	-	-	-	-	-	-	-	-	-	2	1
3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
4	2	2	-	-	-	-	-	-	-	-	-	-	2	-
5	2	3	-	-	-	-	-	-	-	-	-	-	2	2

UNIT I **10 Hours**

ALTERNATOR

Principle of Operation - Construction - Types of rotor - EMF equation - Armature reaction - Regulation of alternator: EMF, MMF and ZPF method - Capability curve of alternator - Permanent Magnet Synchronous Generator

UNIT II **8 Hours**

SYNCHRONOUS MOTOR

Principle of operation - Methods of starting - Phasor diagram - V and Inverted V curve - Power angle characteristics - Hunting in synchronous motor - Application of Synchronous motor as synchronous condenser

UNIT III **10 Hours**

INDUCTION MOTOR

Concept of Rotating Magnetic Field - Construction - Types of rotor - Operation - torque equation - Torque - slip characteristics - Equivalent circuit model - Induction generator - Linear induction motor.

UNIT IV **8 Hours**

STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR

Need for starters - Methods of starting - Fully automated starters: DOL, Autotransformer, star delta starter - rotor resistance starter - Methods of braking, Methods of Speed Control - V/f Control and Pole Changing Techniques

UNIT V **9 Hours**

FRACTIONAL HORSE POWER MOTOR

Double Revolving Field Theory - Methods of Starting : Capacitor start - Capacitor start capacitor run - Shaded pole Equivalent circuit model - Universal motor - Stepper motor

Total: 60 Hours

Reference(s)

1. M.G.Say, Performance and Design of Alternating Current Machines, 3rd Edition, CBS Publisher, 2017
2. D. P. Kothari and I. J. Nagrath, Electric Machines, Tata McGraw Hill Publishing Company Ltd, Fourth Edition 2018
3. Stephen J.Chapman, Electric Machinery Fundamentals, Tata McGraw Hill, New Delhi, 2018
4. E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, Electric Machinery, Tata McGraw Hill publishing Company Ltd, New Delhi ,2015
5. P. S. Bhimbhra, Electrical Machinery, Khanna Publishers, Seventh Edition 2018
6. Acarnley, P. P, Stepping motors: a guide to modern theory and practice, The Institution of Electrical Engineers.

18EE405 INTEGRATED CIRCUITS AND APPLICATIONS

3 0 0 3

Course Objectives

- To understand the fundamentals and characteristics of Op-amp.
- To understand the linear applications of Op-amp.
- To understand the Non-linear applications of Op-amp.
- To understand the operation of A/D and D/A converters using Op-amp.
- To familiarize the students with the application of Special IC's.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the DC and AC characteristics of the Op-amp to design simple circuits in opamp.
2. Analyze the performance of Op-Amp based circuits for linear applications.
3. Design and analyze the output of Op-Amps for Wave shaping circuits.
4. Analyze the performance of A/D and D/A converters for electronic applications.
5. Design and analyze various application circuits using Special IC's.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	2	-	-	-	-	-	-	-	-	2	-
2	3	3	1	2	-	-	-	-	-	-	-	-	2	1
3	3	3	2	2	-	-	-	-	-	-	-	-	3	1
4	2	2	2	2	-	-	-	-	-	-	-	-	2	1
5	2	3	3	2	-	-	-	-	-	-	-	-	2	2

UNIT I **10 Hours**

CHARACTERISTICS OF OPERATIONAL AMPLIFIER

Basic Parameters of Operational Amplifier - Block diagram of Operational Amplifier - Characteristics of Ideal and Practical Operational Amplifier , transfer characteristics - Inverting and Non-inverting Amplifiers, Voltage follower -DC characteristics-AC characteristics-Frequency Response, Stability - Frequency Compensation techniques.

UNIT II **8 Hours**

LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIER

Summing amplifier- Differential amplifier - Instrumentation amplifier - Integrator and Differentiator - Voltage to Current and Current to Voltage converters, Oscillators-Sine Wave (RC Phase Shift and Wein Bridge), Triangular Wave and Saw tooth Wave Generation.

UNIT III **10 Hours**

NON-LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS

Comparators-Zero crossing detector, Schmitt Trigger, Window detector -Clippers, Clampers, Peak Detector-Sample and Hold circuit- Astable and Monostbale Multivibrators - Active filters-Analysis and Design of first order low pass, high pass, band pass and Band stop Butterworth filters.

UNIT IV **9 Hours**

A-D AND D-A CONVERTERS

DAC/ADC performance characteristics -Digital to Analog Converters: Binary weighted and R-2R Ladder types - Analog to digital converters: Successive approximation and Flash Type. Single Power Supply Operational Amplifiers: Need for single power supply operational amplifiers, AC Inverting and Non-Inverting amplifiers.

UNIT V **8 Hours**

SPECIAL ICS

555 Timer circuit -Functional block, Astable and Monostable characteristics, applications; Voltage regulators - fixed voltage regulators, adjustable voltage regulators - switching regulators.

FOR FURTHER READING

566-voltage controlled oscillator circuit; 565- PLL Functional Block diagram -Principle of operation, Applications: Frequency synthesis, AM and FM detection, FSK demodulator.

Total: 45 Hours

Reference(s)

1. David A.Bell, 'Op-amp & Linear ICs', Oxford, 2013.
2. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2015.
3. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system',Tata McGraw Hill, 2009.
4. Michael Jacob J, 'Applications and Design with Analog Integrated Circuits', Prentice Hall of India, New Delhi, 2010.
5. Robert F.Coughlin, Fredrick F. Driscoll,Op-amp and Linear ICs, Pearson, 6th edition,2012
6. S. Salivahanan and V.S. Kanchana Bhaaskaran , Linear Integrated Circuits, First reprint, Tata McGraw Hill, 2015.

18EE406 PYTHON PROGRAMMING 2 0 2 3

Course Objectives

- Understand the history and basics of python.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the functions, files, list, set tuples and dictionaries.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

k. 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.

l. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Construct simple python programs using input output operations.
2. Develop python programs using expressions and statements.
3. Implement python programs using control flow statements and strings.
4. Apply the concepts of functions and files in python programming.
5. Design applications using list, sets, tuples and dictionaries in python.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	2	2	-	-	1	2	2	-	1	1	-
2	2	2	2	2	2	-	-	1	2	2	-	2	2	-
3	2	3	3	3	3	-	-	1	2	2	-	2	1	-
4	2	3	3	3	3	-	-	1	2	2	2	2	1	-
5	2	3	3	3	3	-	-	1	2	2	2	2	3	-

UNIT I **6 Hours**

INTRODUCTION

What is Python - History of Python - Features of Python - Simple Program in Python - Commenting in Python - Quotations in Python - Lines and Indentation - Multi-Line Statements - Input Operations - Output Operations.

UNIT II **4 Hours**

DATA, EXPRESSIONS, STATEMENTS

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III **8 Hours**

CONTROL FLOW STATEMENTS AND STRINGS

if statement-if-else statement-if-elif-else statement- Nested if - While loop - for loop - else statement used with loops - break statement -continue - pass statement - Strings: string slices -immutability - string functions and methods - In-built string methods - string formatting operations - string module.

UNIT IV **6 Hours**

FUNCTIONS AND FILES

Functions: return values -parameters - local and global scope - function composition - recursion; Files: Reading and Writing-Format Operators-Filenames and paths.

UNIT V **6 Hours**

LIST, SET, TUPLES AND DICTIONARIES

Lists as arrays - Lists: list operations - list slices -list methods - list loop - mutability - aliasing - cloning lists - list parameters; Set; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods.

1 **2 Hours**

EXPERIMENT 1

Program to implement basic operators.

2 **2 Hours**

EXPERIMENT 2

Program for Operator Precedence.

3 **2 Hours**

EXPERIMENT 3

Program to implement the concept of function.

4 **3 Hours**

EXPERIMENT 4

Develop the program for selection statements.

5 **3 Hours**

EXPERIMENT 5

Program to implement looping statements.

6 **3 Hours**

EXPERIMENT 6

Program to implement break and continue statements.

7 **3 Hours**

EXPERIMENT 7

Develop a program to implement the concept of Recursion.

8 **3 Hours**

EXPERIMENT 8

Program to implement string functions.

9 **3 Hours**

EXPERIMENT 9

Implement the concept of list.

10 **3 Hours**

EXPERIMENT 10

Develop a program to implement tuples.

11 **3 Hours**

EXPERIMENT 11

Program to implement set,dictionaries.

Total: 60 Hours

Reference(s)

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd edition,Updated for Python 3, Shroff Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python -Revised and updated for Python 3.2, Network Theory Ltd., 2014.
3. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2015.
4. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2017.

18EE407 ELECTRICAL MACHINES II

LABORATORY 0 0 2 1

Course Objectives

- To understand the performance of a three phase induction motor by direct loading method.
- To understand the performance characteristics of an induction generator with self-excitation.
- To analyze the performance parameters of special motors by conducting suitable test.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the load characteristics of three phase induction motor and evaluate its performance.
2. Apply speed control techniques for three phase induction motor.
3. Apply the braking techniques to regulate the speed of three phase induction motor.
4. Evaluate the performance characteristics of self-excited induction generator and axial flux generator.
5. Analyze the load characteristics of BLDC motor and its performance.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	-	1	-	-	-	-	2	2	-	-	3	1
2	2	3	-	2	-	-	-	-	2	2	-	-	3	1
3	2	3	-	3	-	-	-	-	2	2	-	-	3	1
4	3	2	-	3	-	-	-	-	2	2	-	-	2	1
5	2	3	-	1	-	-	-	-	2	2	-	-	2	1

1 **3 Hours**

EXPERIMENT 1

Performance curves of three phase squirrel cage induction motor by direct loading method.

2 **3 Hours**

EXPERIMENT 2

Separation of no load losses in three phase squirrel cage induction motor.

3 **3 Hours**

EXPERIMENT 3

Speed control of three phase induction motor.

4 **4 Hours**

EXPERIMENT 4

Equivalent circuit and circle diagram for three phase induction motor

5 **3 Hours**

EXPERIMENT 5

Braking methods of three phase induction motor.

6 **4 Hours**

EXPERIMENT 6

Load test on self-excited induction generator.

7 **4 Hours**

EXPERIMENT 7

Performance analysis of three phase AC motor coupled Axial Flux Generator.

8 **3 Hours**

EXPERIMENT 8

Speed control of BLDC Motor.

9 **3 Hours**

EXPERIMENT 9

Load characteristics of BLDC motor**.**

Total: 30 Hours

Reference(s)

1. E. Fitzgerald, Charles Kingsley, Jr.Stephen D. Umans, Electric Machinery, Sixth Edition,Tata McGraw Hill Publishing Company Ltd., 2002.
2. M.G.Say, Performance and Design of Alternating Current Machines, 3rd Edition, CBS Publisher
3. D. P. Kothari and I. J. Nagrath, Electric Machines, Tata McGraw Hill Publishing Company Ltd,Fourth Edition 2010
4. Raj put R.K, Electric Machines, Lakshmi publication,fifth edition, reprinted at 2011
5. P. S. Bhimbhra, Electrical Machinery, Khanna Publishers, Seventh Edition 2011
6. Miller T.J.E. Brushless permanent Magnet and Reluctance Motor Drives, Clarendon Press

18EE408 DIGITAL AND INTEGRATED CIRCUITS

LABORATORY 0 0 2 1

Course Objectives

- To analyze the operation of combinational and Sequential digital circuits.
- To apply the principles of Op-amp in linear and non linear applications.
- To understand the applications of 555 timer IC.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
l. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Design and implementation of combinational and sequential logic circuits using logic gates.
2. Design and Implementation of digital circuits using VHDL.
3. Design wave shaping circuits, ADC and DAC using op amp.
4. Design and Implementation of real time applications using Op-Amp.
5. Design and construct astable and monostable multivibrators using IC555 timer.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	1	3	-	-	-	2	2	-	1	2	2
2	2	2	3	-	3	-	-	-	2	2	-	1	2	2
3	2	2	3	1	-	-	-	-	2	2	-	1	2	2
4	3	2	3	-	-	-	-	-	2	2	-	1	2	2
5	2	2	3	1	-	-	-	-	2	2	-	1	2	2

1 **4 Hours**

EXPERIMENT 1

Simulation of logic gates and design Full adder and Full subtractor circuits by using VHDL.

2 **2 Hours**

EXPERIMENT 2

Experimental verification of logic gates and design adder, subtractor and three variable Boolean Functions

3 **4 Hours**

EXPERIMENT 3

Design and implementation of Multiplexer and Demultiplexer using logic gates

4 **4 Hours**

EXPERIMENT 4

Verification of RS and JK Flip-flop and design the bidirectional shift registers by VHDL.

5 **2 Hours**

EXPERIMENT 5

Design and implementation of counters by behavioural modeling of VHDL

6 **4 Hours**

EXPERIMENT 6

Design and implementation of differentiator and integrator circuits by using op-amp.

7 **2 Hours**

EXPERIMENT 7

Design and implementation of Instrumentation amplifier by using op-amp

8 **2 Hours**

EXPERIMENT 8

Design and implementation of simple Microphone to Speaker circuit by using op-amp

9 **2 Hours**

EXPERIMENT 9

Design and implementation of analog to digital converter and digital to analog converter using op-amp.

10 **4 Hours**

EXPERIMENT 10

Design and implementation of Astable and Monostable Multivibrators using IC 555 Timer.

Total: 30 Hours

18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Apply the knowledge of forest, water, food, mineral and energy resources for sustainable exploitation of natural resources
2. Analyze the four types of ecosystems and biodiversity, its values and role of professionals in protecting the environment from degradation
3. Identify the existing environmental challenges related to air, water, soil, noise, thermal pollution and its management plan
4. Analyze the strategies of solid waste management, water management and climate change mitigation as a goal towards sustainable development
5. Analyze the impact of population growth and value education on the development of a country

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	-	-	-	-	-	-	-	-	2	-
2	1	1	-	-	-	-	-	-	-	-	-	-	3	-
3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
4	1	-	-	-	-	-	1	-	-	-	-	-	1	-
5	2	-	-	-	-	-	1	-	-	-	-	-	2	-

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification) - water logging - salinity - case studies. Energy resources: renewable(solar, wind, tidal, geothermal and hydroelectric power) - non renewable energy sources

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: forest ecosystem - desert ecosystem - ecological succession. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity - field study

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - marine pollution - thermal pollution - noise pollution. Disaster management: causes - effects - control measures of floods - earthquake - cyclone – landslides

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - urban problems related to energy. Environmental ethics - issues and possible solutions - solid waste management - causes - effects - 3R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. Environment protection act: Air (Prevention and control of pollution) act - wildlife protection act.

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - women and child welfare programmes - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

FOR FURTHER READING

Human rights: E - waste and biomedical waste -Identification of adulterants in food materials

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

18EE501 POWER SYSTEM ANALYSIS

3 1 0 4

Course Objectives

- To apply the concept of per unit systems in power system computations.
- To develop algorithms for power system planning.
- To understand the application of power system matrices.
- To understand the concept of symmetrical components.
- To analyze the stability of given network.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Apply the concept of per unit systems to construct the reactance diagram and develop the network matrices of the power system network.
2. Evaluate the power flow and losses in a power system network using non-lineariterative solution methods for power system planning.
3. Apply the concepts of bus impedance matrix and reactance diagrams to predict the effects of balanced faults in power system.
4. Analyse the effects of unbalanced faults in power systems using the concept of symmetrical components for power system protection.
5. Evaluate the stability of the power system during transient operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	-	-	-	-	-	-	-	-	2	-	3	-
2	3	3	-	2	-	-	1	-	-	-	-	-	3	-
3	3	3	-	2	-	1	-	-	-	-	2	-	3	-
4	3	3	-	2	-	1	-	-	-	-	2	-	3	-
5	3	3	-	2	-	-	1	-	-	-	-	-	3	-

UNIT I **9 Hours**

POWER SYSTEM MODELING

Single line diagrams -Per unit system -Per unit impedance/ reactance diagrams -Formation of network matrices - Y bus formation using inspection and singular transformation -Z bus formation using step-by- step building algorithm method.

UNIT II **8 Hours**

LOAD FLOW ANALYSIS

Load flow equations and methods of solution -Slack bus concept -Gauss Seidal, Newton Raphson, Fast decoupled methods for load flow studies.

UNIT III **8 Hours**

FAULT ANALYSIS - SYMMETRICAL FAULTS

Importance of short circuit analysis - assumptions in fault analysis - analysis using Thevenin's theorem - Z-bus building algorithm - fault analysis using Z-bus - computations of short circuit capacity, post fault voltage and currents.

UNIT IV **11 Hours**

FAULT ANALYSIS - UNSYMMETRICAL FAULTS

Introduction to symmetrical components - sequence impedances - sequence circuits of synchronous machine, transformer and transmission lines - 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.

UNIT V **9 Hours**

POWER SYSTEM STABILITY

Steady state and transient stability -Swing equation and its solution method (step by step) -Equal area criterion -Factors affecting stability and methods of improving stability.

FOR FURTHER READING

Overview of Indian power scenario- Electricity Deregulation-Captive Power Plants

Total: 60 Hours

Reference(s)

1. I.J. Nagarath, D.P. Kothari, Modern Power System Analysis, Tata McGraw Hill Publishing Company, New Delhi,2013.
2. John Grainger, William Stevenson JR, Power System Analysis, Mcgraw-Hill Series in Electrical and Computer Engineering, New Delhi, 2014.
3. Hadi Saadat, Power System Analysis, PSA Publishers, New Delhi, 2013.
4. P.Kundur, Power System Stability and Control, Tata McGraw Hill Book Company, New Delhi, 2013.
5. Charles A. Gross, Power System Analysis, Wiley India Pvt Ltd, Second edition, 2010.
6. P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, Electrical Power Systems Analysis, Security and Deregulation, PHI Learning Private Limited, New Delhi, 2012.

18EE502 CONTROL SYSTEMS 3 1 0 4

Course Objectives

- To understand the basic concepts of open loop and closed loop control systems.
- To analyze the given system in time domain.
- To understand the concept of frequency domain analysis
- To understand the concept of stability of system
- To design the compensator for different control systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and anengineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Develop a mathematical model of a physical system and compute the transfer function using Block diagram reduction technique and Signal flow graph.
2. Analyze the performance of first and second order system and compute the steady state error using different test signals.
3. Analyze the frequency response of a given system and comment the stability.
4. Analyze the stability of a given system using Routh Hurwitz criterion, Nyquist stability criterion and Root Locus techniques.
5. Apply the concept of lag, lead and lag lead compensator for open loop system and examine a system using state variable techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	-	-	-	-	-	-	-	-	-	3	-
2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
3	3	3	-	2	-	-	-	-	-	-	-	-	3	-
4	3	3	-	2	-	-	-	-	-	-	-	-	3	-
5	3	3	1	2	-	-	-	-	-	-	-	-	3	3

UNIT I **10 Hours**

MATHEMATICAL MODEL OF PHYSICAL SYSTEMS

Introduction- Basic Elements of control systems-Open loop and closed loop system - Elements of Control system - Transfer function of mechanical translational and rotational system, electrical system - Electrical analogy of mechanical system - Block diagram reduction technique - Signal flow graph.

UNIT II **8 Hours**

TIME DOMAIN ANALYSIS

Standard test signals - Time response of first order and second order systems for unit step test signals - Time domain specifications-Steady state response - Static error constants - steady state error - Effects of proportional derivative, proportional integral systems.

UNIT III **9 Hours**

FREQUENCY DOMAIN ANALYSIS

Frequency response of systems - Frequency domain specifications - Correlation between frequency domain and time domain specifications - Bode plot, Polar plot

UNIT IV **10 Hours**

STABILITY ANALYSIS OF CONTROL SYSTEM

Concepts of stability - Necessary conditions for Stability-Characteristics equation - Location of roots in S plane for stability - Routh Hurwitz criterion-Nyquist stability criterion- Root Locus technique-Relative Stability

UNIT V **8 Hours**

COMPENSATOR DESIGN

Compensators, Deign of Lag compensator - Lead compensator - Lag-lead compensator (using Bode plot) - Concept of state, state variable, state model, Controllability and observability

Total: 60 Hours

Reference(s)

1. I.J.Nagrath and M.Gopal, Control System Engineering, NewAge International Publisher,2018
2. M.Gopal, Control System Principles and Design,TataMcGraw-Hill,2012.
3. K.Ogatta, Modern Control Engineering, Pearson Education, NewDelhi, 2015
4. BenjaminC. Kuo, Automatic Control Systems, Prentice-Hall of India Pvt. Ltd.2014
5. M.N.Bandyopadhyay, Control Engineering Theory and Practice, Prentice Hall of India,2009

18EE503 MEASUREMENT AND INSTRUMENTATION 3 0 2 4

Course Objectives

- To understand the fundamental concepts of measuring instruments.
- To understand the operation of various analog instruments.
- To understand the operation of various digital instruments.
- To measure R, L and C elements using DC and AC bridges.
- To learn the principle and working of various transducers.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
j. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Examine the various types of errors in measurement and utilize statistical evaluation techniques to minimize their impact on measurement data.
2. Apply the concept of Faradays Law in various types of Analog Instruments and predict the types of errors associated with them.
3. Analyze voltage, phase, and power quality in electrical systems using digital measurement techniques
4. Design a suitable bridge for the measurement of unknown resistance, Inductance and Capacitance.
5. Assess the operating characteristics of different transducers for real time applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	-	-	2	2	-	-	2	-
2	2	1	-	-	-	-	-	-	2	2	-	-	2	2
3	2	2	-	-	-	-	-	-	2	2	-	-	2	2
4	3	3	2	-	-	-	-	-	2	2	-	-	3	-
5	2	1	-	-	-	-	-	-	2	2	-	-	3	-

UNIT I **9 Hours**

INTRODUCTION

Units and dimensions, Functional elements of an instruments, Static and dynamic characteristics, Errors in measurement, Statistical evaluation of measurement data, Standards and calibration.

UNIT II **9 Hours**

ANALOG INSTRUMENTS

Moving coil instruments: Permanent magnet moving coil instruments, Moving iron: attraction and repulsion type instruments- Torque equations and errors, Single and Three phase watt meters and Energy meters.

UNIT III **10 Hours**

DIGITAL INSTRUMENTS

Introduction, Digital Multi-meter: Block diagram, principle of operation, Digital Voltmeter: Block diagram, principle of operation, Types-Integrating type voltmeter, Digital Phase meter, Power quality analyzer.

UNIT IV **9 Hours**

MEASUREMENT OF ELECTRICAL AND NON ELECTRICAL QUANTITIES

Measurement of Resistance:Kelvin double bridge,Wheatstone bridge, Measurement of inductance and capacitance: Maxwell and Schering bridge,Earth Resistance Tester, Measurement of Temperature: Thermocouples, Radiation and Optical pyrometer.

UNIT V **8 Hours**

TRANSDUCERS

Selection of transducer, Classification of transducers: Resistive ,capacitive & inductive transducers, Piezoelectric, Hall Effect Transducers.

FOR FURTHER READING

Calibration of Meters, Smart sensors.

1 **2 Hours**

EXPERIMENT 1

Displacement measurement using LVDT.

2 **4 Hours**

EXPERIMENT 2

Experimental verification of Wheatstone bridge.

3 **4 Hours**

EXPERIMENT 3

Experimental verification of Kelvin double bridge.

4 **4 Hours**

EXPERIMENT 4

Experimental verification of Maxwells inductance bridge.

5 **4 Hours**

EXPERIMENT 5

Experimental verification of Schering bridge

6 **2 Hours**

EXPERIMENT 6

Calibration of ammeter and voltmeter.

7 **2 Hours**

EXPERIMENT 7

Calibration of Wattmeter.

8 **2 Hours**

EXPERIMENT 8

Calibration of single phase energy meter.

9 **4 Hours**

EXPERIMENT 9

Temperature measurement using RTD, Thermistor and IC AD590.

10 **2 Hours**

EXPERIMENT 10

Measurements using cathode ray oscilloscope.

Total: 75 Hours

Reference(s)

1. A. K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, 19th edition Dhanpat Rai and Co, 2014.
2. E. O. Doebelin, Measurement Systems Application and Design, Tata McGraw Hill Publishing Company, 2007.
3. D. V. S. Murthy, Transducers and Instrumentation, Prentice Hall of India Pvt Ltd, 2004.
4. H. S. Kalsi, Electronic Instrumentation, Tata McGraw Hill, 3rd edition 2012.
5. J. B. Gupta, A Course in Electronic and Electrical Measurements, S. K. Kataria & Sons, Delhi, 2008.

18EE504 POWER ELECTRONICS 3 0 0 3

Course Objectives

- To analyze the static and switching characteristics of power semi-conductor devices.
- To understand the operation of controlled rectifiers.
- To understand and analyze the various types of choppers.
- To evaluate the operation, characteristics and performance parameters of Inverters.
- To understand the operation of ac-ac converters.

Programme Outcomes (POs)

a.Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

l. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the static and dynamic characteristics of power semiconductor devices for reliable application in power electronics systems.
2. Anlayze the input and output parameters of controlled rectifiers with R, RL and RLE Load for power control applications.
3. Apply the various converter topologies to design and analyze the switched mode regulators.
4. Analyze the operation of inverter topologies with different PWM schemes for efficient power conversion.
5. Analyze the performance parameters of AC- AC converters to evaluate their effectiveness in AC-AC power conversion applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	1	1	1
2	3	2	1	-	-	-	-	-	-	-	-	1	3	2
3	3	2	2	-	-	-	-	-	-	-	-	1	3	2
4	2	2	2	-	-	-	-	-	-	-	-	1	3	2
5	2	1	1	-	-	-	-	-	-	-	-	1	3	2

UNIT I **9 Hours**

POWER SEMI-CONDUCTOR DEVICES

Construction Operation Static and Dynamics characteristics of Power Diode-Power BJT -SCR -DIAC - TRIAC- GTO -MOSFET - IGBT Ratings of Devices Protection of Devices.

UNIT II **10 Hours**

CONTROLLED RECTIFIERS

Single Phase and Three Phase Half and Fully controlled rectifier with R, RL, RLE Load - Effect of Freewheeling Diode -Continuous and Discontinuous Mode of operation - Performance Analysis - Dual converter.

UNIT III **8 Hours**

CHOPPERS

Classification -control strategies - Buck, Boost, and Buck-Boost - Performance analysis - PWM techniques for choppers- Switched mode regulators

UNIT IV **12 Hours**

INVERTERS

Single Phase H - Bridge and Cascaded H Bridge - Three Phase Voltage Source Inverters - Single phase and Three Phase Current Source Inverters - Performance analysis - PWM techniques. - Analysis of Harmonic Distortion.

UNIT V **6 Hours**

AC-AC CONVERTERS

Performance analysis of Single Phase and Three Phase AC Voltage Controllers - Single phase Matrix converters.

Total: 45 Hours

Reference(s)

1. Muhammad H.Rashid, Power Electronics Circuits, Devices & Applications 4th Edition, Pearson India, 2017.
2. NedMohan, Tore.M.Undeland, William.P.Robbins, Power Electronics: Converters, Applications and Design,3rd Edition WileyIndia, NewDelhi, 2007.
3. M.D.Singh & K.B Khanchandani. Power Electronics 2nd Edition Tata Mc Graw Hill Publishing Co.Ltd., New Delhi,2008.
4. D. Ronanki, S. Singh, S. Williamson, "Comprehensive Topological Overview of Rolling Stock Architectures and Recent Trends in Electric Railway Traction Systems", IEEE Trans. Transportation Electrification., vol. 3, no. 3, pp. 724-738, May 2017.
5. E. Babaei, S. Alilu, and S. Laali, "A new general topology for cascaded multilevel inverters with reduced number of components based on devel-oped H-bridge,-IEEE Trans. Ind. Electron., vol. 61, no. 8, pp. 3932-3939,Aug. 2014.

18EE507 POWER SYSTEM SIMULATION

LABORATORY **0 0 2 1**

Course Objectives

- To acquire programming skills and experience in the usage of standard packages like Matlab and E-Tap necessary for power system analysis
- To acquire knowledge required for planning, operation and control of power system networks through simulation

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Apply the concepts of graph theory to determine the network incidence matrices.
2. Evaluate the power flow and losses in a power system network using non-linear iterative solution methods.
3. Analyse the short circuit current in a power system network following a fault, using simulation tools.
4. Develop a program to determine the economic loading point of synchronized generating units
5. Analyse rotor angle stability in a power system network using simulation tools.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	2	3	-	-	2	2	2	-	-	3	-
2	2	-	-	2	3	-	-	2	2	2	-	-	3	-
3	2	-	-	2	3	-	-	2	2	2	-	-	3	-
4	2	-	-	2	3	-	-	2	2	2	-	-	3	-
5	2	-	-	2	3	-	-	2	2	2	-	-	3	-

1 **4 Hours**

EXPERIMENT 1

Formation of Bus Admittance Matrix and Bus Impedance Matrix

2 **4 Hours**

EXPERIMENT 2

Formation of Bus incidence matrix and loop incidence matrix.

3 **4 Hours**

EXPERIMENT 3

Formation of Branch path incidence matrix and Basic cutest matrix.

4 **2 Hours**

EXPERIMENT 4

Solution of Power Flow and Related Problems Using Gauss-Seidel method

5 **4 Hours**

EXPERIMENT 5

Solution of Power Flow and Related Problems Using Newton-Raphson Method

6 **4 Hours**

EXPERIMENT 6

Solution of Power Flow and Related Problems Using Fast-Decoupled Load Flow

7 **2 Hours**

EXPERIMENT 7

Short Circuit analysis

8 **2 Hours**

EXPERIMENT 8

Economic Dispatch in Power Systems

9 **2 Hours**

EXPERIMENT 9

Transient Stability Analysis

10 **2 Hours**

EXPERIMENT 10

Contingency Analysis

Total: 30 Hours

18EE508 CONTROL SYSTEMS LABORATORY 0 0 2 1

Course Objectives

- To understand the basic concepts of open loop and closed loop control systems
- To analyze the given system in time domain
- To understand the concept of frequency domain analysis
- To understand the concept of stability of system

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
j. 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.
l. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Construct the transfer function of AC servo motor and analyze the performance of the system.
2. Analyze the time and frequency domain response of linear and nonlinear systems.
3. Apply the bode plot and root-locus technique to analyze the stability of the control system.
4. Analyze the performance of induction motor and PMDC motor with closed loop control system.
5. Design and verify the performance of different types of controllers for given applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	-	-	2	-	-	2	2	-	1	3	2
2	3	3	-	2	-	-	-	-	2	2	-	-	2	-
3	3	-	3	-	-	-	-	-	2	2	-	-	3	-
4	3	3	-	2	1	-	-	-	2	2	-	-	3	2
5	1	-	3	-	2	-	-	-	2	2	-	-	3	1

1 **4 Hours**

EXPERIMENT 1

Determine the transfer function of AC servo motor.

2 **2 Hours**

EXPERIMENT 2

Design a servo mechanism for robotic arm control using PIC.

3 **4 Hours**

EXPERIMENT 3

Analyze the response of given first order system with step, ramp and impulse inputs

4 **4 Hours**

EXPERIMENT 4

Develop a state model for given system and analyze its stability using Bode plot and Root locus

5 **4 Hours**

EXPERIMENT 5

Realization of first order and second order system using op-amp.

6 **2 Hours**

EXPERIMENT 6

Design and analysis of lag and lead compensator.

7 **2 Hours**

EXPERIMENT 7

Design and verify the performance of P, PI and PID controllers

8 **4 Hours**

EXPERIMENT 8

Experimental verification of closed loop control system for 3 phase induction motor

9 **2 Hours**

EXPERIMENT 9

Design and implementation of closed loop control system for PMDC motor.

10 **2 Hours**

EXPERIMENT 10

Study and experimental verification of Programmable Logic Controller for given applications

Total: 30 Hours

Reference(s)

1. I.J.Nagrath and M.Gopal, Control System Engineering, NewAge International Publisher,2018
2. K.Ogatta, Modern Control Engineering, Pearson Education, NewDelhi, 2015
3. M.Gopal, "Control System Principles and Design",TataMcGraw-Hill,2012
4. S.Palani, Control System Engg, TataMcGraw-Hill, 2016

18HS003 PRINCIPLES OF MANAGEMENT 2 0 0 2

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

Programme Outcomes (POs)

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

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. 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.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply the concepts of Management in their work place
2. Apply the concepts oon planning process Tools and techniques in their work environment
3. Apply the management concept for organizing and staffing.
4. Apply the management concept for directing.
5. Apply the management concept for controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	1	2	1	2	1	3	1	-	-
2	-	-	-	-	-	1	2	1	2	1	3	1	-	1
3	-	-	-	-	-	1	2	1	2	1	3	1	-	-
4	-	-	-	-	-	1	2	1	2	1	3	1	-	1
5	-	-	-	-	-	1	2	1	2	1	3	1	-	1

UNIT I **6 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management-Science or Art - Manager Vs Entrepreneur-types of managers-Managerial roles and skills-Evolution of Management-Scientific, Human Relations, System and Contingency approaches- Types of Business organization- Sole proprietorship, partnership, Company-public and private sector enterprises-Organization culture and Environment-Current Trends and issues in Management.

UNIT II **6 Hours**

PLANNING

Nature and purpose 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 **6 Hours**

ORGANISING

Nature and purpose-Formal and informal organization-Organization chart-Organization Structure-Types-Line and staff authority-Departmentalization-delegation of authority- Centralization and decentralization-Job Design-Human Resource Management-HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV **6 Hours**

DIRECTING

Foundations of individual and group behaviour-Motivation-Motivation theories- Motivational techniques-Job satisfaction-Job enrichment-Leadership-types and theories of leadership-Communication-Process of communication-Barrier in communication-Effective communication - Communication and IT.

UNIT V **6 Hours**

CONTROLLING

System and process of controlling-Budgetary and non-Budgetary control techniques-Use of Computers and IT in Management control-Productivity problems and management-Control and Performance-Direct and preventive control-Reporting.

Total: 30 Hours

Reference(s)

1. Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education,7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007..
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008.

18EE602 MICROCONTROLLERS BASED SYSTEM DESIGN 3 0 0 3

Course Objectives

- To understand RISC and CISC architecture, pipelining and evaluation.
- To understand the architectural features of the hardware and interfacing peripheral devices to PIC 16Fxx
- To acquire sound knowledge of PIC Microcontroller
- To gain knowledge of LPC2148 architecture.
- To understand the concepts of MSP430 Architecture

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
c. Design solutions for complex engineering problems and design system components or processes thatmeet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
k. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply the architectural features of PIC microcontrollers to implement basic embedded functions for user-interactive applications.
2. Apply interrupt handling techniques in PIC microcontrollers to implement task switching and real-time response in embedded applications.
3. Analyze the operation of peripheral and interfacing features for data handling and system functionality.
4. Analyze the ARM architecture, instruction sets, and organization for automation.
5. Design embedded solutions using MSP430 by integrating its functional blocks and Code Composer Studio tools for specific application requirements.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2	-	2	-	-	-	-	-	2	-	3	1
2	2	1	2	-	2	-	-	-	-	-	2	-	3	-
3	2	1	2	-	2	-	-	-	-	-	2	-	3	-
4	2	1	2	-	2	-	-	-	-	-	2	-	3	1
5	2	1	2	-	2	-	-	-	-	-	2	-	3	1

UNIT I **9 Hours**

INTRODUCTION TO PIC MICROCONTROLLER

Introduction to PIC microcontrollers, PIC 16FXX architecture, comparison of PIC with other CISC and RISC based systems - Pipelining - Program Memory considerations - Register File Structure - Addressing modes - Simple Operations.

UNIT II **9 Hours**

INTERRUPTS AND TIMER

PIC micro controller Interrupts- External Interrupts-Interrupt Programming - Loop time subroutine - Timers-Timer Programming - Front panel I/O-Soft Keys - key switches- Display of Constant and Variable strings.

UNIT III **9 Hours**

PERIPHERALS AND INTERFACING

I2C Bus for Peripherals Chip Access - Bus operation-Bus subroutines - Serial EEPROM - analog to Digital Converter - UART-Baud rate selection - Data handling circuit - Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

UNIT IV **9 Hours**

INTRODUCTION TO ARM

The ARM architecture -ARM assembly language program -ARM organization and implementation – The ARM instruction set-The thumb instruction set -ARM CPU cores - GPIO Programming, Timer Programming, Interrupt programming, Serial Port Programming, LCD and Keyboard interfacing

UNIT V **9 Hours**

INTRODUCTION TO MSP430

MSP430 Architecture: Introduction - Functional block diagram - Memory - Central Processing Unit - Memory Mapped Input and Output - - Instruction Set - Introduction to Code Composer Studio (CCS v4).Understanding how to use CCS for MSP430 microcontrollers-Interrupt programming-Digital I/O-I/O ports programming using C.

Total: 45 Hours

Reference(s)

1. Peatman,J.B., Design with PIC Micro Controllers PearsonEducation,3rdEdition, 2004.
2. Mazidi, M.A., Rollin Mckinlay, Danny causey PIC Microcontroller, Prentice Hall of India, 2007
3. Myke Predko , Programming and Customizing the PIC Microcontroller TAB electronics,Third Edition, 2009
4. Furber,S., ARM System on Chip Architecture, Addison Wesley trade Computer Publication, 2009.
5. Technical documents related to MSP-EXP430G2 and Tiva C Series TM4C123G

18EE603 DIGITAL SIGNAL PROCESSING 3 1 0 4

Course Objectives

- To understand the signals and systems and their mathematical representation in time/frequency domain
- To analyze the discrete time systems using Z-transform and Inverse Z-transform
- To implement the discrete time systems in Discrete Fourier Transform using Fast Fourier Transform algorithm
- To design FIR, IIR filters with its response and obtaining its realization structure
- To understand the architectural overview and addressing modes in DSP processors

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze mathematical functions, classify signals and systems, and apply sampling and quantization concepts for analog-to-digital conversion.
2. Analyze the stability of discrete-time systems using the Z-transform and apply the discrete time Fourier transform for time domain to frequency domain conversion.
3. Apply the discrete Fourier transform and fast Fourier transform for the discrete-time systems for time domain to frequency domain conversion.
4. Design FIR and IIR filters, analyze their responses, and construct their realization structures.
5. Develop an algorithm using DSP Processor for signal processing applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1	1	-	-	-	-	-	-	-	-	2	1
2	2	3	3	1	-	-	-	-	-	-	-	-	2	1
3	2	3	3	1	-	-	-	-	-	-	-	-	2	1
4	2	3	3	1	-	1	-	-	-	-	-	-	2	1
5	1	2	1	1	-	1	-	-	-	-	-	-	2	1

UNIT I **10 Hours**

SIGNALS AND SYSTEMS

Classification of Systems: Continuous, Discrete, Linear, Causal, Stability, Dynamic, Recursive, Time Variance Systems; Classification of Signals: Continuous and Discrete, Energy and Power; Mathematical representation of Signals; Spectral Density; Sampling techniques, Quantization, Quantization error, Nyquist rate, Aliasing effect

UNIT II **9 Hours**

DISCRETE TIME SYSTEM ANALYSIS

Z-transform and its properties, Inverse Z-transforms; Difference equation - Solution by Z-transform, Application to Discrete Systems - Stability analysis, Frequency response - Convolution - Discrete Time Fourier transform, Magnitude and Phase representation

UNIT III **8 Hours**

DISCRETE FOURIER TRANSFORM

Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm - DIT & DIF using radix 2 FFT - Butterfly structure

UNIT IV **10 Hours**

DESIGN OF DIGITAL FILTERS

FIR & IIR filter realization - Parallel & Cascade forms. FIR design: Windowing Techniques - Need and choice of windows - Linear phase characteristics. Analog filter design - Butterworth and Chebyshev approximations; IIR Filters, Digital design using impulse invariant and bilinear transformation Warping, prewarping

UNIT V **8 Hours**

DIGITAL SIGNAL PROCESSORS

Introduction - Architecture - Features - Addressing Formats - Functional modes - Dedicated MAC unit - Multiple ALUs, Pipelining - Introduction to Commercial DS Processors

FOR FURTHER READING

Lattice structure of IIR and FIR filters, Kaiser Window, Quantization error in FFT algorithm, Applications of Multirate systems, Architecture of TMS320C6X, C0ode composer studio

Total: 60 Hours

Reference(s)

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI, 2007
2. S.K. Mitra, 'Digital Signal Processing - A Computer Based Approach', McGraw Hill Edu, 2013
3. Tarun Kumar Rawat, Digital Signal Processing, Oxford University Press, 2015
4. Richard G. Lyons, Understanding Digital Signal Processing, Prentice Hall, 3rd Edition, 2012
5. S. Salivahanan, A.Vallavaraj, Gnanapriya, Digital Signal Processing, McGraw-Hill, 2nd Edition, 2011

18EE604 POWER SYSTEM PROTECTION AND SWITCH GEAR 3 0 0 3

Course Objectives

- To understand the different types of protection schemes in power system
- To understand the construction and operating principle of protective relays
- To gain knowledge on transmission line and apparatus protection schemes
- To understand the concept of arc phenomena, arc interruption and lightning arresters
- To illustrate the construction and operating principle of circuit breakers

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
f. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the different types of faults and protection schemes in power systems.
2. Evaluate the characteristics of protective relays and recommend suitable relay schemes for power system protection.
3. Select and apply appropriate protection schemes for alternators, transformers, motors, bus bars, and feeders.
4. Apply the arc interruption schemes in Circuit Breakers.
5. Analyze the performance of different types of circuit breakers in electrical systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	2	2	-	-	-	-	1	-	3
2	3	2	-	-	-	2	2	-	-	-	-	-	-	3
3	3	2	-	-	-	2	2	-	-	-	-	-	-	3
4	3	2	-	-	-	2	2	-	-	-	-	-	-	3
5	3	2	-	-	-	3	2	-	-	-	-	2	-	3

UNIT I **8 Hours**

INTRODUCTION TO PROTECTION SCHEMES

Principles and need for protective schemes, Nature and causes of faults, primary and backup protection, Electromagnetic relays, Comparison between static and electromagnetic relays, Step and Touch potential, Zones of protection, Power System Earthing.

UNIT II **10 Hours**

PROTECTIVE RELAY

Non directional and directional over current relays, Static and numerical over current relays, Distance relay - Impedance, reactance and mho relays, Differential and pilot relaying schemes, Auto reclosing andsynchronizing.

UNIT III **9 Hours**

APPARATUS AND LINE PROTECTION

Alternator, transformer, induction motor, bus bar and feeder protection schemes, CTs and PTs and their applications in protection schemes, microprocessor based protective schemes

UNIT IV **8 Hours**

THEORY OF CIRCUIT INTERRUPTION

Physics of arc phenomena and arc interruption, Restriking voltage, Recovery voltage, rate of rise of restriking voltage, resistance switching, current chopping and interruption of capacitive current, lightning arresters and its types.

UNIT V

CIRCUIT BREAKERS **10 Hours**

Introduction- Rating of Circuit Breakers, Types of Circuit Breakers-Miniature, Earth leakage, Air blast, Air break, oil, SF6 and Vacuum circuit breakers with advantages and disadvantages, High voltage dc circuit breakers- Maintenance and Testing of circuit breakers-Recent developments in protective relays.

Total: 45 Hours

Reference(s)

1. Badri Ram, D.N.Viswakarma "Power system Protection and switchgear", Tata Mcgraw Hill, Private Limited, New Delhi, 2013.
2. Bhaveshbhalja, R.P. Maheshwari, Nilesh G. Chothani, "Protection and Swtichgear", Oxford University press, 2014.
3. Sunil S. Rao, "Switchgear Protection and Power Systems", Khanna publishers, New Delhi, 13th Edition, Reprint 2008.
4. V.K.Metha and Rohit Metha "Principles of power system", S. Chand company Ltd, 2011.
5. Wadhwa C L, "Electrical Power Systems", New age International (P) Ltd., Sixth Edition, 2010.
6. Bo, Z.Q., Lin, X.N., Wang, Q.P. et al. Developments of power system protection and control(2016)

18EE607 MICROCONTROLLERS BASED SYSTEM DESIGN LAB 0 0 2 1

Course Objectives

- To understand the instruction sets of different microcontrollers.
- To gain hands-on experience on various microcontrollers.
- To interface the microcontroller for given applications.
- To develop an Integrated Development Environment (IDE) for embedded system.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. 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.
l. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Design and execute a simple program using PIC, ARM & MSP430 controllers.
2. Implement and analyze the interfacing of peripherals devices with PIC, ARM & MSP430 controllers.
3. Analyze the peripheral interfacing of analog and digital Sensors in microcontrollers.
4. Execute analog to digital conversion using PIC16F877a and MSP430.
5. Implement and analyze the interfacing of stepper motor with PIC, ARM & MSP430 controllers.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	3	-	2	-	-	-	2	2	2	1	3	2
2	3	-	3	-	2	-	-	-	2	2	2	1	2	2
3	2	-	3	-	2	-	-	-	2	2	2	1	1	2
4	3	-	3	-	2	-	-	-	2	2	2	1	2	2
5	2	-	3	-	3	-	-	-	2	2	2	1	2	3

1 **14 Hours**

EXPERIMENT 1

Simple programming to design Flashing LED with PIC 16F877A.

2 **4 Hours**

EXPERIMENT 2

Implementation and interfacing of LCD with PIC16F877a.

3 **2 Hours**

EXPERIMENT 3

Implementation and interfacing of stepper motor

4 **2 Hours**

EXPERIMENT 4

Implementation and interfacing of LM35 Temperature Sensor.

5 **2 Hours**

EXPERIMENT 5

Generation of PWM pulse to control DC motor using PIC16F877a.

6 **4 Hours**

EXPERIMENT 6

Simple programming to design Flashing LED with PIC 18FXXX.

7 **4 Hours**

EXPERIMENT 7

Flashing of LEDs using ARM LPC2148.

8 **2 Hours**

EXPERIMENT 8

Interfacing of Relay with ARM LPC2148.

9 **4 Hours**

EXPERIMENT 9

Basic Input and Output Using MSP430.

10 **2 Hours**

EXPERIMENT 10

Analog to Digital Conversion and Interrupts Using MSP430.

Total: 30 Hours

18EE608 POWER ELECTRONICS LABORATORY 0 0 2 1

Course Objectives

- Students will be able to analyse the performance of DC- DC converters.
- Students will be able to analyze the performance of Inverters.
- Students will be able to analyse the performance of Permanent magnet synchronous motor.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. 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.

d. 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.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Design and analyze the performance characteristics of converter for solar PV applications.
2. Design and analyze the performance characteristics of inverter for UPS applications.
3. Analyze the performance characteristics of AC voltage controller for the speed of fans, pumps, and hoists.
4. Analyze the performance characteristics of Switched reluctance motor drive for industrial applications.
5. Design, Simulate and analyze the characteristics of Permanent magnet synchronous motor for Electric vehicle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	1	2	1	-	-	2	2	-	-	1	1
2	3	2	3	1	2	1	-	-	2	2	-	-	3	3
3	3	2	-	2	2	1	-	-	2	2	-	-	3	3
4	2	2	-	2	2	1	-	-	2	2	-	-	2	3
5	1	2	3	2	2	1	-	-	2	2	-	-	3	1

1 **3 Hours**

EXPERIMENT 1

Verification of single phase half and fully controlled converters.

2 **3 Hours**

EXPERIMENT 2

Experimental verification of Boost regulator with TPS55340 and LM5122 ICs and Low-dropout Regulators with TPS7A4901 and TPS7A8300.

3 **2 Hours**

EXPERIMENT 3

Verification of TPS54160 buck regulator and LM3475 hysteretic buck regulator.

4 **2 Hours**

EXPERIMENT 4

Verification of single phase AC voltage controller.

5 **4 Hours**

EXPERIMENT 5

Experimental verification of multilevel inverter

6 **4 Hours**

EXPERIMENT 6

Verification of three phase voltage source inverter and V/f control of three phase VSI fed Induction motor drive.

7 **3 Hours**

EXPERIMENT 7

Four quadrant operation of DC motor using chopper.

8 **2 Hours**

EXPERIMENT 8

Switched reluctance motor drive.

9 **3 Hours**

EXPERIMENT 9

Simulation of Permanent magnet synchronous motor Using MATLAB Software for Electric Vehicle.

10 **4 Hours**

EXPERIMENT 10

Simulation of Permanent magnet synchronous motor Using MATLAB Software for Electric Vehicle.

Total: 30 Hours

18HS002 PROFESSIONAL ETHICS IN ENGINEERING 2 0 0 2

Course Objectives

- To understand Human Values and ethical theory.
- To understand codes of ethics, work place responsibilities, rights, engineering experimentation, global issues and contemporary ethical issues.
- To understand personal ethics, legal ethics, cultural ethics and engineers responsibility.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply human values for sustained lifelong learning.
2. Apply engineering ethics for sustained lifelong learning.
3. Contribute to shape a better character by following ethical actions.
4. Confront and resolve moral issues occurred during technological activities.
5. Resolve moral and ethical problems through exploration and assessment by established experiments.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	1	-	3	1	1	2	1	-	1
2	2	1	-	-	-	1	-	2	1	1	2	1	-	1
3	2	1	-	-	-	1	-	2	1	1	2	1	-	1
4	2	1	-	-	-	1	-	2	1	1	2	1	-	1
5	2	1	-	-	-	1	1	2	1	1	2	1	-	1

UNIT I **6 Hours**

HUMAN VALUES

Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others – Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment - Empathy

UNIT II **6 Hours**

ENGINEERING ETHICS AND PROFESSIONALISM

Scope of Engineering Ethics- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlbergs and Gilligan's theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse

UNIT III **6 Hours**

ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl

UNIT IV **6 Hours**

WORKPLACE RESPONSIBILITIES AND RIGHTS

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights

UNIT V **6 Hours**

GLOBAL ISSUES

Multinational corporations: Technology transfer and appropriate technology - International rights - promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership

FOR FURTHER READING

Sample code of ethics like IETE,ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management.

Total: 30 Hours

Reference(s)

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
3. R S Naagarazan, A text book on professional ethics and human values, New age international (P)limited, New Delhi,2006.
4. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
5. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics - Concepts and Cases, Wadsworth Thompson Learning, United States, 2005.

18EE702 EMBEDDED SYSTEMS 3 0 0 3

Course Objectives

- To understand the embedded system architecture.
- To understand the interfacing techniques between processors & peripheral devices related to embedded processing.
- To gain the knowledge of hard and soft real time operating systems.
- To understand the concept of input and output devices of embedded system.
- To develop efficient programs on any applications.

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the architecture of embedded system for real time applications.
2. Analyze the functions of structural units of processors for memory management.
3. Apply the RTOS concepts in embedded system applications.
4. Analyze the function of communication ports in real time system design.
5. Apply the principles of real-time embedded systems to develop solutions for various applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	-	-	-	-	-	-	-	-	1	2	1
2	1	2	2	-	-	-	-	-	-	-	-	1	2	1
3	1	2	2	-	-	-	-	-	-	-	-	1	2	2
4	1	2	2	-	-	-	-	-	-	-	-	1	2	2
5	1	2	2	-	-	-	-	-	-	-	-	1	2	2

UNIT I **9 Hours**

EMBEDDED SYSTEM

Introduction to embedded system- embedded system architecture - classification of embedded systems- CISC Vs RISC - IC technology - processor technology

UNIT II **8 Hours**

PROCESSOR AND MEMORY ORGANIZATION

Structural units in a processor; selection of processor , selection of memory devices; allocation of memory to program segments and blocks, memory map of a system ; DMA; interfacing processor, memory and I/O units, memory management, watch dog timers.

UNIT III **8 Hours**

REAL TIME OPERATING SYSTEM

Introduction of RTOS, Hard and soft real time systems- examples, RTOS -Interrupt handling, Embedded system design issues in system development process.

UNIT IV **10 Hours**

INPUT / OUTPUT DEVICES

Serial communication using I2C, CAN, USB buses- automobile, computer; parallel communication using ISA, PCI, PCI/X buses, arm bus; device drivers in a system -Serial port & parallel port, Testing of Embedded Systems, System Design Example

UNIT V **10 Hours**

REAL TIME EMBEDDED SYSTEM

Digital camera- washing machine- automated teller machine - open source embedded system software- FreeRTOS

Total: 45 Hours

Reference(s)

1. Rajkamal, Embedded System-Architecture, Programming, Design, Mc Graw Hill, 2013.
2. Peckol,Embedded system Design, John Wiley & Sons,2010
3. Lyla B Das, Embedded Systems-An Integrated Approach, Pearson, 2013
4. Shibu. K.V, Introduction To Embedded Systems, Tata Mcgraw Hill,2009
5. Elicia White,Making Embedded Systems, O Reilly Series,SPD,2011.

18EE703 ELECTRICAL MACHINE DESIGN 3 1 0 4

Course Objectives

- To study the principles of magnetic circuits for static and rotating electrical machines
- To gain knowledge on the design parameters for DC machines
- To analyze the design parameters of Transformers.
- To understand the design parameters for Induction motors
- To understand the design procedure for synchronous machine.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the performance of static and rotating machines using the magnetic circuit parameters.
2. Apply the concepts of electric and magnetic circuits to design DC machines.
3. Design a transformer by selecting the appropriate dimensions.
4. Select appropriate dimensions and design a three phase induction motor for electric vehicle applications.
5. Analyze the design parameters of synchronous machines for industrial application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
1	3	2	2	-	3	-	-	-	-	-	-	-	2	-
2	3	3	3	-	-	-	-	-	-	-	-	-	3	-
3	3	3	3	-	-	-	-	-	-	-	-	-	3	1
4	3	3	3	-	3	-	-	-	-	-	-	-	3	-
5	3	3	3	-	-	-	-	-	-	-	-	-	3	1

UNIT I **8 Hours**

INTRODUCTION

Fundamentals aspects of electrical machine design (Major considerations - Limitations in design, modern trends) - principles of magnetic circuit (types of magnetic materials, BH curves for magnetic materials, magnetic leakage), computation of total MMF in magnetic circuit (Net length of iron - real and apparent flux density of rotating machines) - Basic concepts of computer aided design and its different approaches.

UNIT II **9 Hours**

DC MACHINES

Main dimensions (output equation, Choice of specific loadings of dc machine) Guiding factors for pole design - Armature Design - Design of field system, - Design of Commutator and Brushes.

UNIT III **9 Hours**

TRANSFORMERS

KVA output rating for single and three phase transformers - Volt per turn - Window space factor - Overall dimensions - Temperature rise of Transformers - Design of Tank with & without cooling tubes - Cooling of Transformers

UNIT IV **9 Hours**

INDUCTION MOTORS

Output equation and Main dimensions for three phase induction motors Stator design parameters for three phase induction motor Rotor design parameters - air gap design for three phase induction motor. Design of induction motor for low power applications using Maxwell software.

UNIT V **10 Hours**

SYNCHRONOUS MACHINES

Main dimensions of salient pole machines (runaway speed, output equation, choice of specific loading) - Short circuit ratio and its effects on machine performance - Estimation of air gap length - Armature design and its parameters - Design of damper winding. Design of turbo alternators (output equation, main dimensions and stator design)

Total: 60 Hours

Reference(s)

1. A. K. Sawhney, A Course in Electrical Machine Design, Dhanpat Rai & Sons, New Delhi, Sixth reprint, 2014.
2. M.V .Deshpande, Design & Testing of Electrical Machines, PHI Learning private Limited, New Delhi , Third Print 2013
3. R. K. Agarwal, Principles of Electrical Machine Design, Kataria S K and Sons, New Delhi, 2010
4. V. N. Mittle and Mittle A, Design of Electrical Machines, Standard Publishers Distributors, New Delhi, Fifth reprint, 2013.

18EE704 SOLID STATE DRIVES 3 0 2 4

Course Objectives

- To analyze the motor and load dynamics also predict the steady state stability of drives for
- different loads.
- To Apply power electronic converters to control the speed of DC motors.
- To analyze various speed control techniques and converter topologies for induction motor drives
- To analyze the performance of synchronous motor drives.
- To select the special electrical machines and control schemes for various industrial applications

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply steady state stability principles to drives operating under different load conditions.
2. Analyze the steady state and transient performances of DC drives in constant speed control applications.
3. Analyze the various speed control techniques and converter topologies for effective control of induction motor drives.
4. Analyze the performance of synchronous motor drives in constant speed and low speed application.
5. Select suitable electrical machines and their control schemes for various industrial applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1	-	2	-	-	1	2	2	-	-	1	1
2	3	3	1	-	2	-	-	1	2	2	-	-	2	1
3	3	3	1	-	2	-	-	1	2	2	-	-	2	1
4	3	1	1	-	2	-	-	1	2	2	-	-	2	1
5	3	1	1	-	2	-	-	1	2	2	-	-	2	2

UNIT I **9 Hours**

FUNDAMENTALS OF ELECTRIC DRIVES

Development of Electric Drives - Drive classifications - Advantage of Electric Drives - Equations governing motor load dynamics - Equilibrium operating point and its steady state stability - Mathematical condition for steady state stability and problems - Nature and classification of load torque - Multiquadrant operation.

UNIT II **8 Hours**

CONVERTER / CHOPPER FED DC MOTOR DRIVE

DC motor and their performance - Braking - Steady state and transient analysis of the single and three phase fully controlled converter fed separately excited D.C motor drive - Continuous and discontinuous conduction mode - Dynamic braking with DC chopper - Four Quadrant operation - Chopper fed regenerative braking.

UNIT III **11 Hours**

INDUCTION MOTOR DRIVES

Analysis and performance of three-phase induction motor - Stator voltage - stator frequency control - V/F control, controlled current and controlled slip operation - PWM inverter drives - Voltage Source Inverter, Current Source Inverter and cycloconverter fed induction motor drives - Harmonic behavior of induction motors - Rotor slip power recovery schemes.

UNIT IV **9 Hours**

SYNCHRONOUS MOTOR DRIVES

Principle of vector control - Open loop v/f control - self controlled synchronous motor drive using load commutated thyristor inverter - self-control of CSI and VSI fed synchronous motor - Margin angle control and power factor control - Permanent magnet (PM) synchronous motor.

UNIT V **8 Hours**

BLDC, STEPPER MOTOR DRIVES AND APPLICATIONS

Brushless DC motor drives and its applications - Variable reluctance and permanent magnet stepper motor Drives - Selection of drives and control schemes for steel rolling mills, paper mills, shipping - PLL, PID based control of drives –Closed loop control of BLDC Drives-Development of sensor less BLDC motor control scheme using PIC Controller.

1 **2 Hours**

EXPERIMENT 1

Experimental Verification of Closed loop Control of Siemens 6RA80 DC Drive.

2 **4 Hours**

EXPERIMENT 2

Experimental verification of four quadrant operation of DC motor using Siemens 6RA80 Drive.

3 **4 Hours**

EXPERIMENT 3

Experimental Verification of Speed control of three phase induction motor using Siemens Sinamics G120 Drive.

4 **4 Hours**

EXPERIMENT 4

Design and Verification of three phase inverter fed drive using Siemens Sinamics G120 Drive

5 **4 Hours**

EXPERIMENT 5

Design and Simulation of cyclo-converter fed AC drive using MATLAB

6 **4 Hours**

EXPERIMENT 6

Experimental Verification of V/F control of Induction motor drive using Siemens Sinamics G120 Drive

7 **2 Hours**

EXPERIMENT 7

Design and Simulation of CSI fed Induction motor drive using MATLAB

8 **2 Hours**

EXPERIMENT 8

Design and Simulation of the BLDC controller using MATLAB.

9 **2 Hours**

EXPERIMENT 9

Design and Simulation of closed loop control for BLDC motor using sensor less control technique in MATLAB

10 **2 Hours**

EXPERIMENT 10

Design and Simulation of speed control of SRM motor drive using MATLAB

Total: 75 Hours

Reference(s)

1. Krishan.R ,Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press ,2017.
2. Vedam Subramanyam, Electric Drives: Concepts & Applications, Tata McGraw- Hill Education, 2017.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using8085, 8086, 8051, McGraw Hill Education, 2013.
4. P.S.Bimbra Power Electronics, Khanna Publishers, third Edition, 2003.
5. Ned Mohan, Power Electronics, John Wiley and Sons, 2019.
6. Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press, 2017.

18EE707 EMBEDDED SYSTEMS LABORATORY 0 0 2 1

Course Objectives

- To focus on the embedded system hardware development
- To implement and simulate assembly language and C programs
- To analyze system performance using different processing units

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Demonstrate the interfacing of PIC 16F877A microcontroller with sensors.
2. Design circuits for real time applications using PIC 18FXXXX microcontroller.
3. Develop a program to control electrical appliances using LPC2138 ARM microcontroller.
4. Demonstrate the interfacing of LPC2138 microcontroller with sensors.
5. Design circuits for real time applications using ARM.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	3	-	2	-	-	-	2	2	-	-	3	2
2	3	-	3	-	2	-	-	-	2	2	-	-	2	2
3	3	-	3	-	2	-	-	-	2	2	-	-	2	2
4	3	-	3	-	2	-	-	-	2	2	-	-	2	2
5	3	-	3	-	2	-	-	-	2	2	-	-	2	2

1 **3 Hours**

EXPERIMENT 1

Ultrasonic Sensor based Wireless Liquid level sensing with PIC Microcontroller

2 **3 Hours**

EXPERIMENT 2

Design a digital clock by Interfacing 7 segment display with PIC microcontroller

3 **3 Hours**

EXPERIMENT 3

Interfacing KEYPAD with PIC Microcontroller and display value on serial terminal using UART

4 **3 Hours**

EXPERIMENT 4

Implement the external interrupt with PIC microcontroller

5 **3 Hours**

EXPERIMENT 5

Design a Automatic College Bell using PIC 18FXXXX

6 **3 Hours**

EXPERIMENT 6

Design a calculator by Interfacing 7 segment display with LPC2138

7 **3 Hours**

EXPERIMENT 7

Design and Implementation of ARM Based DC Motor Speed Control

8 **3 Hours**

EXPERIMENT 8

Interfacing LM35 with LPC2138 and display value on serial terminal using UART

9 **3 Hours**

EXPERIMENT 9

Interfacing Zigbee / RF with LPC2138 microcontroller

10 **3 Hours**

EXPERIMENT 10

Design and Implementation of ARM Based Solar Light Illumination control

Total: 30 Hours

Reference(s)

1. Rajkamal,Embedded System-Architecture, Programming, Design, Mc Graw Hill, 2013.

2. Peckol,Embedded system Design, John Wiley & Sons,2010

3. Lyla B Das, Embedded Systems-An Integrated Approach, Pearson, 2013.

18EE708 PROJECT WORK I 0 0 6 3

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness
- Prepare report and present oral demonstrations

Programme Outcomes (POs)

a.**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. **Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. **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.
d.**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.
e. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. **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.
h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. **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.
k. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team,to manage projects and in multidisciplinary environments.
l. **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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Develop the solutions for real world problems
2. Develop the technical ideas, strategies and methodologies to solve the real world problems
3. Apply the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the costeffectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	3	2	-	-	2	1	-	-	-	-	-	3	1
2	2	2	1	3	-	2	-	-	-	-	2	2	2	-
3	-	-	3	2	2	-	-	2	-	-	2	2	3	-
4	-	1	-	2	3	1	2	2	-	-	-	-	1	3
5	-	-	-	-	-	-	-	-	3	3	-	2	-	3

18EE804 PROJECT WORK II **0 0 18 9**

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness
- Prepare report and present oral demonstrations

Programme Outcomes (POs)

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

b. **Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. **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.

d. **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.

e. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g. **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.

h. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. **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.

k. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l. **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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Develop the solutions for real world problems
2. Develop the technical ideas, strategies and methodologies to solve the real world problems
3. Apply the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the costeffectiveness.
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	2	-	2	1	-	3	-	-	-	3	1
2	2	2	2	3	-	2	-	-	3	-	2	2	2	-
3	-	-	3	2	2	-	1	2	3	-	2	2	3	-
4	-	1	-	2	3	2	2	2	3	-	3	-	1	3
5	-	-	-	-	-	-	-	-	3	3	2	2	1	3

18HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topicalissue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communicate effectively on complex engineering activities with the engineering community andwith 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.

m. Design, **analyze**, and evaluate the performance of Electrical & Electronics systems usingcontemporary tools to provide effective solutions for real-world problems

Course Outcomes (COs)

1. Apply appropriate grammar & vocabulary that is expected at the BEC Vantage exam level.
2. Analyse the general meaning of non-routine letters, and of a report of predictable / unpredictable topic.
3. Execute the simple reports of factual nature and factual non-routine letters.
4. Implement for factual information and understand the answer; and take/pass on workplace messages.
5. Analyse express opinions and present arguments to a limited extent; and give simple, preparedpresentations on familiar topics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	1	-	-	-	1	-
2	-	-	-	-	-	-	-	-	2	-	-	-	1	-
3	-	-	-	-	-	-	-	-	3	-	-	-	1	-
4	-	-	-	-	-	-	-	-	-	1	-	-	1	-
5	-	-	-	-	-	-	-	-	-	2	-	-	1	-

UNIT I **9 Hours**

GRAMMAR

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision-making.

1.A Horse and Two Goats - R K Narayan
2.My Lord the Baby - Rabindranath Tagore
3.Twist in the Tale - Jeffery Archer
4. The Third and Final Continent - Jhumpa Lahiri
5.The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day-to-day situations
- To help students acquire the ability to understand a simple technical text in Hindi

Programme Outcomes (POs)

j. **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.

Course Outcomes (COs)

1. Apply simple sentences and use vocabulary required for day-to-day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Evaluate to appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	2	-	-	-	-
2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
3	-	-	-	-	-	-	-	-	-	3	-	-	-	-

UNIT I **9 Hours**

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

UNIT V **9 Hours**

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People,Vee Kumar Publications(P)Ltd., New Delhi,2009
3. Videos, Stories, Rhymes and Songs

18HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

Programme Outcomes (POs)

j. 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.

Course Outcomes (COs)

1. Analyse the listening skill and identify individual sounds of German
2. Apply basic sounds and words while speaking
3. Evaluate the read and understanding skills using short passages on familiar topics
4. Apply basic sentence structures while writing
5. Analyse the useage of basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	2	-	-	-	-
2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
4	-	-	-	-	-	-	-	-	-	2	-	-	-	-
5	-	-	-	-	-	-	-	-	-	3	-	-	-	-

UNIT I **9 Hours**

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV **9 Hours**

Question words-Types of Questions - Nominative case- Verb Conjugation - country – nationalities

UNIT V **9 Hours**

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Reference(s)

Total: 45 Hours

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

18HSJ01 JAPANESE **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Programme Outcomes (POs)

j. 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.

Course Outcomes (COs)

1. Apply the Japanese alphabet while writing a letter
2. Apply the basic sounds of the Japanese language while Speaking
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	2	-	-	-	-
2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
3	-	-	-	-	-	-	-	-	-	2	-	-	-	-
4	-	-	-	-	-	-	-	-	-	2	-	-	-	-
5	-	-	-	-	-	-	-	-	-	2	-	-	-	-

UNIT I **9 Hours**

Introduction to Japanese - Japanese script- Pronunciation of Japanese(Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers).

UNIT II **9 Hours**

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

UNIT III **9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT IV **9 Hours**

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii

adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V **9 Hours**

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

18HSC01 CHINESE **1 0 2 2**

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations

Programme Outcomes (POs)

j. 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.

Course Outcomes (COs)

1. Apply the listening skills to identify individual sounds of Chinese
2. Apply the basic sounds and words while speaking
3. Analyse the reading and understanding skills using short passages on familiar topics
4. Apply the basic sentence structures while writing
5. Apply the basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	2	-	-	-	-
2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
4	-	-	-	-	-	-	-	-	-	2	-	-	-	-
5	-	-	-	-	-	-	-	-	-	3	-	-	-	-

UNIT I **9 Hours**

Hello | 1.Initials and Finals of Chinese | b,p,m,f,d,,n,l,g,k,h,j,q,x | 2. Tones Four | 3.Chinese Syllables |

4.Tone S

UNIT II **9 Hours**

Thank you | Initials and Finals of Chinese | The Neutral Tone | Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**

1. What's your name - In the school; -In the classroom; -In the school | The Interrogative Pronoun | 2 The Sentence | 3 Interrogative Sentences with

UNIT IV **9 Hours**

She is my Chinese teacher | In the library | The Interrogative Pronouns | The Structural Particle | The interrogative Particle

UNIT V **9 Hours**

Her daughter is 20 years old this year | 1.The Interrogative Pronoun | 2. Numbers below 100 | 3.Indicating a Change | The Interrogative Phrase

Total: 45 Hours

18HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

Programme Outcomes (POs)

j. 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.

Course Outcomes (COs)

1. Apply the French alphabet & basic vocabulary skills while writing and speaking
2. Apply the individual sounds of French while speaking
3. Apply the basic sounds and words while speaking
4. Analyse the Reading and understanding skills of French using short passages on familiar topics
5. Apply the basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	2	-	-	-	-
2	-	-	-	-	-	-	-	-	-	2	-	-	-	-
3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
4	-	-	-	-	-	-	-	-	-	2	-	-	-	-
5	-	-	-	-	-	-	-	-	-	3	-	-	-	-

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue francaise, alphabets, les numeros, les jours, les mois. Grammaire Les verbes s"appeler,etre, avoir, les articles definis, indefinis Communication - Saluer, s"informer sur quelquun, demander de se presenter Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l"annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites Grammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : Regulier et Irregulier) - Adjectifs les propositions de lieu Communication - Chercher un logement, d"ecrire son voisin, s"informer sur un lodgement Lexique - L"habitat, les pieces, l"equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, future proche Communication- Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie Lexique - le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l"imparfait
Communication - Propose aÃƒÂ,Â quelqu""un de faire quelque chose, raconteur une sortie au passe parler un film Lexique - Les sorties, la famille, art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite
Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant
Lexique Les services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

1. Saison A1, Methode de francais
2. Hachette FLE

18GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyse the origin and advance of nanomaterials and its classification
2. Apply suitable methods to synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Analyse the physical properties exhibited by nanomaterials
5. Apply the the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
4	1	1	-	-	-	-	-	-	-	-	-	-	-	-
5	2	3	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes- structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- particulate and geometrical nanomagnets-magneto resistance.

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", WileyInterscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

18GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES 3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyse the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Analyse the operation of Bipolar Junction transistor at different modes and different configurations
4. Apply the metal oxide field effect transistor in memory devices
5. Apply the opto-electronic devices in suitable application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
4	1	1	-	-	-	-	-	-	-	-	-	-	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics – carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

18GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Implement the transition mechanisms and the components of a laser system.
2. Analyse the different types of lasers based on pumping method, active medium and energy levels.
3. Apply the rotation of earth, velocity and distance using lasers and apply the same for day today applications.
4. Analyse the role of lasers in surgical and endoscopy applications.
5. Apply the laser techniques in industrial applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
4	1	1	-	-	-	-	-	-	-	-	-	-	-	-
5	1	2	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein"s prediction - Einstein"s relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement - holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting- Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006

18GE0C1 CORROSION SCIENCE AND ENGINEERING 3 0 0 3

Course Objectives

- Understand the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

Course Outcomes (COs)

1. Analyse if corrosion can occur under specific operating conditions in a given equipment orconstruction and indicate regions of immunity, corrosion and passivity of a metal
2. Analyse different corrosion types on metals when exposed to air, water and at high temperatures (> 100^{o}C)
3. Apply the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Evaluate the rate of corrosion on metals using electrochemical methods of testing
5. Execute the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
2	2		-	-	-	-	1	-	-	-	-	-	-	-
3	1	3	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
5	3	3	-	-	-	-	1	-	-	-	-	-	-	-

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

18GE0C2 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles
- Identify the types of fuel cells and to relate the factors of energy and environment
- Analyze various energy storage devices and fuel cells

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Analyse the parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Apply the suitable electrodes, electrolyte, and cell reactions to different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications.
3. Apply the fuel cells based on its construction, production of current for suitable applications
4. Analyse different methods of storing hydrogen fuel and its environmental applications
5. Analyse the types of renewable energy sources like solar cells for sustainable development

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	-	-	-	-	-	-	-	-	-	-	-	-
2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-
4	2	2	-	-	-	-	-	-	-	-	-	-	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries - zinc-carbon, magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell

Total:45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009
2. F. Barbir,PEM fuel cells: Theory and practice, Elsevier, Burlington, MA, Academic Press, 2013
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

18GE0C3 POLYMER SCIENCE **3 0 0 3**

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers and its processing
- Identify suitable polymers for various industrial applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

Course Outcomes (COs)

1. Apply the polymerization reactions and analyze the natural and synthetic polymers
2. Apply the suitable polymerization techniques to synthesize the high quality polymers
3. Analyse the polymers to identify the structural, thermal ,mechanical and electrical features for specific applications
4. Apply the polymer processing methods to design polymer products
5. Analyze the polymers used in electronic and biomedical applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
4	1	1	2	-	-	-	-	-	-	-	-	-	-	-
5	1	3	2	-	-	-	-	-	-	-	-	-	-	-

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration

FOR FURTHER READING

Biodegradable polymers

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2015
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2007
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011

18GE0M1 GRAPH THEORY AND COMBINATORICS 3 0 0 3

Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science & Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory based computing and network security studies in Computer Science.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems

Course Outcomes (COs)

1. Analyse the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	-	-	-	-	-	-	-	-	2	-
2	-	2	-	-	-	-	-	-	-	-	-	-	3	-
3	1	-	-	-	-	-	-	-	-	-	-	-	2	-
4	1	-	-	-	-	-	-	-	-	-	-	-	2	-
5	-	2	-	-	-	-	-	-	-	-	-	-	3	-

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

18GE0M2 ALGEBRA AND NUMBER THEORY 3 0 0 3

Course Objectives

- Understand the basic notions of groups, rings, fields which will then be used to solve related problems.
- Examine the key questions in the Theory of Numbers.
- Implement the integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

m. Design, **analyze**, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems

Course Outcomes (COs)

1. Analyse the concepts of groups and fields in the areas of Engineering.
2. Apply the finite fields to solve engineering problems
3. Apply the divisibility in number theory in various areas of Engineering.
4. Apply the solution of Diophantine equations to solve engineering problems
5. Evaluate the theorems in number theory.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	-	-	-	-	-	-	-	-	1	-
2	-	2	-	-	-	-	-	-	-	-	-	-	2	-
3	1	-	-	-	-	-	-	-	-	-	-	-	2	-
4	1	-	-	-	-	-	-	-	-	-	-	-	1	-
5	-	2	-	-	-	-	-	-	-	-	-	-	1	-

UNIT I **9 Hours**

FIELDS

Group Theory - Rings and Polynomials - Fields.

UNIT II **9 Hours**

FINITE FIELDS AND POLYNOMIALS

Finite Fields - Irreducible Polynomials over Finite fields - Factorization of Polynomials over Finite Fields.

UNIT III **9 Hours**

DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS

Division algorithm- Base-b representations - number patterns - Prime and composite numbers - Fibonacci and Lucas numbers - Fermat numbers - GCD - Euclidean Algorithm - Fundamental theorem of Arithmetic - LCM.

UNIT IV **8 Hours**

DIOPHANTINE EQUATIONS AND CONGRUENCES

Linear Diophantine equations - Congruence s - Linear Congruence s - Applications: Divisibility tests - Modular Designs - Chinese remainder theorem - 2x2 linear systems.

UNIT V **10 Hours**

CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS

Wilson s theorem - Fermat s Little theorem - Euler s theorem - Euler s Phi functions - Tau and Sigma functions - Perfect numbers - Mersenne Primes - Mobius Function.

Total: 45 Hours

Reference(s)

1. Lidl.R., and Pilz. G., Applied Abstract Algebra, Springer-Verlag, New Delhi, 2nd Edition, 2006.
2. Thomas Koshy, Elementary Number Theory with Applications, Elsevier Publications, New Delhi, 2002.
3. San Ling and Chaoping Xing, Coding Theory: A first Course, Cambridge Publications, Cambridge, 2004.
4. Niven.I, Zuckerman.H.S., and Montgomery, H.L., An Introduction to Theory of Numbers, John Wiley and Sons, Singapore, 2004.

18GE0M3 MATHEMATICAL FINANCE AND QUEUEING THEORY

3 0 0 3

Course Objectives

- To provide the required fundamental concepts in probability and queueing models and apply these techniques in networks, image processing etc.
- Acquire skills in analyzing queueing models.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems

Course Outcomes (COs)

1. Apply the stochastic process in finance
2. Apply the concepts of Statistics in finance.
3. Evaluate the basics of finance using the notions of statistics.
4. Analyse the properties of queues in engineering applications.
5. Apply the concepts of queue in open and closed networks.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	-	-	-	-	-	-	-	-	1	-
2	-	2	-	-	-	-	-	-	-	-	-	-	2	-
3	1	-	-	-	-	-	-	-	-	-	-	-	2	-
4	1	-	-	-	-	-	-	-	-	-	-	-	1	-
5	-	2	-	-	-	-	-	-	-	-	-	-	1	-

UNIT I **9 Hour**

APPLIED STOCHASTIC CALCULUS

Brownian motion - Constructions - Non differentiability - Quadratic variation - Stochastic integration - Construction of Ito integral and properties ,the Ito formula - Feynman-Kac formula

UNIT II **9 Hours**

STATISTICS

Basic parameter estimation - Maximum likelihood estimation - Distributions - Regression techniques - Tests for normality - QQ plots - Hypothesis testing - Numerical examples in R.

UNIT III **9 Hours**

CONTINUOUS-TIME FINANCE

Black-Scholes-Merton model of stock prices as geometric Brownian motion, derivation of the Black-Scholes-Merton partial differential equation, the Black-Scholes formula and simple extensions of the model, self-financing strategies and model completeness, risk neutral measures, the fundamental theorems of asset pricing, continuous time optimal stopping and pricing of American options, forwards and futures in Black-Scholes-Merton model.

UNIT IV **9 Hours**

QUEUEING THEORY

Markovian queues - Birth and Death processes - Single and multiple server queueing models - Little s formula - Queues with finite waiting rooms - Finite source models.

UNIT V **9 Hours**

NON-MARKOVIAN QUEUES AND QUEUEING NETWORKS

M/G/1 queue - Pollaczek Khinchin formula - M/D/1 and M/EK/1 as special cases - Series queues - Open and closed Jackson networks.

Total: 45 Hours

Reference(s)

1. M. Capinski and T. Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer, 2005.
2. S. Shreve, Stochastic Calculus for Finance, Vol. 1 and Vol. 2, Springer, 2004.
3. G. R. Grimmett and D. R. Stirzaker, Probability and Random Processes, 3rd Edition, Oxford University Press, 2001.
4. Taha, H.A., Operations Research, Pearson Education, Asia, 8th Edition, 2007.

18GE0E1 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc

Programme Outcomes (POs)

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

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Analyze the role of entrepreneurship in economic development.
2. Apply the different ideas used for entrepreneurship development.
3. Apply the legal aspects of business and its association.
4. Apply the sources of business and its analysis.
5. Analyse the different modes of operation management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	1	2	-	2	-	-	-	-	-
2	-	-	-	-	-	1	2	-	2	-	-	-	-	-
3	-	-	-	-	-	1	2	-	2	-	-	-	-	-
4	-	-	-	-	-	1	2	-	2	-	-	-	-	-
5	-	-	-	-	-	1	2	-	2	-	-	-	-	-

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.

18GE0E2 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promoting the product / services
- Handle the human resources and taxation
- Understand Government industrial policies / support provided and prepare a business plan

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Apply the strategies and plans in marketing management.
2. Analyse the cases involved in human resource management.
3. Analyse the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Apply the various steps involved in preparing the business plan.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	1	2	-	2	-	-	-	-	-
2	-	-	-	-	-		2	-	2	-	-	-	-	-
3	-	-	-	-	-	1	2	-	2	-	-	-	-	-
4	-	-	-	-	-	1	2	-	2	-	-	-	-	-
5	-	-	-	-	-	1	2	-	2	-	-	-	-	-

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment,Segmentation, Targeting and positioning, Formulating marketing strategies,Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases).Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases)

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State Level Institutions-TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.htm

18EE001 ADVANCED POWER SEMICONDUCTOR DEVICES 3 0 0 3

Course Objectives

- To learn the characteristics of different types of semiconductor devices.
- To analyze the characteristics of power transistor
- To understand the construction and working principle of Thyristor
- To understand the operation and analyze the characteristics of power controlled devices
- To explore the need for isolation circuits and protection circuits

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an Engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
l. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the performance characteristics of power semiconductor switches.
2. Assess the performance characteristics of power transistor
3. Analyze the static and dynamic characteristics of thyristor
4. Analyze the static and switching characteristics of power controlled devices
5. Design a snubber and driver circuits for power controlled devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	-	-	-	-	-	1	2	1
2	3	2	-	-	-	-	-	-	-	-	-	1	2	-
3	3	2	-	-	-	-	-	-	-	-	-	1	2	-
4	3	2	-	-	-	-	-	-	-	-	-	1	2	1
5	3	3	3	-	-	-	-	-	-	-	-	1	3	3

UNIT I **9 Hours**

INTRODUCTION

Power switching devices -Attributes of an ideal switch, application requirements- circuit symbols -Power handling capability (SOA); Device selection strategy - On-state and switching losses - EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics - Rating.Introduction to wide band gap semiconductors such as silicon carbide and gallium nitride

UNIT II **9 Hours**

POWER TRANSISTOR

BJTs - Construction, static characteristics, switching characteristics - Negative temperature coefficient and Secondary breakdown - Power Darlington - Thermal protection-dynamic models of BJT

UNIT III **9 Hours**

THYRISTOR

Thyristors - working principle and its operating modes- Two transistor analogy- concept of latching - Gate and switching characteristics - Converter grade and inverter grade and other types; series and parallel operation -Comparison of BJT and Thyristor- Steady state and dynamic models of BJT and Thyristor - thermal protection

UNIT IV **9 Hours**

POWER CONTROLLED DEVICES

Principle, construction, types of Power MOSFETs and IGBTs- static and switching characteristics - Steady state and dynamic models of MOSFET and IGBTs; Basics of GTO, MCT, and IGCT

UNIT V **9 Hours**

FIRING AND PROTECTING CIRCUITS

Necessity of isolation circuit- Pulse transformer- Opto-coupler; Gate drive circuit for SCR,MOSFET, IGBTs and base driving for power BJT - Overvoltage, over current and gate protections, Design of snubbers.

Total: 45 Hours

Reference(s)

1. Timothy L. Skvarenina, The power electronics handbook, CRC press, New Delhi, 2012.
2. M. H. Rashid, Power Electronics circuits, Devices and Applications, Prentice Hall of India, New Delhi, 2011.
3. Shen, Shyh-Chiang, Wide-bandgap device research and development at SRL, Georgia Institute of Technology Semiconductor Research Laboratory, retrieved 2014-09-03.
4. Baliga, B. Jayant, Fundamentals of Power Semiconductor Devices springer, 2008.
5. Ned Mohan, Undeland and Robins, Power Electronics Concepts, applications and design, John Wiley and sons, Singapore, 2000.
6. M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw Hill book Co,New Delhi, 2003.

18EE002 SPECIAL ELECTRICAL MACHINES 3 0 0 3

Course Objectives

- To understand the construction and principle of operation of synchronous reluctance motor.
- To identify the power controllers and understand the modes of operation of switched reluctance motor
- To understand the construction and principle of operation of permanent magnet brushless dc motor.
- To design power controller circuit for permanent magnet synchronous motor.
- To understand the characteristics and modes of excitation of stepper motor.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the performance of synchronous reluctance motor and compute the voltage and torque equation.
2. Analyze the characteristics of switched reluctance motor and design the closed loop control of SRM for suitable applications.
3. Analyze the principle of operation of permanent magnet brushless DC motor and compute EMF and torque equation.
4. Apply suitable power controller circuit in permanent magnet synchronous motor to enhance the performance characteristics.
5. Analyze the performance characteristics of stepper motor and examine the closed loop operation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2	2	1	-	-	-	-	-	-	-	3	-
2	3	2	2	2	1	-	-	-	-	-	-	-	3	1
3	3	2	2	2	2	-	-	-	-	-	-	-	3	1
4	3	1	2	2	2	-	-	-	-	-	-	-	3	1
5	3	1	2	2	1	-	-	-	-	-	-	-	3	2

UNIT I **7 Hours**

SYNCHRONOUS RELUCTANCE MOTORS

Construction and operating principle, Axial and radial air gap motors, Phasor diagram, Voltage and torque equation - Characteristics and its Applications.

UNIT II **9 Hours**

SWITCHED RELUCTANCE MOTORS

Constructional features - Principle of operation - Torque equation -Power controllers - Control circuits for SRM -Torque speed Characteristics - Microprocessor based controller

UNIT III **10 Hours**

PERMANENT MAGNET BRUSHLESS DC MOTOR

Permanent Magnet materials - Characteristics - construction and principle of operation - Types - Difference between mechanical and electronic commutators - EMF and torque equations - torque speed characteristics - Hall sensors - optical position sensors - Microprocessor Based controller.

UNIT IV **9 Hours**

PERMANENT MAGNET SYNCHRONOUS MOTOR

Principle of operation - EMF and Torque equations - self control - vector control - Torque speed Characteristics - Microprocessor based control - Applications

UNIT V **10 Hours**

STEPPER MOTOR

Construction and Principle of operation - Variable reluctance stepper motor, Permanent magnet stepper motor, Hybrid stepper motor, Static and dynamic characteristics ,Driver circuit , Applications and advantages.

Total: 45 Hours

Reference(s)

1. Miller T J E, Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press,Oxford, 2008.
2. Kenjo T, Stepping Motors and Their Microprocessor Controls, Clarendon Press London,2009.
3. Kenjo T and Nagamori S,Permanent Magnet and Brushless DC Motors, Clarendon Press,London,1985.
4. R.Krishnan, Switched Reluctance Motor Drives - Modeling, Simulation, Analysis, Design and Application, CRC Press, New York, 2014.

18EE003 HIGH VOLTAGE ENGINEERING 3 0 0 3

Course Objectives

- To deduce necessary equations to relate insulation parameters of gaseous medium.
- To understand the performance of liquid and solid insulating medium using different methods.
- To explore the methods to generate high voltage and high current.
- To predict a method to measure high voltage and high current in the given application.
- To classify the various high voltage testing methods.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
d. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the performance of gaseous insulating medium using different methods.
2. Assess the conduction and break down characteristics of liquid and solid dielectrics.
3. Analyze the characteristics of high voltage, high current and impulse voltage generators.
4. Apply suitable methods to measure high voltage, high current and impulse voltage.
5. Analyze the procedure for different high voltage tests conducted on electrical apparatus.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	1	-	-	2	-	-	-	-	-	2	1
2	3	-	-	1	-	-	2	-	-	-	-	-	2	1
3	3	-	-	1	-	-	2	-	-	-	-	-	2	1
4	3	-	-	1	-	-	2	-	-	-	-	-	2	1
5	3	-	-	2	-	-	2	-	-	-	-	-	2	1

UNIT I **8 Hours**

CONDUCTION AND BREAKDOWN OF GASEOUS INSULATION MATERIALS

Gases as insulating media-Ionization process and current growth - Townsend's criterion for breakdown-Paschen's law-penning effect- breakdown in non - uniform fields- partial breakdown-corona discharges.

UNIT II **10 Hours**

CONDUCTION AND BREAKDOWN IN LIQUID AND SOLID DIELECTRICS

Liquids as insulators-breakdown mechanisms in liquid dielectrics-electronic breakdown, suspended solid particle mechanism-fundamentals of insulating oils-various processes of breakdown in solid dielectrics-intrinsic breakdown, streamer breakdown, electromechanical breakdown.

UNIT III **10 Hours**

GENERATION OF HIGH VOLTAGE AND CURRENTS

Generation of high DC voltages - multiplier circuits -Van de Graff generator-electrostatic generators - high alternating voltage generation using cascade transformers-production of high frequency AC high voltages-standard impulse wave shapes-Marx circuit-generation of switching surges-impulse current generation-tripping and control of impulse generators.

UNIT IV **9 Hours**

MEASUREMENT OF HIGH VOLTAGES AND CURRENTS

HVDC measurement techniques - measurement of power frequency A.C voltages-rod gap measurement technique-sphere gap measurement technique-potential divider for impulse voltage measurements-measurement of high D.C, A.C and impulse currents-digital recorders.

UNIT V **8 Hours**

HIGH VOLTAGE TESTING AND INSULATION COORDINATION

Indian standards for HV testing, Tests on insulators-testing of isolators and circuit breakers-cabletesting-testing of transformers-surge diverter testing-insulation coordination-correlation between insulation and protection levels.

Total: 45 Hours

Reference(s)

1. M.S.Naidu, and Kamaraju, High Voltage Engineering, Tata McGraw Hill, 4th Edition, 2014.
2. C.L. Wadhwa, High Voltage Engineering Wiley Eastern Limited, 2014.
3. E.Kuffel and M. Abdullah, High Voltage Engineering, Pergamon Press, 2013.
4. Dieter Kind, An Introduction to High Voltage Experimental Technique Wiley Eastern Limited, 2012.
5. Alston, High Voltage Technology BS Publications, 2011.

18EE004 POWER SYSTEM CONTROL 3 0 0 3

Course Objectives

- Understand the application of load forecasting tools
- Understand the real power-frequency relationship and the need for developing the mathematical model of Load Frequency Control Loop
- Understand the reactive power-voltage relationship and the necessity of voltage compensation

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and anengineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Apply the load forecasting tools to estimate the generation and reserve capacity
2. Apply the concept of Laplace transform to construct the transfer function model of isolated and interconnected systems.
3. Analyze the transfer function model of excitation system and voltage control methods.
4. Apply the iterative techniques to determine economical operating point of generating units
5. Analyse the functions of load dispatch centers at National, Regional and State Levels.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	-	-	-	-	-	-	-	-	-	-	3	2
2	3	3	-	-	-	-	-	-	-	-	-	-	3	2
3	3	2	-	-	-	-	-	-	-	-	-	-	3	2
4	3	3	-	-	-	-	-	-	-	-	-	-	3	2
5	3		-	-	2	-	-	-	-	-	-	-	3	2

UNIT I **9 Hours**

INTRODUCTION

System load variation: System load characteristics, load curves, Load-duration curve, load factor and diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves and hot reserves. Overview of system operation: Load forecasting, unit commitment and load dispatching. Overview of system control,Need for voltage and frequency regulation in power system, Plant level and System level controls.

UNIT II **9 Hours**

REAL POWER - FREQUENCY CONTROL

Fundamentals of speed governing mechanism and modeling: Speed-load characteristics-Load sharing between two synchronous machines in parallel; concept of control area, LFC control of a single-area system: Static and dynamic analysis. Multi-area systems: Two-area system modeling; static analysis; tie line with frequency bias control of two-area system. State variable model.

UNIT III **9 Hours**

REACTIVE POWER VOLTAGE CONTROL

Typical excitation system, modeling, static and dynamic analysis, stability compensation; generation and absorption of reactive power: Relation between sending end and receiving end voltage; method of voltage control: Injection of reactive poweR, Static VAR Compensator

UNIT IV **9 Hours**

POWER SYSTEM ECONOMICS

Incremental cost curve, Unit Commitment and its constraints, Solution to unit commitment problem using priority list method- co-ordination equations without loss and with loss, solution by direct method and lambda iteration method. (No derivation of loss coefficients.) Base point and participation factors. Economic dispatch controller added to LFC control.

UNIT V **9 Hours**

COMPUTER CONTROL OF POWER SYSTEMS

Energy control centre: Functions, Monitoring, data acquisition and control. System hardware configuration - SCADA and EMS functions: Network topology determination, security analysis and control. Various operating states: Normal, alert, emergency, in extremis and restorative. State transition diagram showing various state transitions and control strategies.

Total: 45 Hours

Reference(s)

1. Olle. I. Elgerd, Electric Energy Systems Theory, Tata McGraw Hill Publishing Company Ltd,New Delhi, Second Edition, 30th reprint 2008.
2. Allen.J.Wood and Bruce F.Wollenberg, Power Generation, Operation and Control, John Wiley & Sons Inc., New York 2006.
3. P.Kundur,Power System Stability and Control, McGraw Hill Publishing Co, New York, 2009.
4. D P Kothari and I J Nagrath,Modern Power System Analysis, Tata McGraw Hill Publishing Co, New Delhi, 2011.

18EE005 POWER QUALITY 3 0 0 3

Course Objectives

- To understand the power quality problems in grid connected system and isolated systems.
- To summarize the voltage sags and interruptions in a power system under power quality.
- To study the various transient over voltages affect the power system
- To study the various power quality issues and mitigation techniques
- To study various methods of power quality monitoring and harmonic elimination techniques

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the power quality issues and its standards
2. Analyze the performance of Voltage Sags Interruptions and its protections methods
3. Analyze the lightning and switching over voltages and its protections methods
4. Analyze the Sources and effects of harmonics with suitable control methods
5. Predict the power quality problem using suitable measuring equipment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	-	-	-	-	-	-	1	1
2	3	2	1	-	-	-	-	-	-	-	-	-	1	1
3	3	2		-	-	-	-	-	-	-	-	-	3	1
4	3	2	2	-	1	-	-	-	-	-	-	-	3	1
5	2	2	-	-	2	-	-	-	-	-	-	-	2	1

UNIT I **10 Hours**

INTRODUCTION

Terms and definitions: General classes of power quality problems- Transients - Short duration variations - Long duration variation- voltage imbalance - voltage fluctuation - power frequency variations, International standards of power quality, Computer Business Equipment Manufacturers Associations (CBEMA) and ITI curves

UNIT II **7 Hours**

VOLTAGE SAGS AND INTERRUPTIONS

Sources of sags and interruptions - Estimating voltage sag performance - Principle of protection-solutions at end user level- Motor starting sags

UNIT III **8 Hours**

TRANSIENT OVERVOLTAGES

Sources of over voltages - Principle of over voltage protection -Devices for over voltage protection - Utility capacitor switching transients -Lightning protection -Computer tools for transient analysis

UNIT IV **10 Hours**

FUNDAMENTALS OF HARMONICS

Harmonic distortion- Voltage Vs Current distortion-Harmonic vs Transients-Power system Quantities under Non sinusoidal conditions- Harmonics indices -sources of harmonics - Effect of harmonic distortion-Inter harmonics-Harmonic distortion evaluation - Devices for controlling harmonic distortion - IEEE and IEC standards

UNIT V **10 Hours**

POWER QUALITY MONITORING

Monitoring considerations - Historical perspective of power quality measuring instruments - Power quality measuring equipment- Assessment of power quality measurement data-Application of intelligent systems-Power quality Monitoring standards

Total: 45 Hours

Reference(s)

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 2005
2. M.H.J Bollen,"Understanding Power Quality Problems: Voltage Sags and Interruptions", (New York: IEEE Press, 2011
3. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", (New York: Wiley, 2014
4. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, Electrical Power Systems Quality, McGraw Hill, 2003
5. C.Sankaran, CRC Press,"Power Quality", New York, 2002.

18EE006 ENERGY STORAGE SYSTEMS 3 0 0 3

Course Objectives

- Understand the significance of energy storage schemes.
- Understand the working of two types of mechanical energy storage systems
- Understand the concepts of various models of batteries
- Understand the performance of passive energy storage elements.
- Understand the principles of different methods of thermal energy storage schemes

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. : Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
F. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the importance of energy storage systems for thermochemical and organic fuel systems.
2. Analyze the principles of mechanical energy storage systems for industrial applications.
3. Apply electrochemical concepts to evaluate the performance of primary and secondary battery systems.
4. Analyze the performance characteristics of electromagnetic energy storage systems for real time applications.
5. Apply thermal energy storage methods to assess environmental impacts and practical benefits.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	-	2	2	-	-	-	-	-	2	1
2	2	-	-	-	-	2	2	-	-	-	-	-	2	2
3	3	3	-	-	-	2	2	-	-	-	-	-	-	3
4	2	-	-	-	-	2	2	-	-	-	-	-	2	2
5	1	-	-	-	-	2	2	-	-	-	-	-	-	2

UNIT I **8 Hours**

INTRODUCTION

Need and importance of Energy storage, Periodic Storage, Modes of Storage: Thermo-chemical energy storage, Energy Storage in Organic Fuels, Hydrogen Storage.

UNIT II **9 Hours**

MECHANICAL ENERGY STORAGE

Introduction - Potential Energy Storage - Energy Storage in Pressurized Gas - Pumped-Hydro Storage - Kinetic Energy in Mechanical Systems - Linear and Rotational Kinetic Energy - Internal Structural Energy Storage, Applications

UNIT III **10 Hours**

ELECTROCHEMICAL ENERGY STORAGE SYSTEMS

Fundamental concepts - Reaction Mechanisms in Electrochemical Cells - Practical Parameters, Equivalent Circuit, Types of batteries: Primary, Secondary, Lithium, Solid-state and molten solvent, lead acid, Nickel Cadmium Batteries; Zinc Manganese dioxide, Applications.

UNIT IV **9 Hours**

ELECTROMAGNETIC ENERGY STORAGE SYSTEMS

Superconducting Magnet Energy Storage (SMES) systems, Energy in a Material in a Magnetic Field, Superconductive Materials, Super capacitor: Electrochemical Double Layer Capacitor (EDLC): principle of working, structure, performance and applications

UNIT V **9 Hours**

THERMAL ENERGY STORAGE

Basic Principles - Benefits - Methods - Sensible TES- Latent TES - Cold TES - Seasonal TES - Thermal Energy Savings - Environmental Impacts - Applications.

FURTHER READING

Ocean wave energy - conversion, principle, power plants, tidal energy conversion, Scope and development

Total: 45 Hours

Reference(s)

1. Huggins, Robert A., Energy Storage, First, Springer US, 2010.
2. Ibrahim Dincer,Mark A. Rosen, Thermal Energy Storage Systems and Applications, 2nd Edition, Wiley, 2011.
3. Ru-shiliu, Leizhang, Xueliang sun, Electrochemical technologies for energy storage and conversion, First, Wiley publications, 2012.
4. J. Walter Schultze, Tetsuya Osaka ,Electrochemical Microsystem Technologies, Madhav Datta 2002, CRC Press
5. Jackson and Webster, Medicine and Clinical Engineering, Prentice Hall of India Ltd, New Delhi, 2013

18EE007 POWER PLANT INSTRUMENTATION

3 0 0 3

Course Objectives

- To analyze the various measurement techniques and equipments in power plants
- To understand the various units of operation in power plant control
- To gain the knowledge of various aspects in boiler control
- To illustrate the various turbine control methods in power plant
- To understand the automation process of power plant

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze appropriate measuring instrument to measure the physical quantities at power plants
2. Select the suitable equipment for various functions at power plants
3. Design and analyze a suitable controller for boiler
4. Analyze the performance parameters of turbine in various operating conditions
5. Apply the various automation systems in power plants.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	-	-	-	-	-	-	2	1
2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
4	3	-	-	-	-	-	-	-	-	-	-	-	3	2
5	3	-	-	-	3	-	-	-	-	-	-	-	2	2

UNIT I **9 Hours**

PARAMETERS OF POWER PLANTS AND ITS MEASUREMENT

Measurement of feed water flow,air flow,steam flow and coal flow-Measurement steam temperature & steam pressure - Drum level measurement -Radiations detector-Smoke density measurement -Dust monitor - Speed vibration, shell temperature monitoring & control - Flue gas analyzer - Fuel composition analyzer.

UNIT II **9 Hours**

UNIT OPERATIONS

Evaporation, Distillation, leaching, Gas Absorption, Heat exchangers, Humidification and Dehumidification, Drying, Size Reduction, Crystallization, Mixing.

UNIT III **9 Hours**

BOILER CONTROL

Air/fuel ratio control- Burners for liquid and solid fuels - Burner management - Furnace safety interlocks -Firing rate demand - Steam temperature control - Control of deaerator -Furnace draft control - Flue gas dew point control - Trimming of combustion air - Soot blowing.

UNIT IV **10 Hours**

CONTROL OF TURBINE

Types of steam turbines - Impulse and reaction turbines- Turbine governing system- Speed and load control-Transient speed rise- Free governor mode operation -Automatic load Frequency Control - Turbine oil system - Oil pressure drop relay - Oil cooling system -Turbine run up system-Wind Power Regulation-yaw control-Pitch angle control.

UNIT V **8 Hours**

AUTOMATION SYSTEMS

Digital Command Control (DCC) - Supervisory Control and Data Acquisition(SCADA) - Distributed Control System (DCS).

FURTHER READING

Smart power plant-AI incorporated power plant-Betavoltaics- digital twin technology.

Total: 45 Hours

Reference(s)

1. Everett Woodruff, Herbert Lammers, Thomas Lammers, Steam Plant Operation,13th Edition McGraw Hill, 2016
2. McCabe W. L, Smith J, Peter Harriot,Unit operation of chemical Engineering, Seventh Rev Edition, Tata McGraw Hill Publishing Company, 2017
3. Rajput R.K., A Text book of Power plant Engineering, 5th Edition, Lakshmi Publications, 2013
4. P.K.Nag, Powerplant Engineering, Tata McGraw-Hill Education, 5th edition, 2016
5. Sam Dukelow, Control of Boilers, Instrument Society of America, 1991. Krishnaswamy.K and Ponnibala.M., Power Plant Instrumentation, PHI Learning Pvt.Ltd., New Delhi, 2016
6. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1985.

18EE008 INDUSTRIAL ELECTRONICS 3 0 0 3

Course Objectives

- To study about the physical phenomena of different types of sensors.
- To understand about the measuring principal of MEMS devices and technologies.
- To understand about the MEMS devices and technologies and applications.
- To study about the role of FPGA in industrial applications.
- To understand the concept of signal processing in various domain.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

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

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Assess the characteristics of various sensors.
2. Analyze the performance of different types of MEMS devices.
3. Apply MEMS techniques to control the industrial devices.
4. Analyze the role of FPGA in reconfigurable systems.
5. Assess the characteristics of various micro sensors.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
2	2	2	2	3	-	-	3	-	-	-	-	-	2	1
3	2	2		3	-	-	3	-	-	-	-	-	2	
4	1	1	3	3	-	-	-	-	-	-	-	-	2	2
5	2	3	-	3	-	-	-	-	-	-	-	-	1	2

UNIT I **9 Hours**

PHYSICAL PHENOMENA IN SENSORS

Introduction-Piezoresistive Effect-thermoelectric Effect-Piezoelectric Effect-Pyroelectric Effect-Photoelectric Effect in Semiconductors-temperature Effect in p-n Junctions.

UNIT II **9 Hours**

MEMS DEVICES

Introduction-Sensing and Measuring Principles-MEMS actuation Principles-MEMS Devices.

UNIT III **9 Hours**

MEMS TECHNOLOGIES AND APPLICATIONS

Introduction-Modeling and Scaling Laws-MEMS Materials-Deposition-Etching-Molding-Biomedical and Aerospace applications-Market Trends.

UNIT IV **9 Hours**

FPGAS AND RECONFIGURABLE SYSTEMS

Introduction-advanced Hardware resources in FPGAs-Software tools for FPGAs-role of FPGAs in reconfigurable Systems-applications.

UNIT V **9 Hours**

MICRO SENSORS

Introduction to micro sensors - Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, and flow micro sensors - Introduction to Nano sensors-Smart temperature sensor.

FOR FURTHER READING

Continuous time Signals-Time Domain analysis of Continuous time Signals-Frequency Domain analysis of Continuous time Signals-Signal Processors-Discrete time (Digital) Filters.

Total: 45 Hours

Reference(s)

1. Maloney, Timothy. Modern Industrial Electronics, Upper Saddle River: Prentice Hall. 2015
2. Rehg, James, A., Sartori, Glenn. Industrial Electronics. Upper Saddle River: Prentice Hall. 2016.
3. G.K.Mithal,"IndustrialElectronics",Khanna Publishers,Delhi, 2016.
4. M. H. Rashid,"Power Electronics Circuits, Devices and Application", PHI, 2017.
5. Ifan G.Hughes and Thomas P.A.Hase,Measurements and their Uncertainties:A Practical Guide to Modern Error Analysis, Oxford University Press, 2016.
6. Gerord C.M. Meijer,Smart Sensor Systems,John Wiley and Sons, 2015.

18EE009 VLSI DESIGN **3 0 0 3**

Course Objectives

- To explain the fundamental concepts and techniques involved in the fabrication of VLSI circuits
- To understand the technology, design concepts and analyzing of VLSI circuits
- To understand the technology, design concepts and analyzing of VLSI circuits

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
d. g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n. Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the procedures in the fabrication of integrated circuits.
2. Asses the various fabrication methods of CMOS.
3. Analyze the characteristics of MOS transistors.
4. Apply the rules of stick diagram and layout rules for compact design.
5. Develop the programs for combinational and sequential circuit by using Verilog HDL.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
2	3	2	1	-	-	-	1	-	-	-	-	-	2	-
3	3	2	-	-	-	-	-	-	-	-	-	-	1	-
4	2	3	1	-	-	-	-	-	-	-	-	-	2	-
5	2	-	3	-	2	-	-	-	-	-	-	-	1	-

UNIT I **9 Hours**

OVERVIEW AND FABRICATION OF VLSI DESIGN TECHNOLOGY

The VLSI design process - Moore's law, Y chart - Architectural design - Logical design - physical design - Layout styles - Full custom - Semi custom approaches. Overview of wafer fabrication - wafer processing - oxidation - patterning - Diffusion -Ion implantation - Deposition process and metallization.

UNIT II **8 Hours**

TRENDS IN VLSI FABRICATION

Silicon gate NMOS & PMOS fabrication process - CMOS fabrication process, N-well CMOS process, P-well CMOS process -Twin tub process-Silicon on insulator-Introduction to BICMOS process - BICMOS fabrication in N-well process.

UNIT III **8 Hours**

MOS TRANSISTOR PROPERTIES AND CMOS INVERTER

Basics of MOS transistors-types & operation-Basic electrical properties of MOS and CMOS circuits- Ids versus Vds relationships, Transconductance-pass transistor and transmission gates, Design of simple Circuits by Transmission gate - NMOS inverter- Determination of pull up to pull down ratio for an nMOS inverter-CMOS inverter-MOS transistor circuit model.

UNIT IV **10 Hours**

MOS,CMOS CIRCUIT AND SUBSYSTEM DESIGN PROCESS

MOS layers - Stick diagrams - nMOS design style - CMOS design style - Design rules and layout - Lambda based design rules - Contact cuts - Layout diagrams-Double metal MOS process rules

UNIT V **10 Hours**

VERILOG PROGRAMMING

Introduction-lexical conventions, Data types, Modules & ports - Gate level modeling - dataflow level modeling - behavioral level modeling (Examples: adders, counters, flip flops, Multiplexers/Demultiplexers, FSM).

Total: 45 Hours

Reference(s)

1. Eshranghian E, Pucknell D A and Eshraghian S,"Essentials of VLSI circuits and systems", PHI, NewDelhi, 2008, 1st edition.
2. Charles H.Roth,"Fundamentals of Logic Design", Jaico Publishing House, 2006, 4th edition.
3. Weste N H, kamran Eshranghian,"Principles of CMOS VLSI Design-A system perspective", Pearson Education, India, 2010, 2nd edition-third impression.
4. Kiran Kumar V. G., Nagesh H. R.,"Fundamentals of CMOS VLSI Design", sanguine technical publishers-pearson, First impression -2012
5. S. M. Kang,Y Leblebici, and C. Kim,"CMOS Digital Integrated Circuits: Analysis and Design", McGraw-Hill, 4th Ed., 2014
6. Samir Palnitkar,"Verilog HDL: A Guide to Digital Design and Synthesis, Volume 1",Sun Micro systems-PHI Second Edition 2006 -ISBN 0-13-044911-3

18EE010 ARTIFICIAL INTELLIGENCE TECHNIQUES

3 0 0 3

Course Objectives

- To understand the problem solving intelligent agents.
- To learn the searching techniques for optimization techniques.
- To understand the propositional and first-order logic.
- To learn the software agents in AI techniques
- To learn the applications and learning models in AI Techniques

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the characteristics of AI that makes it useful to real-world problems
2. Analyze the different searching techniques for any real time applications
3. Apply the propositional and first-order logic in domain knowledge representation.
4. Analyze the functions of software agents to enhance intelligent agent interactions.
5. Apply artificial intelligence in natural language processing and robotics applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	-	2	-	-	-	-	-	-	-	1	1
2	2	2	-	-	2	-	-	-	-	-	-	-	1	2
3	3	2	-	-	2	-	-	-	-	-	-	-	1	1
4	2	-	-	2	2	-	-	-	-	-	-	-	1	1
5	2	-	-	2	2	-	-	-	-	-	-	-	1	1

UNIT I **9 Hours**

INTRODUCTION

Introduction - Definition - Future of Artificial Intelligence - Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving - Problem solving agents - Uniformed search strategies - heuristic function.

UNIT II **8 Hours**

SEARCHING TECHNIQUES

Local search algorithms and optimization problems - Local search in continuous spaces - Online search agents and unknown environments - optimal Decisions in games - Constraint satisfaction problems (CSP).

UNIT III **10 Hours**

KNOWLEDGE REPRESENTATION

First order logic : Representation revisited - Syntax and semantics for first order logic - Inference in First order logic: Prepositional versus first order logic - Unification and lifting - Forward chaining - Backward chaining.

UNIT IV **9 Hours**

SOFTWARE AGENTS

Architecture for Intelligent Agents - Agent communication - Negotiation and Bargaining -Argumentation among Agents - Trust and Reputation in Multi-agent systems.

UNIT V **9 Hours**

APPLICATIONS

AI applications - Language Models - Information Retrieval- Information Extraction - Natural Language Processing - Machine Translation - Speech Recognition - Robot - Hardware - Perception – Planning,Moving

FOR FURTHER READING

Language Models - Text Classification - Information Retrieval - Information Extraction - speech recognition.

Total: 45 Hours

Text Book(s)

1. Russell, Peter Norvig, Artificial Intelligence A Modern Approach, 3rd Edition, Prentice Hall of India, 2011.

Reference(s)

1. Nils J. Nilsson, Artificial Intelligence: A new Synthesis, Harcourt Asia Pvt. Ltd., 2000
2. Elaine Rich and Kevin Knight, Artificial Intelligence, 3rd Edition, Tata McGraw-Hill, 2011
3. George F. Luger, Artificial Intelligence-Structures And Strategies For Complex Problem Solving, Pearson Education / PHI, 2002

18EE011 COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS

3 0 0 3

Course Objectives

- To understand the need for field analysis based design of electrical apparatus.
- To formulate the mathematical model of electromagnetic field equations.
- To understand the concept of Finite Element Method and Finite Difference Method.
- To gain knowledge about the different elements of CAD package.
- To apply suitable method for the design of different Electrical apparatus.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society

Course Outcomes (COs)

1. Apply the field analysis based design to understand the basic principle of energy conversion.
2. Compute the mathematical equation of electromagnetic field and stored energy in electric and magnetic fields
3. Analyze the different methods of Finite Element Method to solve mathematical models and to find solution techniques.
4. Apply process involved in the typical CAD package
5. Apply Finite Element Method for the design of different Electrical apparatus.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2	1	-	-	-	-	-	-	-	-	2	-
2	1	2	3	2	2	-	-	-	-	-	-	-	3	-
3	2	3	2	2	3	-	-	-	-	-	-	-	3	1
4	1	3	2	2	3	-	-	-	-	-	-	-	2	1
5	2	1	3	2	2	-	-	-	-	-	-	-	2	-

UNIT I **8 Hours**

INTRODUCTION

Conventional design procedures - Limitations - Need for field analysis based design - Review of Basic principles of energy conversion - Development of Torque/Force.

UNIT II **9 Hours**

MATHEMATICAL FORMULATION OF FIELD PROBLEMS

Electromagnetic Field Equations - Magnetic Vector/Scalar potential - Electrical vector /Scalar potential - Stored energy in Electric and Magnetic fields - Capacitance - Inductance- Laplace and Poisson's Equations - Energy functional.

UNIT III **10 Hours**

PHILOSOPHY OF FEM

Mathematical models - Differential/Integral equations - Finite Difference method - Finite element method - Energy minimization - Variational method- 2D field problems - Discretisation - Shape functions - Stiffness matrix - Solution techniques.

UNIT IV **9 Hours**

CAD PACKAGES

Elements of a CAD System -Pre-processing - Modelling - Meshing - Material properties- Boundary Conditions - Setting up solution - Post processing.

UNIT V **9 Hours**

DESIGN APPLICATIONS

Voltage Stress in Insulators - Capacitance calculation - Design of Solenoid Actuator - Inductance and force calculation - Torque calculation in Switched Reluctance Motor.

Total: 45 Hours

Reference(s)

1. S.J Salon, "Finite Element Analysis of Electrical Machines", Kluwer Academic Publishers, London, 1995.
2. Nicola Bianchi, "Electrical Machine Analysis using Finite Elements", CRC Taylor& Francis, 2005.
3. Joao Pedro, A. Bastos and Nelson Sadowski, "Electromagnetic Modeling by Finite Element Methods", Marcell Dekker Inc., 2003.
4. P.P.Silvester and Ferrari, "Finite Elements for Electrical Engineers", Cambridge University Press, 1983.
5. D.A.Lowther and P.P Silvester, "Computer Aided Design in Magnetics", Springer Verlag, New York, 1986
6. S.R.H.Hoole, "Computer Aided Analysis and Design of Electromagnetic Devices", Elsevier, New York, 1989.

18EE012 BIO MEDICAL INSTRUMENTATION 3 0 0 3

Course Objectives

- To understand the basic components of a biomedical instrumentation
- To analyze the various physiological measurements like ECG,EEG,EMG
- To analyze the blood measurements and cardiac rate
- To understand the parameters of medical imaging system
- To illustrate the functions of therapeutic devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society

Course Outcomes (COs)

1. Analyze the function of neural system and apply different types of electrodes and sensors in biomedicine electrical safety
2. Examine the typical waveforms of the electro-physiological and blood flow measurement meters
3. Analyze the non - electrical parameter measurements by using different sensors
4. Apply the different types of medical imaging techniques for parameter measurement.
5. Apply the therapeutic and assisting devices for medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	-	-	-	1	-	-	-	-	-	2	3
2	3	2	1	-	-	-	-	-	-	-	-	-	2	3
3	3	2	1	-	-	-	-	-	-	-	-	-	3	2
4	3	2	1	-	-	-	-	-	-	-	-	-	2	3
5	3	2	1	-	-	-	1	-	-	-	-	-	3	2

UNIT I **9 Hours**

HUMAN PHYSIOLOGY AND BIO POTENTIAL ELECTRODES

Cell and their structures - Action and resting potential - Nervous system: Functional organization of the nervous system - Structure of nervous system, neurons - synapse - transmitters and neural communication-Cardiovascular system- Basic components of a biomedical system -Different types of electrodes-Sensors used in biomedicine Electrical safety- Grounding and isolation

UNIT II **9 Hours**

ELECTRO-PHYSIOLOGICAL AND BLOOD FLOW MEASUREMENT

ECG-EEG-EMG-ERG-Lead system and recording methods-Typical waveforms-Electromagnetic and Ultrasonic Blood flow meters

UNIT III **8 Hours**

NON-ELECTRICAL PARAMETER MEASUREMENT

Measurement of blood pressure-Blood flow cardiac output-Cardiac rate-Heart sound-Measurement of gas volume-Flow rate of CO2 and O2 in exhaust air-pH of blood

UNIT IV **9 Hours**

MEDICAL IMAGING PARAMETER MEASUREMENTS AND BLOOD CELL COUNTING

X- RAY machine-Computer tomography-Magnetic resonance imaging system-Ultra sonography-Endoscopy-Bio-telemetry-Manual and automatic counting of RBC, WBC and Platelets

UNIT V **10 Hours**

ASSISTING AND THERAPEUTIC DEVICES

Cardiac pacemakers-Defibrillators - Ventilators-Muscle stimulators-Heart lung machine-Dialyzers-Elements of audio and visual aids

FURTHER READING

Biosensors - Digital Command Control (DCC)-Supervisory Control and Data Acquisition(SCADA)-Distributed Control System(DCS)

Total: 45 Hours

Reference(s)

1. R.S.Khandpur, Hand Book of Bio-Medical instrumentation, Tata McGraw Hill publishing company Ltd., 2017
2. J.G. Webster,Medical Instrumentation: Application and Design, John Wiley and Sons, NewYork, 2015
3. Leslie Cromwell,Biomedical Instrumentation and measurement, Tata McGraw Hill, 2017
4. G. Well,Biomedical Instrumentation and Measurements,Prentice Hall of India, New Delhi, 2016
5. Jackson and Webster,Medicine and Clinical Engineering, Prentice Hall of India Ltd, New Delhi, 2015

18EE013 ADVANCED CONTROL SYSTEMS 3 0 0 3

Course Objectives

- To understand the physical nonlinearities and analyze nonlinear systems using phase plane technique.
- To analyze nonlinear systems with the describing function technique.
- To understand and apply LQR controllers and Kalman filter for optimal control problems.
- To analyze system using adaptive control, least squares and recursive least square techniques.
- To analyze the need for robust control and use them for control and estimation.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society

Course Outcomes (COs)

1. Analyze phase plane technique for non-linear systems.
2. Analyze describing function technique for non-linear systems.
3. Evaluate Performance measures for optimal control problem.
4. Evaluate system identification and adaptive control.
5. Create optimal controller for different applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	-	-	-	-	-	-	-	-	-	-	2	-
2	3	3	-	-	-	-	-	-	-	-	-	-	2	-
3	3	3	-	-	-	-	-	-	-	-	-	-	2	-
4	3	3	-	-	-	-	-	-	-	-	-	-	-	2
5	3	3	-	-	-	-	-	-	-	-	-	-	-	2

UNIT I **9 Hours**

PHASE PLANE ANALYSIS

Features of linear and non-linear systems - Common physical nonlinearities - Methods of linearization - Concept of phase portraits - Singular points - Limit cycles - Construction of phase portraits - Phase plane analysis of linear and non-linear systems - Isocline method.

UNIT II **9 Hours**

DESCRIBING FUNCTION ANALYSIS

Basic concepts - Derivation of describing functions for common nonlinearities - Describing function analysis of non-linear systems - limit cycles - Stability of oscillations.

UNIT III **9 Hours**

OPTIMAL CONTROL AND ESTIMATION

Introduction- Performance measures for optimal control problem - LQR tracking - LQR regulator - Optimal estimation - Discrete Kalman Filter

UNIT IV **9 Hours**

SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL

Introduction to system identification - The least squares estimation - The recursive least squares estimation - Introduction to adaptive control - Gain scheduling controller - Model reference adaptive controller -Self-tuning controller.

UNIT V **9 Hours**

ROBUST CONTROL

Introduction - Norms of vectors and matrices - Norms of systems - H2 optimal controller - H2 optimal estimation - H-infinity controller - H-infinity estimation.

Total: 45 Hours

Reference(s)

1. Gopal M, Modern Control System Theory, New Age International, 2015.
2. Mohandas KP, Modern Control Engineering, Sanguine Technical Publishers, 2016.
3. Sinha A, Linear Systems: Optimal and Robust Control, CRC Press, 2007.
4. Astrom KJ & Wittenmark B, Adaptive Control, Dover Publications, 2013.
5. Kirk DE, Optimal Control Theory: An Introduction, Dover Publications, 2012.

18EE014 ELECTRICAL AND HYBRID VEHICLES 3 0 0 3

Course Objectives

- To understand the basics of electric and hybrid vehicles.
- To illustrate the drive system adopted for hybrid vehicles.
- To understand the different types of power electronic converter used in electric vehicles.
- To categorize electric storage devices for electric vehicle system.
- To explore the control strategies for vehicle drive system.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society

Course Outcomes (COs)

1. Analyze the vehicle mechanics and mathematical model for hybrid electric vehicles.
2. Apply the drive system to configure and control the hybrid electric vehicles.
3. Analyze the performance characteristics of power converters for control of electric vehicles.
4. Apply the principle of energy storage systems for vehicle applications.
5. Analyze the control techniques adopted for propulsion systems in electric vehicle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	-	1	1	2	-	-	-	-	2	2
2	2	-	3	2	-	2	2	2	-	-	-	-	2	2
3	1	-	3	2	-	1	1	2	-	-	-	-	2	2
4	2	-	-	-	-	2	3	2	-	-	-	-	2	2
5	1	-	-	-	-	2	2	2	-	-	-	-	2	2

UNIT I **9 Hours**

INTRODUCTION

History of electric and hybrid vehicles, Social and environmental importance of hybrid and electric vehicles, Basics of vehicle propulsion and mechanics, hybrid traction, electric vehicle architecture, Power train components, Mathematical models to describe vehicle performance

UNIT II **9 Hours**

ELECTRIC PROPULSION

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, Drive system efficiency

UNIT III **9 Hours**

POWER CONVERTERS FOR ELECTRIC DRIVES

Introduction to power electronics switches, DC/DC Converters, Cell balancing converters, Buck Converter, Boost Converter, Buck-Boost Converter, Fourth Order DC/DC Converters, Power train boost Converters, Cell Balancing Converters

UNIT IV **9 Hours**

ENERGY STORAGE

Introduction to Energy Storage Requirements, Battery Fundamentals, Parameters and Modeling, Types, Battery based energy storage and its analysis: Types, Parameters and Modeling, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices

UNIT V **9 Hours**

ELECTRIC PROPULSION SYSTEM AND MOTOR CONTROL SYSTEM

DC Motors Characteristics, Speed and Torque Control, Regenerative Braking. - AC Motors Characteristics, Speed and Torque Control- Reluctance Motors Characteristics, Speed and Torque Control, Regenerative Braking.

FOR FURTHER READING

Impact of modern drive-trains on energy supplies, Basics of vehicle performance, Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies

Total: 45 Hours

Reference(s)

1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2011.
2. Mehrdad Ehsani, YimiGao, Sebastian E.Gay, Ali Emadi, "Modern Electric and Fuel Cell Vehicles, Theory and Design", CRC Press, 2009.
3. James Larminie,John Lowry,"Electric Vehicle Technology Explained", Wiley, 2012.
4. Ali Emadi.,"Advanced Electric Drive Vehicles",CRC Press, 2014.
5. Jack Erjavec.,"Hybrid, Electric, and Fuel-Cell Vehicles", Cengage Learning, 2012.

18EE015 SMART GRID TECHNOLOGIES 3 0 0 3

Course Objectives

- To summarize the components used in smart grid and technologies involved in smart grid.
- To understand the concept of smart metering and implementation of demand side integration.
- To analyze the concepts in automated distribution systems in smart grid.
- To analyze the concepts in automated transmission systems in smart grid.
- To analyze the significance of power electronics in smart grid.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

c. 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.

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Examine the operating principles and models of Smart Grid Components.
2. Analyze the protocols of smart metering used in demand Side Integration.
3. Outline the distribution system automation in Smart Grid.
4. Analyze the transmission system automation in Smart Grid.
5. Analyze the power quality improvement concepts in Smart Grid.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	3	-
2	2	1	1	1	3	-	-	-	-	-	-	-	3	2
3	2	1	1	1	3	-	-	-	-	-	-	-	3	2
4	2	2	2	1	3	-	-	-	-	-	-	-	3	2
5	2	2	2	1	3	-	-	-	-	-	-	-	3	2

UNIT I **9 Hours**

INTRODUCTION

Electrical Grid - Definition of Smart Grid - Opportunities, Challenges and Benefits of Smart Grid - Inventory of Smart Grid Technologies - Operating Principles and Models of Smart Grid Components, Implementation of Smart Grid- Early Smart Grid initiatives - Overview of the technologies required for the Smart Grid

UNIT II **9 Hours**

SMART METERING AND DEMAND-SIDE INTEGRATION

Introduction - Smart metering - Smart meters- An overview of the hardware used-Communications infrastructure and protocols for smart metering, Demand-side integration- Services provided by DSI , Implementations of DSI, Hardware support to DSI implementations, Flexibility delivered by prosumers from the demand side, System support from DSI

UNIT III **9 Hours**

DISTRIBUTION AUTOMATION

Distribution automation, automated meter reading (AMR), automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), High Efficiency Distribution Transformers, Phase Shifting Transformers

UNIT IV **9 Hours**

TRANSMISSION SYSTEM AUTOMATION

Substation automation, Feeder Automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area Monitoring systems (WAMS)

UNIT V **9 Hours**

POWER ELECTRONICS IN THE SMART GRID

Fault current limiting Shunt compensation, D-STATCOM ,Active filtering ,Shunt compensator with energy storage, FACTS- Reactive power compensation, Series compensation, Unified power flow controller

FOR FURTHER READING

Smart appliance Technology - Pricing for Smart Appliances on demand. Security issues in DG, Distribution Automation, AMI, Electric Vehicle Management Systems - Approach to assessment of smart grid cyber security risks - Methodologies.

Total: 45 Hours

Reference(s)

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Smart Grid: Technology and Applications, Jo& Sons, New Jersey, 2012.
2. Stuart Borlase Smart Grid :Infrastructure, Technology and Solutions,CRC Press 2012.
3. Ryszard Strzelecki, Grzegorz Benysek, Power Electronics in Smart Electrical Energy Networks, Springer, New Zealand, 2008.
4. James Momoh, SMART GRID: Fundamentals of Design and Analysis, John Wiley and Sons, New York, 2012
5. Bernd M. Buchholz, Zbigniew Styczynski, Smart Grids - Fundamentals and Technologies in Electricity Networks, Springer,2014.

18EE016 FLEXIBLE AC TRANSMISSION SYSTEMS 3 0 0 3

Course Objectives

- To understand the needs and working of FACTS devices.
- To understand the working of shunt compensators.
- To understand the operation of shunt compensation devices.
- To understand the concept of Static Voltage and Phase Angle Regulator.
- To understand the concept of Emerging FACTS controllers.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society

Course Outcomes (COs)

1. Analyze the necessity and benefits of FACTS controllers.
2. Analyze the shunt compensation devices used for power factor improvement.
3. Analyze series compensation devices based on their operating characteristics.
4. Analyze the operation of thyristor controlled voltage and phase angle regulators.
5. Analyze the operation of UPFC and IPFC FACTS controllers.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	-	-	-	-	-	-	-	-	-	-	3	1
2	2	3	-	-	-	-	-	-	-	-	-	-	3	1
3	2	3	-	-	-	-	-	-	-	-	-	-	3	1
4	2	3	2	-	-	-	-	-	-	-	-	-	3	1
5	2	3	2	-	-	-	-	-	-	-	-	-	3	1

UNIT I **9 Hours**

INTRODUCTION TO FACTS

Electrical Transmission Network - opportunities for FACTS - Power Flow in AC System - relative importance of controllable parameter.

UNIT II **10 Hours**

SHUNT COMPENSATION

Need for compensation - introduction to shunt compensation - Thyristor Controlled Reactor (TCR) - Thyristor Switched Capacitor (TSC) - Comparison of TCR & TSC.

UNIT III **9 Hours**

SERIES COMPENSATION

Introduction to series compensation - Thyristor Switched Series Capacitor (TSSC) - Thyristor Controlled Series Capacitor (TCSC) - Comparison of TSSC & TCSC.

UNIT IV **8 Hours**

STATIC VOLTAGE PHASE ANGLE REGULATOR

Objectives of voltage & phase angle regulators - approaches to Thyristor - Controlled Voltage & Phase Angle Regulator.

UNIT V **9 Hours**

EMERGING FACTS CONTROLLER

STATCOM - Unified Power Flow Controller (UPFC) & Interline Power Flow Controller (IPFC) - Introduction to sub synchronous resonance.

FOR FURTHER READING

Static Series Compensators: GCSC, TSSC, TCSC, and SSSC - Special Purpose Facts Controllers: NGH-SSR Damping Scheme and Thyristor-Controlled Braking Resistor.

Total: 45 Hours

Reference(s)

1. R. Mohan Mathur and Rajiv K.Varma, Thyristor Based FACTS Controller for Electrical Transmission Systems, Wiley Interscience Publications, 2016.
2. Narain G. Hingorani & Laszlo Gyugyi, Understanding FACTS - Concepts & Technology of Flexible AC Transmission Systems, Standard Publishers, New Delhi, 2015.
3. T. J. E. Miller, Reactive Power Control in Electric System, John Wiley & Sons, 2014.
4. G. K. Dubey, Thyristerized Power Controller, New Age international (P) Ltd., New Delhi 2016.
5. Narain G. Hingorani, Flexible AC Transmission, IEEE Spectrum, April 1993, pp 40-45.
6. Elinar V. Larsen, Juan J Sanchez - Gasca Joe H. Chow, Concepts for design of FACTS controllers to damp power swings, IEEE Transactions on Power Systems, Vol. 10, No. 2, May 1995.

18EE017 ILLUMINATION ENGINEERING 3 0 0 3

Course Objectives

- To impart basic knowledge on Illumination.
- To understand the types of sources and accessories used in lighting.
- To understand the measurement techniques of illumination and its parameters.
- To illustrate the design procedures applicable for interior lighting.
- To illustrate the design procedures applicable for exterior lighting.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

m. PSO1: Modeling, design and Analysis of Electrical and Electronic Systems using design principles and software tools

n. PSO2: Develop electrical machineries/Appliances for various Domestic and industrial needs

Course Outcomes (COs)

1. Asses the various schemes of lighting.
2. Select the lighting source and its control technique based on the requirement.
3. Analyse the various parameters of illumination and their measuring techniques.
4. Apply the lighting procedure for designing exterior environments.
5. Apply the lighting procedure for designing interior environments.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
1	3	-	-	-	-	-	-	-	-	-	-	-	1	-
2	3	-	-	-	-	-	-	-	-	-	-	-	-	3
3	2	3	-	-	-	-	-	-	-	-	-	-	1	-
4	2	-	3	-	-	-	-	-	-	-	-	-	3	2
5	2	-	3	-	-	-	-	-	-	-	-	-	3	2

UNIT I **7 Hours**

INTRODUCTION

Light and Lighting, Basic Concepts and Units, Photometry and Measurement, Quantity and Quality of Lighting. Factors affecting lighting, artificial lighting, Lighting scheme.

UNIT II **8 Hours**

ACCESSORIES

Light sources: Daylight, Incandescent, Electric Discharge, Fluorescent, Arc lamps, Lasers, Neon signs, Energy Efficiency, LED - LCD displays, Luminaries, Wiring, Switching, Control circuits.

UNIT III **10 Hours**

CALCULATION AND MEASUREMENT

Luminance measurement, Effect of voltage variation, Lighting calculations and characteristic curves, Solid angle, Inverse square and cosine laws, Illumination from point, line and surface sources, Photometry and Spectro - photometry, photocells.

UNIT IV **10 Hours**

INTERIOR LIGHTING

Lighting design procedure for Industrial, Residential, Office, Departmental stores, Indoor stadium, Theatres and Hospitals-Energy Efficient Lighting.

UNIT V **10 Hours**

EXTERIOR LIGHTING

Environment and glare, Lighting Design procedure for Flood, Street, Sport, Aviation and Transport lighting, Lighting for Displays and Signalling-Energy Efficient Lighting.

FURTHER READING

Special Features of Aesthetic Lighting : Monument and statue lighting, Auditorium lighting

Total: 45 Hours

Reference(s)

1. Joseph B. Murdoch, Illumination Engineering from Edisons Lamp to the Laser, Visions Communications, Washington DC, USA, 1994
2. Jack L. Lindsey, Applied Illumination Engineering, Prentice Hall of India, New Delhi, 2008.
3. Marc Schiler, Simplified Design of Building Lighting, John Wiley and Sons, 1997.
4. IES Lighting Handbook, 1993.
5. D.C. Pritchard, Lighting, Routledge, 6th Edition, 2016

18EE018 ENERGY AUDITING 3 0 0 3

Course Objectives

- To understand the Indian energy scenario and international energy policies.
- To study the energy utilization of electrical systems.
- To analyze the energy audit techniques by using suitable tools and energy balance.
- To study the energy management features and audit procedure.
- To gain the knowledge on financial management in energy audit.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
m. PSO1: Modeling , design and Analysis of Electrical and Electronic Systems using design principles and software tools
n. PSO2: Develop electrical machineries/Appliances for various Domestic and industrial needs

Course Outcomes (COs)

1. Analyze the importance of energy policies, energy conservation act features and energy security.
2. Apply the energy conservation technique in electrical and electromechanical devices.
3. Choose the suitable energy audit technique using appropriate equipment to improve the system efficiency .
4. Apply energy management principles, procedure and bench marking in energy audit.
5. Analyze the energy conservation opportunities and the various financial technique adopted in energy management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	-	-	-	2	2	-	-	-	2	2	-
2	2	-	-	-	-	-	2	2	-	-	-	2	1	-
3	2	-	-	-	-	-	-	2	-	-	-	2	2	2
4	3	-	-	-	-	-	2	2	-	-	-	2	1	2
5	3	2	-	-	-	-	2	2	-	-	-	2	2	-

UNIT I **10 Hours**

ENERGY SCENARIO AND ENERGY POLICY

Role of energy in economic development and social transformation- Indian energy scenario- Energy statistics 2018 -international energy policies-G20 and OPEC countries - Need for use of new and non-renewable energy-Energy conservation act-2001 & its features - Energy Security

UNIT II **8 Hours**

ELECTRICAL ENERGY UTILITY SYSTEM

Transmission and Distribution losses-Transformer losses - Electricity Tariff- Load management and maximum demand control- Electric motor-losses in induction motor- efficiency calculation-factors affecting motor performance-power factor - energy efficient motors.

UNIT III **7 Hours**

ENERGY AUDIT INSTRUMENTS AND ENERGY BALANCE

Electrical measurements- Instruments used in energy audit: Wattmeter - flue gas analyzers- PQ analyzers- infrared thermography-Energy efficiency calculation in lighting and pumping applications-Material balance- energy balance - features

UNIT IV **10 Hours**

ENERGY MANAGEMENT AND AUDIT

Definition and objective of energy management - Principle of energy management - Key elements of energy management -Roles and responsibilities of energy manager - energy audit definition -types-Detailed energy audit procedure- understanding energy cost -Bench marking.

UNIT V **10 Hours**

EVALUATION OF SAVING OPPORTUNITIES AND FINANCIAL MANAGEMENT

Determination of cost saving -conservation opportunities - Estimating cost of implementation -Financial analysis techniques-plant energy audit report - Simple payback period, Return on investment, Net present value, Internal rate of return

FOR FURTHER READING

Energy conservation and management -case studies - BEE rules and regulations.

Total: 45 Hours

Reference(s)

1. Jose Golden Berg; Thomas Johansson, A K N Reddy ,Robert Williams Energy for a sustainable world, WileyEastern, 1988.
2. BEE reference book 1/2/3/4
3. Albert Thumann,Terry Niehus A Handbook of Energy Audits, Ninth Edition, 2012.
4. Charles E Brown, Springer, World Energy Resources, 2012.
5. Craig B. Smith,"Energy Management Principles", Pergamon Press, 2015.

18EE019 RENEWABLE ENERGY SOURCES 3 0 0 3

Course Objectives

- To understand the importance and recent scenario of conventional and renewable energy resources.
- To impart knowledge on solar energy harvesting in various forms and solar PV technologies.
- To understand the various types of wind energy systems, safety and environmental factors of its installations.
- To explore the processes in biomass and biogas conversion system.
- To familiarize the basic concepts of hydro power, geothermal energy and Hydrogen energy storage system.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
f. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. 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.
m. Design, **analyze**, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society

Course Outcomes (COs)

1. Analyze the energy scenario and its impact on economic and social development.
2. Examine the solar energy system with various measurement techniques and factors affecting them.
3. Assess the resources, safety and environmental aspects of different types of wind energy conversion systems.
4. Apply the energy conversion techniques in biomass and biogas systems.
5. Analyze the performance of alternative energy sources to evaluate their suitability in sustainable energy solutions.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	-	2	3	-	-	-	-	2	2	1
2	2	2	-	-	-	2	3	-	-	-	-	2	2	2
3	2	-	-	-	-	2	3	-	-	-	-	2	1	2
4	1	-	-	-	-	2	3	-	-	-	-	2	1	2
5	1	-	-	-	-	2	3	-	-	-	-	2	2	2

UNIT I **5 Hours**

INTRODUCTION

Worlds Energy Scenario - Global warming - Reserves of Energy Resources - Environmental Aspects of Energy Utilization - Energy consumption in various sectors and its changing pattern - Renewable Energy Scenario in India and around the World - Role of energy in economic development and social

transformation, Government policies and schemes to promote renewable energy implementations.

UNIT II **10 Hours**

SOLAR ENERGY

Solar Radiation - Measurements of Solar Radiation - Flat Plate and Concentrating Collectors - Solar heating and cooling techniques - Solar thermal plant - Solar Photo Voltaic - Solar Cells and Modules- Types- factors affecting solar power generation - Solar PV Applications.

UNIT III **10 Hours**

WIND ENERGY

Wind Data and Energy Estimation - site selection - wind resource assessment - Types of Wind Energy Systems - factors influencing wind - wind shear - Safety and Environmental factors.

UNIT IV **10 Hours**

BIOMASS AND BIOGAS ENERGY

Biomass resources and their classification - biomass direct combustion-biomass gasifiers - Biomass conversion processes - Biogas plants - Digesters - Ethanol production - Bio diesel - Cogeneration - Electricity generation through biomass and biogas systems.

UNIT V **10 Hours**

OTHER RENEWABLE ENERGY SOURCES

Hydropower - Types, site selection, construction, environmental issues. geothermal energy - site selection, geothermal power plants. Hydrogen energy storage system - Fuel cell - types - construction and applications.

FOR FURTHER READING

Tidal energy -Ocean thermal power plant-bloom energy- hybrid power generation system.

Total: 45 Hours

Reference(s)

1. D.P Kothari, K. C Singal, Rakesh Ranjan, Renewable energy sources and emerging technologies, PHI Learning Pvt. Ltd 2011.
2. S.P Sukhatme, J.K Nayak, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.
3. G.N. Tiwari, Solar Energy - Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.
4. Solanki, Solar Photovoltaics: Fundamental Technologies and Applications, Prentice-Hall of India Pvt. Limited, 3rd Edison, 2015.
5. David Pimentel, Biofuels, Solar and Wind as Renewable Energy Systems, benefits and risks, Springer,2008.
6. Priscila Goncalves Vasconcelos Sampaio & Mario Orestes Aguirre Gonzalez"Photovoltaic solar energy: Conceptual framework", Renewable and Sustainable Energy Reviews Volume 74, July 2017.

18EE020 AUTOMOTIVE ELECTRONICS 3 0 0 3

Course Objectives

- To understand the basic components of automotive electronics.
- To illustrate the components of charging system and starter motor for starting system.
- To analyze the different types of ignition system used in automobiles.
- To understand the types of batteries and lighting systems used in automobiles.
- To summarize the various sensors and actuators used in automobiles.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
l. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Apply various types of control systems in automotive vehicles.
2. Examine the operating principle of starter motor for starting system and generator for charging system.
3. Analyze the various ignition triggering devices used in ignition system.
4. Analyze the types of batteries, testing methods and lights used in automotive applications.
5. Analyze the types of sensors and actuators used in automobiles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	-	-	1	1	2	-	-	-	2	2	-
2	2	-	-	-	-	1	1	2	-	-	-	2	2	-
3	2	-	-	-	-	1	1	2	-	-	-	2	2	-
4	2	-	1	-	-	1	1	2	-	-	-	2	2	-
5	2	-	1	-	-	1	1	2	-	-	-	2	2	-

UNIT I **9 Hours**

INTRODUCTION TO AUTOMOTIVE ELECTRONICS

Automobile Systems -Engine- Engine control- Ignition system -Ignition timing- Drive train- Suspension Brakes-Steering system. Control systems- Proportional, Proportional Integral and Proportional Integral differential controller - Closed-Loop Limit-Cycle Control, electronic dashboard instruments -On-board diagnostic systems.

UNIT II **10 Hours**

STARTING AND CHARGING SYSTEMS

Requirements of Starter Motor, Starter Motor types, construction and characteristics, Starter drive mechanisms, Starter Switches and Solenoids, Charging system components, Generators and Alternators, types, construction and Characteristics. Voltage and Current Regulation, Cut-out relays and regulators. Charging circuits for D.C. Generator.

UNIT III **9 Hours**

IGNITION SYSTEM

Battery Coil and Magneto-Ignition System, Components, Centrifugal and Vacuum Advance Mechanisms, Spark Plugs, Electronically-Assisted and Full Electronic Ignition System, Non-Contact-type Ignition Triggering devices, Capacitive Discharge Ignition Distributor-less Ignition System.

UNIT IV **9 Hours**

BATTERIES AND LIGHTING SYSTEMS

Principle and construction of Lead Acid Battery, Characteristics of Battery, Battery Rating, Capacity and Efficiency, Various Tests on Battery, Battery-Charging Techniques. Lighting system: insulated and earth return system, head light and side light, LED lighting system, head light dazzling and preventive methods.

UNIT V **8 Hours**

SENSORS AND ACTUATORS

Sensors - Oxygen Sensors, Throttle Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Crankshaft Position Sensor, Manifold Absolute Pressure Sensor -Engine Coolant Temperature Sensor, Knock Sensor, Airflow rate sensor. Actuators - Fuel Metering Actuator, Fuel Injector, Ignition Actuator.

FOR FURTHER READING

Future Automotive Electronic Systems - Alternative Fuel, Chassis Electrical, Low tire pressure warning system.

Total: 45 Hours

Reference(s)

1. Tom Denton, Automobile Electrical and Electronic Systems, Automotive Technology: Vehicle Maintenance and Repair, 4th Edition, Butterworth-Heinemann, 2011.
2. W. H. Crouse, Automotive Electrical Equipment, McGraw-Hill, 1996.
3. A W Judge, Modern Electrical Equipment for Automobiles, Chapman & Hall, 1992.
4. P. L. Kohli, Automotive Electrical Equipment, First Edition, McGraw-Hill, 2017.
5. Robert Bosch Automotive Hand Book, 9th Edition, Robert Bosch, 2014.

18EE021 COMPUTER NETWORKING 3 0 0 3

Course Objectives

- To understand the concept of data communication and networking models.
- To understand the functions of OSI layered architecture and its protocols.
- To explore the routing, addressing and security aspects of computer networks.
- To recognize the real-time multimedia application in wired and wireless networks.
- To understand the usage of application layers and analyze its protocols

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
l. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Compare the OSI model with TCP/IP protocol suite and analyze the errors and flow control algorithms for communication between adjacent nodes in a network.
2. Analyze the performance of various LAN protocols.
3. Analyze protocols used in the internet layer for the given network.
4. Analyze various protocols used for the process to process delivery services and traffic reduction mechanisms.
5. Develop a client/server network using application protocols and analyze the capabilities of application layer utilities.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	2	-	-	-	-	-	-	-	1	3	-
2	1	2	1	2	-	-	-	-	-	-	-	1	3	-
3	1	2	1	2	2	-	-	-	-	-	-	1	3	-
4	1	2	1	2	-	-	-	-	-	-	-	1	3	-
5	1	2	1	2	-	-	-	-	-	-	-	1	3	-

UNIT I **9 Hours**

PHYSICAL/DATA LINK LAYER

Building a network - Types of networks - Circuit Switching and Packet Switching OSI model-TCP/IP protocol suite- Transmission media- error control and flow control.

UNIT II **9 Hours**

LOCAL AREA NETWORK

Multiple Access Protocols - Ethernet (802.3) - SONET - Optical fiber in CSMA/CD LAN - FDDI - CDMA LAN - Fiber to the curb-FTH - ATM -Wireless LAN 802.11 - Bluetooth

UNIT III **9 Hours**

IP AND NETWORKS LAYER

IPv4-ICMPv4-IGMP- Mobile IP - Next-generation IP: IPv6, ICMP v6 - Routing Protocols: distance vector-link state, routing (RIP,OSPF4, metrics)- multicast routing: DVMRP-MOSPF

UNIT IV **9 Hours**

TRANSPORT LAYER

Transport Layer Services - Multiplexing and Demultiplexing - User Datagram Protocol (UDP) - Principles of Reliable Data Transfer - Transmission Control Protocol (TCP).Congestion Control Congestion Avoidance (DECbit, RED)

UNIT V **9 Hours**

APPLICATION LAYER

WWW- HTTP- FTP- Telnet- Domain namespace. Network security: Attacks, confidentiality: ciphers, Digital signature, Authentication, Key management

FOR FURTHER READING

Multimedia Networking: Properties of audio/video- Streaming Stored Audio and Video Voice over IP- Case Study: VoIP with Skype

Total:45 Hours

Reference(s)

1. Behrouz Foruzan, Data communication and Networking, Tata McGraw-Hill, 2013,5th edition.
2. William Stallings, Data and Computer Communication, PHI 2010.
3. Andrew S.Tannenbaum, Computer Networks, PHI, 2010.
4. Larry L.Peterson&S.Peter Davie, Computer Networks, Harcourt, 2008.
5. James F.Kurose& Keith W.Ross, Computer Networking A Top-down Approach Featuring the Internet, PHI, 2007.

18EE022 INTERNET OF THINGS 3 0 0 3

Course Objectives

- To learn the basic issues, policy and challenges in the Internet.
- To develop the communication mechanisms for IoT applications.
- To understand the various types protocols in Internet.
- To develop the device discovery for IoT devices.
- To understand the various modes of communications and services with Internet.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society

Course Outcomes (COs)

1. Apply the components of IoT for physical and logical design representation.
2. Apply the working principles of sensors and actuators, integrate microcontroller platforms for IoT.
3. Assess the IoT architecture and protocols for designing an IoT environment.
4. Develop schemes for device discovery for managing the devices involved in IoT.
5. Analyze the use of cloud services for IoT that provides a storage platform.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
1	2	2	-	-	1	-	-	-	-	-	-	-	2	-
2	2	3	-	-	3	-	-	-	-	-	-	-	3	-
3	2	3	-	-	2	-	-	-	-	-	-	-	2	1
4	2	3	-	-	3	-	-	-	-	-	-	-	1	2
5	2	3	-	-	3	-	-	-	-	-	-	-	2	-

INTRODUCTION TO INTERNET OF THINGS

Characteristics of IoT, Physical Design of IoT -n IoT Protocols, IoT communication models, Iot Communication APIs IoT enabled Technologies - Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols.

UNIT II **11 Hours**

PROTOTYPING IOT OBJECTS USING MICROPROCESSOR/MICROCONTROLLER

Basics of Sensors and actuators - examples and working principles of sensors and actuators, Equivalent Microcontroller platform - Setting up the board - Programming for IOT - Reading from Sensors, Communication: Connecting microcontroller with mobile devices - communication through bluetooth ,wifi.

UNIT III **9 Hours**

IOT ARCHITECTURE AND PROTOCOLS

State of the art, Architecture Reference Model, Reference Model and architecture, IoT reference Model- Zigbee, RFID, BLE, NFC.

UNIT IV **8 Hours**

DEVICE DISCOVERY

Device Discovery capabilities - Registering a device, De-register a device, Querying for devices. Technologies available - IBM Foundation Device Management Service, Intel IOTivitiy, XMPP Discovery extension.

UNIT V **8 Hours**

CLOUD SERVICES FOR IOT

Introduction to Cloud Storage models and communication APIs Webserver - Web server for IoT, Cloud for IoT, Python web application framework designing a RESTful web API.

FOR FURTHER READING

Integrating wireless sensor networks with the IOT - case study of intrusion of sensor networks, Amazon Web services for IOT.

Total: 45 Hours

Reference(s)

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.
2. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on-Approach), 1stEdition, VPT, 2014.
3. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, Apress Publications, 2013.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , The Internet of Things Key applications and Protocols, Wiley, 2012.
5. Designing the Internet of Things (Nov 2013) by Adrian McEwen & Hakim Cassimally.

18EE023 DIGITAL IMAGE PROCESSING

3 0 0 3

Course Objectives

- To understand the fundamentals of a digital image.
- To analyze a digital image using different digital image processing techniques.
- To implement the various techniques to perform Image Segmentation.
- To design filters to restore and recognize the digital image.
- To implement the various techniques to perform Image Compression.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. PSO1: Modeling , design and Analysis of Electrical and Electronic Systems using design principles and software tools
n. PSO2: Develop electrical machineries/Appliances for various Domestic and industrial needs

Course Outcomes (COs)

1. Apply the image sampling and quantization techniques in image processing systems.
2. Analyze the effectiveness of spatial and frequency domain filters in an image.
3. Apply the various techniques for image segmentation.
4. Design a filter to restore and recognize a digital image.
5. Apply the various techniques for image compression of a digital image.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3	1	1	-	-	-	-	-	-	-	2	1
2	1	2	3	1	1	-	-	-	-	-	-	-	2	1
3	1	2	3	1	1	-	-	-	-	-	-	-	2	1
4	1	2	3	1	1	-	-	-	-	-	-	-	2	1
5	1	2	3	1	1	-	-	-	-	-	-	-	2	1

UNIT I **9 Hours**

DIGITAL IMAGE FUNDAMENTALS

Elements of digital image processing systems, Elements of visual perception, Image sampling and quantization, Basic Relationships between pixels. Image Transforms:Discrete fourier transform, Cosine, Hadamard, Haar, Walsh and Slant transform

UNIT II **9 Hours**

IMAGE ANALYSIS

Histogram processing, Equalization and specification techniques, Basics of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Image smoothing and sharpening using frequency domain filters

UNIT III **9 Hours**

IMAGE SEGMENTATION

Point, line and edge detection - Detection of isolated points, Line detection, Edge models, Basic edge detection, Edge linking and boundary detection. Thresholding -basic global thresholding, Otsu's method, Multiple, Variable and multivariable thresholding. Region-based segmentation - Region growing, Region splitting and merging

UNIT IV **9 Hours**

IMAGE RESTORATION AND RECOGNITION

Image degradation/ restoration model, Noise models, Restoration - Spatial Filtering, Constrained Least square filtering, Inverse filtering, Wiener Filtering, Object recognition -Patterns and pattern classes, Matching - Minimum Distance classifiers, Neural networks-Background, Training by Back Propagation

UNIT V **9 Hours**

IMAGE COMPRESSION

Fundamentals, Basic compression methods - Huffman coding, Golomb coding, Arithmetic coding, LZW coding, Run-length coding, Lossless and Lossy predictive coding, Block transform coding, Wavelet coding

FOR FURTHER READING

KL transform and their properties, Homomorphic filtering, Morphological image processing - Erosion and Dilation, Opening and closing, Segmentation using morphological watersheds, Applications of neural networks in image processing, Digital image watermarking

Total: 45 Hours

Reference(s)

1. C.Rafeal Gonzalez and E.Richard Woods, Digital Image Processing, Fourth Edition, Pearson Education 2018.
2. S Jayaraman, S Esakkirajan T Veerakumar, Digital Image Processing , Mc Graw-Hill, 2015.
3. K.William Pratt, Digital Image Processing, John Wiley, 2007.
4. Anil K.Jain, Fundamentals of Digital Image Processing, PHI, 1997.
5. M.A.Sid Ahmed, Image Processing Theory, Algorithm and Architectures, McGraw-Hill, 1995.

18EE024 COMMUNICATION ENGINEERING

3 0 0 3

Course Objectives

- To understand modulation concepts of communication systems.
- To analyze different analog and digital modulation schemes.
- To analyze the concept of telephone modems and Optical Fiber Communications.
- To Analyze wireless data transmission network and error networks in the communication system.
- To understand the concept of optical fiber system and analyze their application in the communication system.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Apply the time and frequency domain techniques in amplitude modulation.
2. Apply angle and phase modulation technique to design FM transmitter and receiver.
3. Analyze different types of modulation techniques in the digital communication system using time and frequency.
4. Analyze coding and error correction in data transmission.
5. Apply wavelength division multiplexing concept to develop a fiber optic communication system for telephone and television applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2	-	-	-	-	-	-	-	-	-	3	-
2	3	2	3	-	-	-	-	-	-	-	-	-	3	-
3	1	3	1	-	-	-	-	-	-	-	-	-	3	-
4	2	3	1	-	-	-	-	-	-	-	-	-	3	-
5	3	2	3	-	-	-	-	-	-	-	-	-	3	-

UNIT I **9 Hours**

AMPLITUDE MODULATION

Elements of communication systems, Time and frequency domain, Noise and communications, Amplitude modulation, introduction, full carrier AM in the time domain and frequency domain, Quadrature AM and AM stereo, suppressed-carrier AM, AM Transmitters, AM Receivers.

UNIT II **9 Hours**

ANGLE MODULTION

Angle modulation, Phase modulation, Angle modulation spectrum, FM and Noise, FM stereo, FM measurements, FM Transmitters, FM Receivers, Receivers topologies, FM Demodulators

UNIT III **9 Hours**

DIGITAL COMMUNICATION

Introduction, Pulse Modulation, Pulse code modulation, Delta Modulation, Line codes, Time division multiplexing, vocoders and Data Compression, Digital modulation-Introduction, Frequency and phase shift keying, Quadrature Amplitude Modulation- Communication Protocol for Electric Power System.

UNIT IV **9 Hours**

DATA TRANSMISSION AND MODEMS

Data coding, Asynchronous Transmission, Synchronous Transmission, Error detection and Correction, Data compression and encryption. Telephone Modems, Modem to computer connections, Cable Modems and Digital subscriber Lines.

UNIT V **9 Hours**

FIBER OPTIC SYSTEMS

Basic fiber optic systems, repeaters, and optical amplifiers, wavelength division multiplexing, submarine cables, SONET, Fiber in local area networks, local telephone applications, cable television applications, experimental techniques, optical time-domain reflectometry.

FOR FURTHUR READING

Local area networks, wide area networks, satellite communication, cellular communication.

Total: 45 Hours

Reference(s)

1. Roy Blake, Electronic Communication Systems, Thomson Delmar Ltd, New York, 2013.
2. Wayne Tomasi, Electronic Communication Systems, Pearson Education Asia Ltd, New Delhi, 2012.
3. Louis Frenzel, Principles of Electronic Communication Systems by 3rd Edition, TMH publications,2010.
4. William Schweber, Electronic Communication System, Prentice Hall of India Ltd, India, New York, 2010.
5. Miller, Modern Electronic Communication, Prentice Hall of India, New Delhi, 2010.

18EE025 AUTOMATION AND CONTROL 3 0 0 3

Course Objectives

- To impart knowledge about automation and control methods of AC and DC drives
- To understand the role of PLC in automation.
- To understand hardware requirements and programming in PLC.
- To understand SCADA graphics by interfacing PLC to SCADA.
- To analyze the different components used in distributed control systems.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Outline the architecture of industrial automation system.
2. Analyze the architecture, interfacing and communication techniques of PLC.
3. Implement the PLC Programming languages for suitable applications.
4. Design SCADA graphics by interfacing with PLC.
5. Analyze the features and advantages of Distributed Control System.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	2	-	-	-	-	-	-	-	2	-
2	2	1	-	2	2	-	3	-	-	-	-	-	2	1
3	2	1	-	2	2	-	3	-	-	-	-	-	2	1
4	3	1	2	-	3	-	-	-	-	-	-	-	3	1
5	3	-	-	-	2	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

INTRODUCTION

Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, Introduction of DC and AC servo drives for motion control.

UNIT II **9 Hours**

PROGRAMMABLE LOGIC CONTROLLERS

Components of PLC - sink and source I/O cards - Processor - Memory: Types of memory, Input and Output modules: Discrete, Analog -Scan time of PLC -Interfacing computer and PLC: RS232, RS485, Ethernet - Selection criteria for PLC

UNIT III **9 Hours**

PLC PROGRAMMING

Programming languages - Ladder logic components: User and bit Instructions, branch instructions, internal relay instruction Boolean logic using ladder logic programming , Latching -Timers: On Delay timer, OFF Delay timer and Retentive timer - Counters: Up Counter and Down Counter. PLC in Traffic Light Control, Home Automation, Bottle filling system

UNIT IV **9 Hours**

SCADA

Real time monitoring and control - SCADA System Architecture (First generation-Monolithic, Second Generation-Distributed, Third generation-Networked Architecture)- SCADA hardware-Remote terminal units-SCADA software-DNP & IEC protocols -Implementation and protection by interfacing PLC to SCADA

UNIT V **9 Hours**

DISTRIBUTED CONTROL SYSTEM

Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

FURTHER READING

PLC in Motor Speed Control- Implementation of PLC and SCADA in various electrical fields-case study

Total: 45 Hours

Reference(s)

1. S.K.Singh, "Industrial Instrumentation", Tata Mcgraw Hill, 2015.
2. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall India, 2014.
3. Benjamin C Kuo, Automatic Control Systems, Prentice Hall of India, 2014.
4. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2014
5. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 201

18EE026 SIGNALS AND SYSTEMS

3 0 0 3

Course Objectives

- To understand the various signals, systems and its basic operations.
- To analyze Linear Time Invariant systems by using Laplace Transform.
- To understand the concept of sampling and its reconstruction from samples.
- To apply Fourier series and Fourier transform to continuous time signals and systems using differential equations.
- To apply Fourier series and Fourier transform to discrete time signals and systems using difference equations.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Analyze the functions to classify the signals and systems.
2. Analyze the differential equations using Laplace Transform to predict the Linear Time Invariant systems
3. Apply the sampling theorem to convert continuous-time signals to digital signals for digital communication.
4. Analyze the continuous time signals in frequency spectrum by using continuous time Fourier series and Fourier transform.
5. Analyze the discrete time signals in frequency spectrum using discrete time fourier series and fourier transform.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1	1	-	-	-	-	-	-	-	-	2	-
2	2	3	1	1	-	-	-	-	-	-	-	-	2	-
3	3	1	1	1	-	-	-	-	-	-	-	-	1	-
4	3	3	1	1	-	-	-	-	-	-	-	-	2	-
5	3	3	1	1	-	-	-	-	-	-	-	-	2	-

UNIT I **11 Hours**

INTRODUCTION TO SIGNALS AND SYSTEMS

Signals- Classification - standard signals - basic operations on signals - Representation of signals in terms of impulse function -Continuous time and discrete time systems - Linear Time Invariant System: Continuous and Discrete - LTI systems represented by Linear Constant Coefficient differential and difference equations.

UNIT II **7 Hours**

LAPLACE TRANSFORM

Laplace Transform - Region of Convergence - Properties of Laplace Transform - Inverse Laplace Transform - Analysis and characterization of LTI systems using the Laplace Transform - Unilateral Laplace Transform.

UNIT III **7 Hours**

SAMPLING

Representation of continuous time signals by samples - Sampling theorem - Reconstruction from samples using interpolation - Effect of under sampling - Aliasing error - Discrete time processing of continuous time signals.

UNIT IV **10 Hours**

FOURIER ANALYSIS OF CONTINUOUS TIME SIGNALS AND SYSTEMS

Representation of CT periodic signals by Continuous Time Fourier Series (CTFS) - Properties of CTFS - Representation of CT aperiodic signals by Continuous Time Fourier Transform (CTFT) - CTFT of CT periodic signals - Properties of CTFT - Response of CT LTI systems to complex exponentials - Frequency response of systems characterized by differential equations.

UNIT V **10 Hours**

FOURIER ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS

Representation of periodic signals by Discrete Time Fourier Series (DTFS) - Properties of DTFS - Representation of periodic and aperiodic signals by Discrete Time Fourier Transform (DTFT) - Properties of DTFT - Response of DT LTI systems to complex exponentials- Frequency response of systems characterized by difference equations.

FOR FURTHER READING

Z Transform Analysis of Discrete Time Signals and Systems

Total: 45 Hours

Reference(s)

1. Alan V Oppenheim, Alan S Willsky and S Hamid Nawab, Signals and Systems, Second edition, PHI Learning Private Limited, New Delhi, 1997.
2. Simon Haykin and Barry Van Veen, Signals and Systems, Wiley India Private Limited, Second Edition, 2007.
3. Samir S. Soliman, Mandyam Dhati Srinath, Continuous and Discrete Signals and Systems, Second Edition, Prentice-Hall International, 1998.
4. M. J. Roberts, Signals and Systems:Analysis using Transform method and MATLAB, Second Edition, McGraw-Hill Education, 2011.
5. John. G. Proakis and Dimitris. G. Manolakis, Digital Signal Processing:Principles, Algorithms and Applications, Fourth Edition, Pearson Education, New Delhi, 2007.

18EE027 POWER SYSTEM DEREGULATION 3 0 0 3

Course Objectives

- To interpret the need for restructuring of Power Systems, different market models, and market power.
- To analyze the market model, operations and challenges faced in deregulation environment.
- To infer the transmission open access and congestion management methods.
- To apply the concepts and terminologies in pricing methodology and available transfer capability.
- To explain the deregulation process in Indian and International market.

Programme Outcomes (POs)

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

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

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society

Course Outcomes (COs)

1. Analyze the restructuring process, new entities in power market and benefits
2. Assess the challenges faced in deregulation environment with their market model and operations.
3. Analyze the transmission open access and congestion management methods.
4. Compute the pricing of power transaction and available transfer capability in deregulation environment.
5. Analyze the deregulation process in Indian and International market.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
2	3	2	-	-	-	-	-	-	-	-	-	-	3	1
3	2	-	-	-	3	-	-	-	-	-	-	-	3	2
4	2	-	-	-	3	-	-	-	-	-	-	-	3	2
5	3	2	-	-	-	-	-	-	-	-	-	-	3	-

UNIT I **8 Hours**

POWER SYSTEM DEREGULATION: AN OVERVIEW

Introduction- Motivation for Restructuring of Power System- Electricity Market Entities and Model- Milestones of Deregulation-International Scenario - Benefits of deregulation- Basic Terminologies.

UNIT II **10 Hours**

COMPETITIVE WHOLESALE ELECTRICITY MARKET

Introduction - Restructuring models - Role of Independent system operator - Power exchange (PX) - Market Clearing Price (MCP) - Market operations - Whole sale electricity market characteristics - Challenges in wholesale electricity market.

UNIT III **9 Hours**

TRANSMISSION OPEN ACCESS

Introduction - Transmission open access- Types of Transmission services in open access - FERC order 889 - Structure of OASIS: Functionality and Architecture of OASIS - Congestion management - congestion management methods: An overview: Rescheduling of generation-Power World Simulation model.

UNIT IV **10 Hours**

PRICING AND AVAILABLE TRANSFER CAPABILITY

Introduction - Transmission cost components - Transmission pricing methods - Postage stamp method - contract path method-MW Mile method - Marginal participation method - Available Transfer Characteristics (ATC): Introduction -Definition - Methods of Static ATC Determination - Method based on multiple load flow and continuation power flow - method based on linear sensitivity factors - Power World Simulation model.

UNIT V **8 Hours**

INTERNATIONAL AND INDIAN POWER MARKET

Introduction - California Markets - New York Markets - PJM interconnection - Indian power sector past and present status-growth of power sector in India - overview - Time line of Indian power sector- Players in the Indian power sector.

FOR FURTHER READING

Electric Energy Trading, Electricity Price Forecasting, Demand Side Management

Total: 45 Hours

Reference(s)

1. M.Shahidepour, Hatim Tamin and Zuyi Li, "Market operations in electric power system forecasting, scheduling and risk management", John Wiley sons, 2002.
2. M.Shahidepour and M. Alomoush, "Restructured Electrical Power Systems: Operation: Trading, and Volatility", Marcel Dekker, Inc., 2001.
3. P.Venkatesh, B.V.Manikandan, S.Charles Raja and A.Srinivasan, "Electrical power systems analysis, Security and Deregulation", PHI 2012.
4. Loi Lei Lai, "Power system Restructuring and Deregulation" John Wiley sons, 2001.
5. Kankar Bhattacharya Maath H.J. Bollen and Jaap E.Daalder, "Operation of restructured power systems", Kluwer academic publishers, USA, first edition, 2001.

18EE028 WIND AND SOLAR ENERGY CONVERSION SYSTEMS **3 0 0 3**

Course Objectives

- To provide an overview of available wind & solar energy systems.
- To understand the operation of solar photovoltaic system.
- To learn the design and control principles of Wind turbine.
- To understand the grid connected solar and wind energy conversion system.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

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

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society

Course Outcomes (COs)

1. Analyze the global and Indian energy scenario, rules and regulations associated with it.
2. Analyse the I-V characteristics of Solar PV System and various types of MPPT algorithm.
3. Analyze the control mechanism for wind turbine.
4. Apply the generators and power converters in wind energy conversion systems.
5. Design converter control topologies for grid connected PV systems and its applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	-	-	-	-	-	-	-	-	1	2
2	2	-	-	-	-	-	-	-	-	-	-	-	1	2
3	2	1		1	-	-	1	-	-	-	-	-	1	2
4	2	1	2	1	-	-	1	-	-	-	-	-	1	2
5	2	1	2	1	-	-	1	-	-	-	-	-	1	2

UNIT I **9 Hours**

INTRODUCTION

World energy resources-Indian energy scenario -Energy source and their availability, overview of solar PV systems and wind energy –Government bodies and its functions-MNRE & TEDA, wind and solar energy survey in India and World.

UNIT II **9 Hours**

PHOTO VOLTAIC ENERGY CONVERSION SYSTEM

Solar cell - Construction-operation-types – PV arrays and their characteristics- Sun intensity, angles-Influence on insolation, Temperature –Importance of bypass diodes and blocking diodes ,parasitic capacitance and shading effect -Conditions for maximum power transfer-Conversion efficiency - Maximum Power Point Tracking algorithms.

UNIT III **9 Hours**

WIND ENERGY SYSTEM

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Aerodynamics of Wind turbine. HAWT - VAWT - Power developed-Thrust-Efficiency- Tip speed ratio-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction.

UNIT IV **9 Hours**

GENERATORS AND POWER CONVERTERS FOR WECS

Wind energy systems, Power conditioning schemes, Generators for WECS, Classification of generators-Self excited induction generator, DFIG, PMSG, Advanced converter topology for wind energy system, Concepts of mini/micro grids.

UNIT V **9 Hours**

GRID CONNECTED SOLAR PV SYSTEM

Grid connected system, Grid related problems, Grid codes, Grid integrated solar PV system, Power conditioning schemes, DC-DC Converters, Inverters, Design of solar PV system, Solar PV wind hybrid system.

Total: 45 Hours

Reference(s)

1. D.P Kothari, K. C Singal, Rakesh Ranjan, Renewable energy sources and emergingtechnologies, PHI Learning Pvt. Ltd 2011.
2. Solanki, Solar Photovoltaics: Fundamental Technologies and Applications, Prentice-Hallof India Pvt. Limited, 3rd Edition, 2015.
3. D. Yogi Goswami , “Principles of Solar Engineering” 3rd Edition, CRC Press, 2015.
4. Bin Wu, Yongqiang Lang, NavidZargari, Samir Kouro, “Power Conversion and Controlof Wind Energy Systems”, John Wiley & Sons, 2011.
5. Siegfried Heier, “Grid Integration of Wind Energy Conversion Systems”, 3rd Edition,Wiley, 2009.

18EE029 INTEGRATION OF SCIENCE AND TECHNOLOGY IN INDUSTRY 4.0

3 0 0 3

Course Objectives

- To learn the basic issues, policy and challenges in the Internet.
- To develop the communication mechanisms for IoT applications.
- To understand the various Internet protocols and Industrial Internet of ThingsApplications.
- To understand the concepts of Internet security systems and business models.
- To understand the various modes of communications and services with Internet.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Analyze the hardware and software architectures of various Embedded System design applications using IoT.
2. Apply the components of IoT to represent its physical and logical design.
3. Analyze the Industrial IoT and IIoT architectures and its layers.
4. Apply the IoT architecture and protocols for designing an IoT and M2M environment.
5. Analyze the schemes for device discovery for managing the devices involved in IoT.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	2	2	-	-	-	-	-	-	3	-
2	2	2	2	3	2	-	-	-	-	-	-	-	3	-
3	2	2	2	3	2	-	-	-	-	-	-	-	3	-
4	1	2	2	3	2	-	-	-	-	-	-	-	3	-
5	1	2	3	2	2	-	-	-	-	-	-	-	3	-

UNIT I

INTRODUCTION TO INDUSTRY 4.0 **8 Hours**

Introduction: Sensing & actuation, Communication and Networking - Industry 4.0: Globalization and Emerging Issues, the Fourth Revolution, Smart and Connected Business Perspective, Smart Factories.

UNIT II

INTRODUCTION TO INDUSTRIAL INTERNET OF THINGS **9 Hours**

Comparison of Industry 4.0 Factory and Today's Factory, Internet of Things (IoT) , Industrial Internet of Things (IIoT) , Internet of Services - IoMT (Internet of Medical Things), Smart Manufacturing, Smart Devices and Sensors, Smart Cities, Smart Grid , Smart Metering and Home automation.

UNIT III

INDUSTRIAL IOT ARCHITECTURES AND LAYERS **9 Hours**

IIoT-Introduction, Industrial IoT: Business Model and ReferenceArchitecture: IIoT-Business Models-IIoT Reference Architecture-Industrial IoT- Layers: IIoT Sensing-IIoT Processing and communication-Industrial IoT- Layers: IIoT Communication- Networking.

UNIT IV

IDENTITY MANAGEMENT MODELS IN IOT **10 Hours**

Introduction, Vulnerabilities of IoT, Security requirements, Challenges for a secure Internet of Things, identity management, Identity portrayal, Different identity Management model: Local identity, Network identity, Federated identity, Global web identity, Identity management inInternet of Things, User-centric identity management, Device-centric identity management, Hybrid identity management.

UNIT V

INTRODUCTION TO M2M TO IOT **9 Hours**

M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT.

Total: 45 Hours

Reference(s)

1. Alasdair Gilchrist ,Industry 4.0 - The Industrial Internet of Things, Kindle Edition**,** Apress Publications, 2013.
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.
3. Vijay Madisetti and ArshdeepBahga, Internet of Things (A Hands-on-Approach), 1stEdition, VPT, 2014.
4. Francis daCosta, Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, 1st Edition, Apress Publications, 2013.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , The Internet of Things Key applications and Protocols, Wiley, 2012.

18EE030 ELECTRIC VEHICLE CHARGING STATION 3 0 0 3

Course Objective(s)

- Understand the basic characteristics of batteries and its charging requirements.
- Analyse the various types of chargers and technologies for EV charging technology.
- Outline the management systems and smart control in EV charging technology.

Program Outcome(s)

a.Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.

b.Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcome (s)

1. Analyse the characteristics of batteries and charger requirements in Electric vehicle.
2. Analyse the performance parameters of converters in ON board charger for Electric Vehicles.
3. Apply the concept of power converters to design OFF board charger for Electric Vehicles.
4. Analyse the performance of Fast charger while integerating with unipolar and bipolar DC voltage bus.
5. Analyse the impacts of charger circuits on grid and management systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	-	1	1	-	-	-	-	-	-	1	-	-
2	2	2	1	1	1	-	1	-	-	-	-	1	1	1
3	1	3	2	2	2	-	2	-	-	-	-	1	1	1
4	1	3	2	1	2	-	2	-	-	-	-	2	1	1
5	1	2	2	2	2	-	1	-	-	-	-	2	2	2

UNIT I **8 Hours**

CHARACTERISTICS OF ELECTRIC VEHICLE BATTERIES

Types of batteries – Characteristics of Electric vehicle battery - Lead Acid battery – Lithium Ion battery – AH rating - C-rate - Charging and discharging characteristics – Exponential area – Charger requirements – Types of charging methods

UNIT II **9 Hours**

ON BOARD CHARERS

LEVEL 1 and 2 Charger - Topology for On board charger - AC/DC Converters – Front end converter – Output and input analysis – Unidirectional and Bidirectional power flow – Multifunctional on board chargers – IEC and IEEE standards of On board charger – charger ports

UNIT III **10 Hours**

OFF BOARD CHARGERS

LEVEL 3 Charger – Bidirectional AC/DC Converter – Bidirectional DC/DC Converter – Unidirectional AC/DC Converter - Unidirectional DC/DC Converter – Vienna Rectifier – Phase Shift full bridge converter - IEC and IEEE standards of Off board charger – Charger ports

UNIT IV **9 Hours**

FAST CHARGERS

Need for Fast charging –Architecture of Fast charger – Fast charging station with Unipolar DC voltage bus – Fast charging station with Bipolar DC voltage bus – Wireless charging – Impacts of fast charger on grid

UNIT V **9 Hours**

STATION MANAGEMENT AND GRID IMPACTS

Smart Charging Station - Management and supervisory Control system – business model of charging points – Vehicle to Grid(V2G) interactions - Impacts on grid – power quality issues –Load management challenges.

FOR FURTHER READING

Load Management, Renewable Energy Integrated EV charging station, Smart grid, Bidirectional grid power flow

Total: 45 Hours

REFERENCE(s)

1. D Smith, “Electric Vehicle Charging Station (EVCS): Renewable Energy meets the Ultra- Low Emission Vehicle”, 2015.
2. Morris Brenna, Federica Foiadelli, Carola Leone, Michela Longa, “Electric Vehicles Charging Technology Review and Optimal Size Estimation”, Journal of Electrical Engineering & Technology, 2020.
3. Tianjin Chen, Xiao-Ping Zhang, Jianji Wang, Jianing Li, Cong Wu, Mingzhu Hu, and Huiping Bian, “A Review on Electric Vehicle Charging Infrastructure Development in the UK”, Journal of Modern Power Systems and Clean Energy, Vol. 8, No. 2, March 2020.
4. Mary Fitzpatrick, “Electric Vehicle Charging Stations”,Connecticut General Assembly, Office of Legislative Research, 2016.
5. Tariq Muneer, Mohan Kolhe, Aisling Doyle, “Electric Vehicles: Prospects and Challenges”, Elsevier Science, 2017.

18EE031 POWER SYSTEM FOR ELECTRIC VEHICLE **3 0 0** 3

Course Objective(s)

- Understand the basic characteristics of power system methodologies in EV.
- Analyse the various types of drive system and technologies for EV.
- Design and analyse the different types of battery charges and battery storage systems.

Program Outcome(s)

a.Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.
b.Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c.Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, andsynthesis of the information to provide valid conclusions.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcome (s)

1. Analyse the mathematical models of Hybrid and Electric vehicles.
2. Analyze the various control strategies of DC drives in Electric vehicles.
3. Apply different energy storage technologies for Hybrid Electric vehicles.
4. Analyse the performance of various battery charging stations in Electric vehicles.
5. Analyse the various configurations of Hybrid Electric vehicles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	-	-	-	-	-	-	-	-	-	-	-	-
2	1	2	1	-	-	-	1	-	-	-	-	-	1	1
3	1	2	2	1	-	-	1	-	-	-	-	-	2	2
4	1	3	1	1	-	-	1	-	-	-	-	-	1	1
5	1	2	2	2	-	-	2	-	-	-	-	-	2	2

UNIT I **8 Hours**

VEHICULAR POWER SYSTEM

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies-Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance, Capabilities, Automation system computer facilities

UNIT II **9 Hours**

DRIVE SYSTEM

Introduction to electric components used in hybrid and electric vehicles- Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, and Switched Reluctance Motor drives- drive system efficiency.

UNIT III **9 Hours**

ENERGY STORAGE SYSTEM

Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Metal Air Battery, Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System.

UNIT IV **11 Hours**

BATTERY CHARGERS

Basic charger circuits, Microprocessor based charger circuit, Conductive charger, Standard power levels of conductive chargers, Inductive (Principle of inductive charging, Soft- Switching power Converter for inductive charging), Battery indication methods Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Battery Swapping Station, Move and charge zone.

UNIT V **8 Hours**

POWER SYSTEM IN SPECIAL VEHICLES

Electrical power system in air craft, sea and undersea vehicles, Space vehicles- Hybrid vehicle control strategies- Supporting subsystem. Configuration of HEV (Series, Parallel, Series-parallel & Complex), Fixed & variable gearing, Single & multiple motor drive, In-wheel drives.

FOR FURTHER READING

Load Management, Renewable Energy Integrated EV charging station, Smart grid, Bidirectional grid power flow

Total: 45 Hours

REFERENCE(s)

1. John G. Hayes, G. Abas Goodarzi “Electric Powertrain - Energy Systems, Power Electronicsand Drives for Hybrid, Electric and Fuel Cell Vehicles”, Wiley, 2018.
2. Ion Boldea and S.A Nasar, ‘Electric drives’, CRC Press, 2016.
3. Gilbert M. Masters, “Renewable and Efficient Electric Power Systems”, Wiley, 2013.
4. Chris Mi, M. Abul Masrur, David Wenzhong Gao, ’Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives’, Wiley, 2011.
5. Iqbal Husain, ‘Electric and Hybrid Vehicles: Design Fundamentals’, CRC Press, 2nd Edition,

18EE0YA ENERGY CONSERVATION AND MANAGEMENT 3 0 0 3

Course Objectives

- To understand the need for energy conservation and current trends.
- To identifying energy conservation opportunities in mechanical equipment.
- To fix the energy saving potential targets for individual cost centers.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

k. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyse the of Indian energy scenario and energy conservation act features.
2. Apply the energy conservation technique in electro mechanical devices and HVAC systems
3. Select the suitable energy audit technique using appropriate tools to improve the system efficiency
4. Analyze the different financial technique adopted in energy management system
5. Analyse the role of energy efficiency, features, demand side management and barriers in electrical system

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	-	-	2	-	-	-	-	-	3	-
2	2	1	-	-	-	-	-	-	-	-	-	-	2	3
3	1	2	-	-	-	-	-	-	1	-	2	-	2	1
4	2	1	-	-	-	-	-	-	1	-	2	-	3	-
5	1	2	-	-	-	-	1	-	-	-	-	-	2	-

UNIT I **10 Hours**

ENERGY SCENARIO

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, Indian energy scenario- energy needs of growing economy, energy intensity, energy conservation and its importance-Energy Conservation Act 2001 and its features.

UNIT II **8 Hours**

ELECTRICAL ENERGY CONSERVATION

Input electrical energy requirements in pumps, fans, and compressors-load factor estimation in the equipments - Energy conservation potential -Electrical energy conservation in refrigeration and A/C system -Operation and maintenance practices for electrical energy conservation Case examples.

UNIT III **8 Hours**

ENERGY MANAGEMENT

Definition, energy audit, need, types of energy audit. Energy management (audit) approaches-understanding energy costs- Benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, fuel and energy substitution, energy audit instruments and metering.

UNIT IV **10 Hours**

FINANCIAL MANAGEMENT

Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, and - elements of monitoring system

UNIT V **9 Hours**

ENERGY EFFICIENCY AND DEMAND SIDE MANAGEMENT

Basic concepts-Importance of demand side managements- Efficiency gains-Estimation of energy efficiency potential-Cost effectiveness- Barriers for energy efficiency and DSM.

Total: 45 Hours

Reference(s)

1. Jose Golden Berg; Thomas Johansson, A K N Reddy ,Robert Williams - Energy for a sustainable world, Wiley Eastern.
2. BEE reference book 1/2/3/4
3. Albert Thumann,Terry Niehus, Handbook of Energy Audits, 2012 Ninth Edition
4. Charles E Brown, Springer, 2012,World Energy Resources
5. Energy Conservation In Process Industry, - W. F. Kenny
6. Energy Engineering and Management - Amlan Chakrabarti - Prentice hall India 2011.

18EE0YB ELECTRICAL SAFETY 3 0 0 3

Course Objectives

- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety
- To understand the causes of accidents due to electrical hazards
- To know the various protection systems in Industries from electrical hazards
- To know the importance of earthing
- To distinguish the various hazardous zones and applicable fire proof electrical devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

c. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyse the concepts in electrical circuit and hazards involved in it
2. Analyse the electrical hazards in Industries
3. Apply the various protection systems for electrical hazards
4. Apply the different earthing for electrical systems
5. Analyse the different hazardous zones in Industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	-	-	-	-	-	-	-	-	-	-	2	1
2	2	3	-	-	-	-	-	-	-	-	-	-	2	1
3	2	1	-	-	-	-	-	-	-	-	-	-	1	1
4	2	-	3	-	-	-	-	-	-	-	-	-	1	2
5	2	-	3	-	-	-	-	-	-	-	-	-	2	2

UNIT I **9 Hours**

CONCEPTS AND STATUTORY REQUIREMENTS

Review of Electrical concept - electrostatics, electro magnetism, stored energy - working principles of major electrical equipment - Typical supply situation - Indian electricity act and rules - statutory requirements from electrical inspectorate.

UNIT II **9 Hours**

ELECTRICAL HAZARDS

Primary and secondary hazards - Energy leakage - clearances and insulation - excess energy current surges - electrical causes of fire and explosion - national electrical safety code ANSI.

UNIT III **9 Hours**

PROTECTION SYSTEMS

Fuse, circuit breakers and overload relays - protection against over voltage and under voltage - safe limits of amperage - safe distance from lines - capacity and protection of conductor joints and connections, overload and short circuit protection - no load protection - earth fault protection. FRLS insulation - insulation and continuity test - system grounding - equipment grounding - earth leakage circuit breaker (ELCB) - ground fault circuit interrupter - electrical guards - Personal protective equipment.

UNIT IV **9 Hours**

SELECTION, INSTALLATION, OPERATION AND MAINTENANCE

Role of environment in selection - protection and interlock - discharge rod and earthing devices - safety in the use of portable tools - preventive maintenance.

UNIT V **9 Hours**

HAZARDOUS AREAS

Hazardous area classification and classification of electrical equipments for hazardous areas (IS, API and OSHA standards).

Total: 45 Hours

Reference(s)

1. Fordham Cooper, W., Electrical Safety Engineering, Butterworth and Company, London, Third Edition, 2013.
2. Indian Electricity Act and Rules, Government of India.
3. Power Engineers, Handbook of TNEB, Chennai, 2010.
4. Accident prevention manual for industrial operations, N.S.C., Chicago, 1982.

18EE0YC INDUSTRIAL DRIVES AND CONTROL 3 0 0 3

Course Objectives

- To study the industrial control methods of AC and DC drives
- To Understand the theory and applications of Industrial AC and DC drive systems
- To analyze the operation of Artificial-Intelligence Based drive

Programme Outcomes (POs)

j. 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.

k. 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.

l. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Apply the control techniques for industrial AC/DC Drives.
2. Apply the solid state speed control schemes for induction motor drives.
3. Analyse the steady state and transient performances of DC drives.
4. Apply control techniques for synchronous motor drives.
5. Compute Artificial-Intelligence Techniques for Industrial drives

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	-	3	-	1	-
2	-	-	-	-	-	-	-	-	-	1	3	-	2	3
3	-	-	-	-	-	-	-	-	-	-	3	-	2	1
4	-	-	-	-	-	-	-	-	-	1	3	2	1	-
5	-	-	-	-	-	-	-	-	-	2	3	-	2	1

UNIT I **10 Hours**

INTRODUCTION TO MOTOR CONTROL

Motors - Load system, Dynamics, load torque, - Speed control and multi quadrant operation, Braking of series and separately excited DC motor, speed torque characteristics of induction motor and DC Motors - Control strategies for AC and DC drives.

UNIT II **9 Hours**

INDUCTION MOTOR DRIVES

Variable frequency operation of 3-phase inductions motor Drive -Scalar control - Principle of vector or field oriented control - Direct and Indirect vector control- Constant torque operations- Case study: FPGA based Industrial control of induction motor

UNIT III **8 Hours**

DC MOTOR DRIVES

Starting, Braking and Speed Control- Open and Closed loop control- Transient analysis of separately excited motor with armature and field control, Chopper Control DC drives, Case study: ARM processor based industrial DC drive system; PLC based industrial DC drive system.

UNIT IV **10 Hours**

SYNCHRONOUS MOTOR DRIVES

Principles of synchronous motor control - Adjustable frequency control - Voltage Source Inverter Drive with open loop control, Self controlled Synchronous motor with electronic commutation and load commutated thyristor inverter - Principle of Vector control. Case study: DSP processor based Synchronous Motor drives.

UNIT V **8 Hours**

ARTIFICIAL-INTELLIGENCE BASED DRIVES AND APPLICATIONSMAND SIDE MANAGEMENT

AI-Based Techniques - Applications in Electrical Machines and Drives - Neural-Network Based Drives - Commercial AI based Drives -Fuzzy Logic Concept- Applications of Fuzzy Logic to Electric Drives - Selection of drives -Steel rolling mills, Paper mills, Lifts and Cranes, Sugar mills.

FOR FURTHER READING

Neuro-fuzzy based control of DC drives, Design of AC drives using Brain Emotional Learning Based Intelligent Controller, Varialbe frequency control of multiple synchronous motor drives

Total: 45 Hours

Reference(s)

1. Bimal K Bose, "Power Electronics and Variable Frequency Drives - Technology and Application", IEEE Press, 1997
2. Gopal K Dubey, Fundamentals of Electric Drives, Narosa Publishing House, New Delhi, 2005.
3. Peter Vas, "Vector Control of AC Machines", Oxford University Press, 1990.
4. Ned Mohan, Advanced Electric Drives: Analysis, Control and Modeling using Simulink, John Wiley and Sons Ltd, 2001
5. Peter Vas, Artificial-Intelligence-based Electrical Machines and Drives, Oxford University Press, 1999.

18EE0XA EMBEDDED CONTROL OF ELECTRIC DRIVES 0 0 0 1

Course Objectives

- To provide introduction on Electric drives and their purposes
- To bring awareness about basic elements of automation - Sensing, Actuation and Control.

Programme Outcomes (POs)

a.Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. 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.

d. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the AC drives, DC drives and servo drives
2. Analyze the various controllers and sensing units for Electric drives

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	2	3	-	-	-	-	-	-	-	-	1	-
2	3	-	2	1	-	-	-	-	-	-	-	-	1	1

UNIT I

Introduction to Electric Drives AC Drives, DC Drives, Servo Drives Selection of Electric Drives as per application, Basic components of Drives Control Introduction to Controllers : PLC, Microcontrollers Introduction to Sensing Circuits Basic Control Algorithms: On/Off Control, Hysteresis Control, P, PI, PID control Control of AC Drives - VFD and TRIAC Firing Angle control.Control of DC Drives - PWM Control Bi-Directional Control using DIR input Position Control using Encoders Voltage and Current Control Fault Detection

Reference(s)

1. Vedam Subramanyam,"Electric Drives: Concepts and Applications", Tata McGraw-Hill, New Delhi, 2004.
2. Hamid A. Toliyat, "DSP Based Electromechanical Motion Control", 1st Edition, CRC Press, 2004.

18EE0XB DESIGN OF EMBEDDED SYSTEM FOR DC MOTOR CONTROL

0 0 0 1

Course Objectives

- To introduce Motor Control Applications and chip-sets available in market
- To bring awareness about basic elements of automation - Sensing, Actuation and Control

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Analyze the motor control using embedded system.
2. Select suitable controller for Dc motor control .

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	2	3	-	-	-	-	-	-	-	-	1	-
2	1	2		3	-	-	-	-	-	-	-	-	1	-

UNIT I 15 Hours

DESIGN OF EMBEDDED SYSTEM FOR DC MOTOR CONTROL

Introduction to Motor Control Differences between DC, BLDC, Stepper and Servo MotorsMicrocontrollers – Basics Motor control Peripherals,ADC, Digital Ports, PWM, Capture Unit, Compare Unit, Comparison of Microcontrollers for Motor Control in the market,TI, ST, Atmel, Microchip Selection of External Motor Control Drivers, Importance of Optocouplers, Over Voltage / Current detection PWM control basics Current Sensing Circuit and Current Control Bi-Directional Control using H-Bridges Position Control using Encoders Fault Detection

TOTAL:15 Hours

Reference(s)

1. Ion Boldea and Nasar S A, "Electric Drives", CRC Press LLC, New York, 2005.
2. Bose B K,"Modern Power Electronics and AC Drives", Pearson Education, New Delhi, 2003.

18EE0XC INDUSTRIAL AUTOMATION 0 0 0 1

Course Objectives

- To understand the various Industrial Measurement techniques
- To analyze about various configurations of PLC.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

k. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the various Measurement techniques for industrial automatiuon.
2. Analyze the various architectures of PLC & SCADA.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	2	-	3	-	-	-	-	-	-	-	2	1
2	1	2	3	-	-	-	-	-	-	-	-	-	2	1

UNIT I

Introduction to Instrumentation Basics, Instrumentation Standards, Introduction to Industrial Measurement techniques : Pressure Measurement, Temperature Measurement, Flow Measurement, Level Measurement, Basic Control Loops and Tuning, Introduction to Field Instruments, Principle and Operation of Transmitters, Principle and Operation of Flow meters, Principle and Operation of Control Valves, Single Loop Controllers and Operation, Principle and Operation of Data acquisition System

UNIT II

CENTUM VP overview, CENTUM VP system architecture, FCS hardware configuration, HIS configuration, Network details, Address settings, Introduction to CENTUM VP engineering, Project creation, Project attribute utility, IOM creation/ IOM builder settings, Practice session, Creation of open loop, Creation of closed loop, Introduction to FCS simulation, Concept of download : Offline download, Online download, IOM load, System defined windows: Faceplate, Tuning, System defined windows, Practice session

UNIT III

Creation of cascade loop, Signal selectors, Configuration of FOUT block, Configuration of SPLIT block , Creation of control group window, Creation of trend window, HIS setup window , Scheduler, Practice session, Concept of discrete I/Os, switches, Concept of interlocks, Configuration of sequence table, configuration of logic chart , Configuration of MC-2 block, Configuration of MC-2 in logic chart, TPCFL block, CALCU block, Overview window, Graphics window, Practice session, Introduction PLC concepts Types of PLCs, Difference between DCS and PLC, PLC System Configuration, PLC Hardware Configuration, Prosafe-RS safety PLC-features, hardware details, Introduction to Work bench, Project Creation, Screens of Workbench - Link Architecture

UNIT IV

Hardware Architecture - I/O Wiring – Dictionary, I/O Variable Creation and Wiring, Introduction to FBD, FBD logic using digital signal, Configuration of SCALER Block, Configuration of FILTER Block, Configuration of MUXREAL4 Block, Configuration of SEL_R Block, Configuration of ANLG_S Block, Offline Download/Online download, I/O Lock Window/Forcing Function, Introduction to Integration with CENTUM VP for implementing SCADA, Engineering on SENG Side, Engineering on CENTUM VP Side, Function Blocks for Integration, Introduction to Ladder diagrams, Introduction to Structured text, SOE Viewer

TOTAL:15 Hours

Reference(s)

1. Besterfield D. H. Quality Control. New Jersey, 2001.
2. Goetsch D. L., Davis S. B..Introduction to TQM for production, processing and services. New Jersey: Prentice Hall, 2003.

18EE0XD QUALITY MANAGEMENT SYSTEM 0 0 0 1

Course Objectives

- To understand the quality management tools and standards.
- To analyze about product verification methods and quality cost.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

k. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the product verification methods and quality management tools.
2. Analyze the quality standards and quality cost for industrial automation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	-	-	2	-	-	-	-	-	3	-	1	1
2		-	-	-	-	1	2	-	-	-	3	-	1	1

UNIT I

PRODUCT VERIFICATION METHODS

Inspection - Quality control - Quality Assurance - Special process - Six sigma - FMEA – Zero Defects.

UNIT II

BASIC QUALITY MANAGEMENT TOOLS

Causes and Effect diagram - Check sheet- Control chart - Histogram - Pareto chart -Scatter diagram - Stratification (Flow chart or Run chart).

UNIT III

QUALITY STANDARDS

ISO-9000 System - Environment Management System - 5S Work Place Management - KANBAN / JIT/ TwoBin System.

UNIT IV QUALITY

COST

Cost of Quality - Rework - Rejection - Replacement - Product Failure - Warrantee - Failure Analysis -8D Report.

Reference(s)

1. Besterfield D. H. Quality Control. New Jersey, 2001.

2. Goetsch D. L., Davis S. B..Introduction to TQM for production processing and services. New Jersey: Prentice Hall, 2003.

18EE0XE PRODUCT LIFECYCLE MANAGEMENT 0 0 0 1

Course Objectives

- To understand the Product Life Cycle Management in Industry
- To understand the Product Life Cycle Management in Industry

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts,and demonstrate the knowledge of, and need for sustainable development.
k. Demonstrate knowledge and understanding of the engineering and management principles andapply these to own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Assess the various features in Product life cycle management
2. Analyze the procedures in the PLM

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO1 1	PO12	PSO1	PSO 2
1	-	-	-	-	-	-	2	-	-	-	3	-	1	-
2	-	-	-	-	-	-	2	-	-	-	3	-	1	-

Unit-I

Introduction Product Life Cycle Management (PLM)

Definition, PLM life cycle model, Threats of PLM, Need for PLM, Opportunity & Benefits of PLM, Views, Components & Basics of PLM

Unit-II

PLM Concepts

Characteristics of PLM, Environment driving PLM, PLM Elements, Drivers of PLM, Conceptualization,Design, Development, Validation, Production support to PLM.

Unit-III

Digital Manufacturing of PLM

Digital manufacturing, Benefits of manufacturing, Virtual learning curve, Manufacturing Rest, Productionplanning.

Reference(s)

1. Grieves Michael, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006.
2. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003)
3. Stark, John. Product Lifecycle Management: 21st Century Paradigm for Product Realization, Springer-Verlag, 2004.

18EE0XF APPLICATIONS OF SYNCHRONOUS GENERATOR IN INDUSTRIES 0 0 0 1

Course Objectives

- To understand about the various tests to be conducted in generators.
- To analyze the open circuit and short circuit characteristics of generator.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the different offline tests and online tests of generator.
2. Apply the technical standards and grid codes for generator stations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2	3	-	-	-	-	-	-	-	-	1	2
2	1	-	2	-	3	-	-	-	-	-	-	-	1	2

Introduction to practical aspects of generator testing, Distinction between factory and field tests, Details of electrical tests (test procedure & analysis of results) - Off-Line Tests -Tests on Stator: Insulation Resistance (Polarization Index), Winding Resistance, Core hot-spots, Capacitance & tan-delta, Partial discharge, High voltage, Winding & core temperature detectors - Tests on Field: Insulation Resistance, Winding resistance, Winding impedance, Field short circuit & ground detectors, High voltage, Pole drop test, Magnetization.On-Line Tests - Generator Open-circuit & Short-circuit Characteristics - Step tests for excitation system - Separation tests - Factory acceptance tests - Introduction to Indian Grid Code - Power Scenario in India - Technical standards and Grid codes for generator stations.

Total: 15 Hours

Reference(s)

1. Ion Boldea, Synchronous Generators, CRC Press, 2nd Edition, Taylor & Francis Group,2016.
2. M.V. Deshpande, Electrical Machines, PHI Learning, 1st Edition, 2013.
3. Dr Ravi Segal, GE- Energy, Bengaluru.

18EE0XG REACTIVE POWER MANAGEMENT AND ENERGY STORAGE DEVICES

0 0 0 1

Course Objectives

- To understand the practical aspects of reactive power problem.
- To exemplify the IEEE standards and models for Power System Stabilizers.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. 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.

d. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the practical aspects of reactive power problem and sources of reactive power.
2. Analyze the functions of Power System Stabilizers and Energy Storage Devices.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-	2	3	-	-	-	-	-	-	-	-	1	-
2	1	-	3	2	-	-	-	-	-	-	-	-	1	1

Introduction to the problem of VAR control-Practical aspects of reactive power problem: Voltage stability, Static & Dynamic VAR requirements, Torsional modes and Sub-synchronous resonance-Sources of reactive power: Capacitor & Reactor, Transformer, Synchronous condenser, Excitation system-Static excitation system, Functionality ,Technical features ,IEEE standards, Generator capability, Under excitation and over excitation limiters-Power system stabilizer (PSS):Function ,Design ,IEEE standard models for PSS-Introduction to Energy Storage (ES) devices: Need for ES, Types & application of ES devices.

Total: 15 Hours

Reference(s)

1. D. M. Tagare, Reactive Power Management, Tata McGraw Hill Publishing Company Ltd, Fourth Edition 2007.
2. Ter-Gazarian, A.G, Energy Storage for Power Systems, 2nd Edition, IET Publications,2011.

18EE0XH SUBSTATION DESIGN 0 0 0 1

Course Objectives

- To understand the operation and basic concepts of substation devices.
- To identify the international standards and codes for substation

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Design, **analyze**, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n. Apply **technology** to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Examine the components, types and industrial topics of Electrical Substation.
2. Construct a single line diagram of distribution panel

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	-	-	-	-	-	-	-	-	2	1
2	1	1	-	-	-	-	-	-	-	-	-	-	2	1

Introduction to the problem of VAR control-Practical aspects of reactive power problem: Voltage stability, Static & Dynamic VAR requirements, Torsional modes and Sub-synchronous resonance-Sources of reactive power: Capacitor & Reactor, Transformer, Synchronous condenser, Excitation system-Static excitation system, Functionality ,Technical features ,IEEE standards, Generator capability, Under excitation and over excitation limiters-Power system stabilizer (PSS):Function ,Design ,IEEE standard models for PSS- Introduction to Energy Storage (ES) devices: Need for ES, Types & application of ES devices.

Total: 15 Hours

Reference(s)

1. John D MC Donald, Electric Power Substation Engineering, CRC Press, Taylor & Francis Group,3rd Edition,2012.

2. L.G. Hewitson, Mark Brown, Ramesh Balakrishnan, Practical Power System Protection, Newnes,2004.

18EE0XI DESIGN OF GRID TIED SOLAR PV SYSTEM 1 0 0 1

Course Objectives

- To understand the fundamentals of Solar PV System.
- To know about the different components of Solar PV System and understand its selectioncriteria.
- To be able to design practical Solar PV On-Grid Systems.

Programme Outcomes (POs)

a. An ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex Electrical and Electronics engineering problem.
b. An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
c. 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.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Select a suitable Solar PV System Components for grid tied system.
2. Design a practically applicable Solar PV On-grid System.

Articulation matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	3	-	-	-	-	-	-	-	-	-	2	1
2	1	3	2	-	-	-	-	-	-	-	-	-	2	1

Contents :

- Energy and Power Concepts
- Exercises for Household, Industrial and Commercial Load Calculations
- Solar Radiation & Measurements
- Overview of Solar Photo Voltaic System (SPV)
- Types, Sizes and Specifications of Different Components of SPV
- Selection Criteria, Guidelines and Standards for Different Components of SPV
- Factors affecting SPV Module Performance
- System sizing & Design of On-grid SPV Power Plants

Total:15Hours

Reference(s)

1. Solanki, C.S., 2013. Solar photovoltaic technology and systems: a manual fortechnicians, trainers and engineers. PHI Learning Pvt. Ltd.
2. SCGJ, 2016. Solar PV Installer (Suryamitra): Participant Handbook. Unifiers Socialventures Pvt Ltd.

18EE0XJ DESIGN OF INDOOR AND OUTDOOR LIGHTING USING DIALUX

1 0 0 1

Course Objectives

- To understand the lighting calculations, types of lamps and its usage in indoorapplications.
- To design the illumination system for indoor and outdoor applications using Dialux software .

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

c. 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.

d. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the different parameters in illumination system and design of illumination system for various locations.
2. Design a lighting system for indoor and outdoor applications using Dialux software

Articulation matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	3	-	-	-	-	-	-	-	-	2	1
2	1	3	-	-	3	-	-	-	-	-	-	-	2	1

Unit I **7 Hours**

Introduction on Lighting Design and Its Purpose - Brief Introduction on Types of Lamp and ItsUsage - Calculation of various factors - Manual Lighting calculation for Indoor Applications {Power Plants, Process Industries, Commercial Building}- Manual Lighting calculation forOutdoor applications {Switchyard, Street Lighting} - Standards on IS, IEC, BS etc.

Unit II **8 Hours**

Luminaire selection-Overview of Lighting Software - Lighting calculation for Indoor Applications using Lighting software{Power Plants, Process Industries, Commercial Building} Lighting calculation for Outdoor applications using Lighting software {Switchyard, Street Lighting}.

TOTAL: 15 Hours

Reference(s)

1. Joseph B. Murdoch, Illumination Engineering from Edison's Lamp to the Laser, Visions Communications, Washington DC, USA, 1994
2. Jack L. Lindsey, Applied Illumination Engineering, Prentice Hall of India, New Delhi, 2008.
3. Sivanagaraju S, Balasubba Redddy M, Srilatha M, Generation and Utilization of Electrical Energy, Pearson Edition 2010.
4. https://www.lightnowblog.com/2016/03/introduction-to-lighting-design/
5. https://posoco.in/wp-content/uploads/2020/05/Report-on-Pan-India-Lights-Off-Event-9-PM-9-Minutes-on-5th-April-2020.pdf

18EE0XK DESIGN OF POWER CONVERTERS FOR INDUSTRIAL APPLICATION 1 0 0 1

Course Objectives

- To analyze the conceptual design of converter, inverter for AC motor speed control application.
- To understand and analyze the various types of Sensing circuits.
- To understand the Hardware design for DC Drives.
- To analyze the Solar panel performance for pumping application.
- To understand the PCB design constraints associated in AC and DC Drives.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Evaluate the performance of converter and its filters design parameters.
2. Evaluate the performance of Inverter design and its gate drivers.
3. Analyze the performance of power supply design using DC-DC converter.

Course Content

Rectifier Design – Inverter design – Selection of switching devices and gate driver – Bootstrap method for High voltage side Gate driver - dc –dc converter design – voltage, current and temperature sensing circuit – speed control techniques for AC and DC drives–PCB design.

Total : 15 Hours

Reference(s)

1. Muhammad H.Rashid, “Power Electronics Circuits, Devices & Applications” , 4th Edition, Pearson India, 2018.
2. “Control Integrated Power System (CIPOS™) IKCM30F60GD” – Application Note by Infineon.
3. Gustavo Azevedo “Losses and CMV Evaluation in Transformerless Grid-Connected PV Topologies”, IEEE International Symposium on Industrial Electronics (ISlE 2009) Seoul Olympic Parktel, Seoul, Korea July 5-8, 2009.
4. Infineon “2ED020I12-F2 1200 V dual high-side gate driver IC with galvanic isolation, DESAT and short circuit clamping”, Datasheet of Dual IGBT Driver IC.

18EE0XL LITHIUM BATTERY TECHNOLOGY FOR EV

1 0 0 1

Course Objectives

- To understand and analyze the various types of lithium ion batteries
- To analyze the conceptual design of lithium ion batteries for various applications
- To analyze the types of batteries used in electronics and electric vehicles

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the performance of different types of batteries and how these are different based on different applications.
2. Analyze the performance of lithium ion batteries based on their assembly.
3. Analyze the performance of batteries used in high performance Electric Vehicle.

Course Content

Introduction to Li-ion Battery -Voltage, Current, Watts, Ampere-hour, Watt-hour-Structure of a Li-ion cell, Evolution of the Li-ion cells, Li-ion cell chemistries - Electrical Cell Model- Identifying RC Value of Cell using MATLAB-SOC Estimation using the RC Value -Battery Pack Design: Identifying Number of Cells in Series and Parallel-Battery Aging -Peak Load Optimization - Importance of Mechanical Enclosure- Battery Pack Modelling: Cell Testing Methods and Techniques - Battery pack Modelling -Battery Charging Topologies -Fast Charging.

Total : 15 Hours

Reference(s)

1. Jiuchun Jiang, Caiping Zhang , “Fundamentals and Applications of Lithium-ion Batteries in Electric Drive Vehicles”, Wiley Publications 2015.
2. Junqiu Li , “Modeling and Simulation of Lithium-ion Power Battery Thermal Management”, Springer Nature Singapore,2022.
3. Thandavarayan Maiyalagan, Perumal Elumalai , “Rechargeable Lithium-Ion Batteries-Trends and Progress in Electric Vehicles”, CRC Press, 2020.
4. Gianfranco Pistoia, “ Lithium-Ion Batteries -Advances and Applications ” ,Elsevier Science,2013.
5. Tariq Muneer, Mohan Kolhe, Aisling Doyle, “Electric Vehicles: Prospects and Challenges”, Elsevier Science, 2017.

18EE0XM POWER PLANT AUTOMATION USING SCADA AND DCS 1 0 0 1

Course Objectives

- To Gain Knowledge on Industrial Automation
- To understand Concept of PLC and Applications
- To understand the Hardware design of Industrial automation Equipment.
- To Gain Knowledge on AC and DC power in automation
- To understand the basics working of Industrial robots.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. 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.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Evaluate the Working of Industrial automation equipment.
2. Analyze the Industrial automation Documents.
3. Analyze the Industrial Standard communication.
4. Apply PLC based wiring concept of panel in industries.

Course Content

Introduction to power plant automation – Major players of power automation – Components of power plant automation –Communication protocols — Basics of – DCS – SCADA – Industrial power(AC and DC) – Sensors – Vision systems – Pneumatic's –Industrial control panel and its components - Industrial safety and its equipment – Basic Program example of SCADA .

Total : 15 Hours

Reference(s)

1. Rajput R.K., "A Text book of Power plant Engineering", 5th Edition, Lakshmi Publications, 2013.
2. Vikalp Joshi, Manoj Singh Adhikari, Raju Patel, "Industrial Automation ",BPB Publications, 2019.
3. Robert Radvanovsky, Jacob Brodsky "Handbook of SCADA/Control Systems Security", CRC Press, Taylor & Francis Group,2016.
4. K. Krishnaswamy, M. Ponni Bala , "Power Plant Instrumentation", PHI Learning, 2013.
5. K.L.S. Sharma , "Overview of Industrial Process Automation", Second Edition, Elsevier Science, 2016.

18EE0XN POWER SYSTEMS DESIGN AND ANALYSIS USING ETAP **1 0 0 1**

Course Objectives

- To acquire knowledge required for planning, operation and control of power system networks through simulation
- To understand the Industrial Power networks.
- To acquire programming skills and experience in the usage of standard packages E-Tap necessary for power system analysis
- To Design and simulate power systems.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

Course Outcomes (COs)

1. Analyze the real and reactive power voltage of each bus in power systems.
2. Analyze the fault current in the power system network.
3. Selection of transformer and cable rating.
4. Design as suitable starter for electric motors.
5. Assess the stability of the power system during steady and transient operations.

Course Content

Load Flow Analysis With Supporting Hand Calculations-Cable capacity and Sizing-Transformer MVA Sizing-Short Circuit Analysis With Supporting Hand Calculations-Protection & Coordination Analysis-Arc Flash Analysis Using IEEE:1584-2002 Standard-Motor Starting Analysis- Short Circuit Study -Transient Stability Analysis -Harmonic Analysis-Ground Grid Analysis.

Total : 15 Hours

Reference(s)

1. P.Kundur,Power System Stability and Control, McGraw Hill Publishing Co, New York, 2009.
2. D P Kothari and I J Nagrath,Modern Power System Analysis, Tata McGraw Hill Publishing Co, New Delhi, 2011.
3. Hemchandra Madhusudan Shertukde, "Power Systems Analysis Illustrated with MATLAB and ETAP", CRC Press, Taylor & Francis Group,2019.
4. Mohammed Alsaaq, Power System Harmonic Analysis Using ETAP, Lap Lambert Academic Publishing GmbH KG, 2014.
5. Nasser Tleis,Power Systems Modelling and Fault Analysis, Elsevier Science,2007.

18GE0XA ETYMOLOGY 1 0 0 1

Course Objectives

- To increase vocabulary and enhance use, knowledge, and understanding of the English language.
- To stimulate an appreciation for the English language, including how it developed, how new wordsenter the language, and how it continues to be dynamic.
- To demonstrate the importance of a broad-based vocabulary for effective oral and written communication.

Programme Outcomes (POs)

j. 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.

Course Outcomes (COs)

1. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	2	-	-	-	-
2	-	-	-	-	-	-	-	-	-	2	-	-	-	-

UNIT I **7 Hours**

CONVENTIONS

Acronyms, Abbreviations, Initialises, Jargon Neologisms - Idiomatic Expressions, Euphemisms Spoonerisms Malapropisms ; Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym Apheresis - Blend word Assimilation - Colloquial language Clipped word

UNIT II **8 Hours**

WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics - Loan words Metathesis ; Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

Total: 15 Hours

Reference(s)

1. Norman, Lewis. Word Power Made Easy, Goyal Publisher. Edition 2. 2014.
2. C T Onions. The Oxford Dictionary of English Etymology, Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont, Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library. 1961.

18GE0XB GENERAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of psychology.
- Defining Psychology and the subject matter of psychology.
- To provide an awareness of various methods and branches of psychology.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large.
2. Understand the different fields of psychology and its uses.
3. Deal people effectively in their personal and social life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	2	1	-	-	-	-	-
2	-	-	-	-	-	-	-	2	2	-	-	-	-	-
3	-	-	-	-	-	-	-	2	3	-	-	-	-	-

UNIT I **15 Hours**

GENERAL PSYCOLOGY

Psychology - Introduction - Mind body relationship - Methods and Scope of Psychology -Motivation- Types of Needs- Motivational Cycle- Intelligence: Concept of Intelligence and IQ- measurement - Social psychology: individual behavior and group behavior - Group dynamics- group formation- social influence-social cognition, stereotypes- prejudice- discrimination - Definitions, formation of attitude, factors of attitude formation-change of attitude.

Total: 15 Hours

Reference(s)

1. Atkinson & Atkinson, Introduction to Psychology, 6th Ed McGraw-Hill Publications. 1975
2. Mishra, B. K, Psychology: The study of human behavior, 2nd Ed New Delhi: Prentice Hall of India Learning Pvt. Ltd. 2016.
3. Baron, R.A., Branscombe. N.R, Social Psychology, 14th Ed. New Delhi; Pearson Education. 2016
4. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, 7th Ed. New Delhi: Tata McGraw Hill. 1993.

1 0 0 1

18GE0XC NEURO BEHAVIORAL SCIENCE

Course Objectives

- To provide an introduction to the Cognitive Neuro Science of languages.
- To provide an understanding of the Cognitive processes.

Programme Outcomes (POs)

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Identify the psychological problems that will impact mental health.
2. Value ethical conduct in professional and personal life.
3. Recognize the need for rationale and evidence in decision-making.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	1	-	-	-	-	-
2	-	-	-	-	-	-	-	-	2	-	-	-	-	-
3	-	-	-	-	-	-	-	-	3	-	-	-	-	-

UNIT I **15 Hours**

NEURO BEHAVIOURAL SCIENCE

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds

Total: 15 Hours

Reference(s)

1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996
2. Horon C Philip. Sexology and Mind. Academic Press. 1993
3. Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996.

18GE0XD VISUAL MEDIA AND FILM MAKING 1 0 0 1

Course Objectives

- To acquire fundamental knowledge on development of filmmaking as an art
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	2	2	-	-	-	-	-	-	-
2	-	-	-	-	-	2	2	-	-	-	-	-	-	-

UNIT I **15 Hours**

ART OF FILMMAKING

History of Cinema (Origin and Narrative) Cinema as a visual medium -Significance of Editing Styles of Editing Editing as a methodology (Hollywood s Invisible Editing) Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production) Different types of shots and angles - Film style and Narrative (Italian Neo-realism, Avant Garde, Russain Formalism, Alternative Cinema etc.,) Regional Cinema to National Cinema Basics of Script Writing (Double and Single Column) Basics of Video Production (script to screen) Final submission of a script for five minutes short film

Total: 15 Hours

Reference(s)

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009.
2. Belavadi, Vasuki, Video Production. India: OUP, 2013.

18GE0XE YOGA FOR HUMAN EXCELLENCE 1 0 0 1

Course Objectives

- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individual consciousness
- To apply the knowledge by the way of practice and introspection

Programme Outcomes (POs)

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the historical aspects and schools of yoga
2. Ensure their physical & mental wellness through yoga practice
3. Develop the power to concentrate and have stress free mind

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	2	2	-	-	-	-	-
2	-	-	-	-	-	-	-	2	2	-	-	-	-	-
3	-	-	-	-	-	-	-	2	2	-	-	-	-	-

UNIT I **15 Hours**

YOGA FOR HUMAN EXCELLENCE

What is Yoga , History of Yoga - Yoga in todays scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar Standing Asanas - Sitting Asanas - Prone Asanas - Supine Asanas - MudrasRelaxation - Pranayama - Meditation

Total: 15 Hours

Reference(s)

1. Vethathiri Publications, Yoga Practices-2, Erode, 2012.
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009.
3. Ramesh Partani, The Complete Secret, Ru Education, 2013.
4. http://www.sarvyoga.com/
5. http://www.wikihow.com/Do-Superbrain-Yoga

18GE0XF VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Solve problems creatively in mathematics and its applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **15 Hours**

VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

Total: 15 Hours

Reference(s)

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997

18GE0XG HEALTH AND FITNESS 1 0 0 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts
2. Understand the fundamental concepts of yogic practice and physical fitness
3. To acquire the knowledge about nutrition and health consciousness

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	1	-	2	-	-	-	-	-
2	-	-	-	-	-	2	-	-	2	-	-	-	-	-
3	-	-	-	-	-	2	-	-	2	-	-	-	-	-

UNIT I **5 Hours**

FITNESS

Meaning & Definition, Need & importance of Physical fitness, Types Physical fitness - Exercise, Training and Conditioning and it is important

UNIT II **5 Hours**

YOGA AND MEDITATION

Meaning and definition; Principles of practicing;Basic Asana and it important; Pranayama and Meditation - Relaxation Techniques

UNIT III **5 Hours**

NUTRITION AND BALANCE DIET

Nutrition and Balance Diet: Needs and Important, Significant of Nutritional Food - Tips for balance diet. Common Diseases for IT professionals: Common diseases - cause prevention-First aid for common sports injuries.

Total: 15 Hours

Reference(s)

1. Anderson, Bob., Pearl, Bill.,&Burke, Edmund R., (2001). Getting in Shape Workout Programs for Men&Women. Mumbai: Jaico Publishing House
2. Baechle, Thomas. R, & Earle, Roger. W., (2000). Essentials of Strength Training and Conditioning. Champaign: Human Kinetics
3. Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers
4. Singh, Hardayal, (1995). Science of Sports training. New Delhi: D.V.S. Publications
5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited

18GE0XH CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMICOMPOSTING

1 0 0 1

Course Objectives

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact proceedures of biodegradation of unwanted solid residues

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Understand the role of recycling of garbage leading to the sustenance of our healthand environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	2	-	-	-	-	-	-	-	-
2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	2	-	-	-	-	-	-	-	-

VERMICOMPOSTING TECHNOLOGY

Ecological roles and economic importance of earthworms - need for earthworm culture, scope and importance of vermiculture , limiting factors - types of worm culturing and the relative benefits Small scale and commercial methods: process & advantages , Vermicomposting equipments, devices, Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle), vermicastings in organic farming/horticulture - Marketing the products of vermiculture quality control, market research, marketing techniques , Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives Artificial Earthworm as a standalone biodegradation assembly.

Total: 15 Hours

Reference(s)

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.4
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
3. www.organicgrowingwithworms.com.au
4. New York Times , Scientists Hope to Cultivate and Immune System for Crops

18GE0XI BLOG WRITING **1 0 0 1**

Course Objectives

- To sharpen and improve writing skills, including draft writing, voice, and format.
- To develop general and global knowledge.
- To experiment with non-written forms of online communications, including images, audio and video.
- To be able to add content to your website without the assistance of a web designer.

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
j. 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.

Course Outcomes (COs)

1. Understand the flow of language in natural manner.
2. Understand the elements of a blog and be able to use them effectively.
3. Find a niche for a long-term blog.
4. Gain insight into the strategies, methods and writing of successful bloggers.
5. Develop their creative thinking.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
2	-	-	-	-	-	-	-	-	-	1	-	-	-	-
3	-	-	-	-	-	2	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	2	-	-	-	-	-	-	-
5	-	-	-	-	-	-	2	-	-	-	-	-	-	-

UNIT I **7 Hours**

Concept: What is blog writing? Types of blog posts -personal experience, opinion, reviews, advice, news/updates. Focusing your blog - concept, audience, uniqueness, posts. Company blogs. Structure: Types of structure - inverted pyramid, feature article, list, story, other options. Creating effective openings. Planning a post.

UNIT II **8 Hours**

Voice: Defining and achieving voice. Exploring various voices. Stylistic tipsÃƒÂ¢??rhythm, verbs, interesting words, senses, emphasis. Smartness and sarcasm. Reliability - accuracy, provability, specificity. Transparency about payments. Sample Blogs and Activities

Total: 15 Hours

Reference(s)

1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Leccese and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9. $29.95 paperback.
2. Blogging Heroes, by Michael Banks. Choose 15 of the 30 interviews/profile segments to read, be sure to include the segments on Chris Anderson and Brian Lam.
3. Complete Guide to Blogging, Huffinghton Post.

18GE0XJ INTERPERSONAL SKILLS 1 0 0 1

Course Objectives

- To communicate and work effectively, both individually and in groups
- To be able to understand and manage ones own and others emotions
- To define and solve problems by making decisions about the best course of action

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Express themselves clearly and confidently
2. Listen to others completely and with empathy
3. Assert an opinion without diminishing others opinion
4. Be responsible and timely with a willingness to collaborate
5. Develop innate personality traits to handle certain social situations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	2	-	2	-	-	-	-	-
2	-	-	-	-	-	-	2	-	2	-	-	-	-	-
3	-	-	-	-	-	-	2	-	2	-	-	-	-	-
4	-	-	-	-	-	-	2	-	2	-	-	-	-	-
5	-	-	-	-	-	-	2	-	2	-	-	-	-	-

UNIT I **7 Hours**

INTRODUCTION

Conversational Skills - Active Listening - Team working Empathy - Emotional Intelligence

UNIT II **8 Hours**

SKILLS

Conflict Resolution and Mediation skills - Decision making and Problem Solving - Negotiation and Persuasion skills

Total: 15 Hours

Reference(s)

1. Stephen P. Robbins, Phillip L. Hunsaker, Training in Interpersonal Skills, Pearson, 2015
2. Robert B. Cialdini, Influence: The Psychology of Persuasion, Harper Business; Revised Edition, 2006
3. Suzanne C De Janasz, Karen O Dowo & Beth Z Schneder, Interpersonal Skills in Organisations, McGraw-Hill Education; 5th Edition, 2014

18GE0XK COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

1 0 0 1

Course Objectives

- Understand the role of National Service Scheme in community
- Identify the needs and problems of the community and involve in problem solving
- Develop competence required for group living and acquire leadership qualities

Programme Outcomes (POs)

Course Outcomes (COs)

1. understand the community in which they work and render their service
2. develop among themselves a sense of social and civic responsibility

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT I **15 Hours**

COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

Introduction and Basic Concepts of NSS: History-philosophy-aims & objectives of NSS- Emblem, flag, motto, song, badge- Organizational structureroles and responsibilities functionaries. NSS Programmes and Activities: Concept of regular activities, special camping, DayCamps-Basisofadoption of village/slums-Methodology of conducting Survey -Financial pattern ofthescheme -Coordination withdifferent agencies-Maintenance oftheDiary. Community Mobilization: Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community-Identifying methods of mobilization-Youth-adult partnership.Health, Hygiene & Sanitation: Definition, needs and scope of health education- Food and Nutrition - Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan). Entrepreneurship Development: Definition & Meaning - Qualities of good entrepreneur - Steps/ways in opening an enterprise -Role of financial and support service Institutions.

Total: 15 Hours

Reference(s)

1. A Hand book on National Service Scheme, Anna University, Chennai, 2012
2. http://nss.nic.in/intro.asp
3. Delgado-Gaitn and Concha, The Power of Community: Mobilizing for Family and SchoolingNew York: Rowman & Littlefield Publishing, Inc. 2001
4. James Bailey,Guide to Hygiene and Sanitation in Aviation, World health organization, 2nd edition. 1980
5. AnuradhaBasu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009

18GE0XL NATIONAL CADET CORPS 1 0 0 1

Course Objectives

- To understand the importance of NCC and its organization.
- To realize the skills in the applications of drill and weapon training.
- To analyze the factors in National unity
- To identify the utility of smart materials in engineering applications.

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Recall the motto and aim of NCC.
2. Implement synergy in disaster management.
3. Execute an example patriotic leader to serve nation

ii. Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	2	-	2	-	-	-	-	-
2	-	-	-	-	-	-	1	-	2	-	-	-	-	-
3	-	-	-	-	-	-	1	-	2	-	-	-	-	-

UNIT I **12 Hours**

NCC STRUCTURE AND TRAINING

NCC ORGANIZATION
National Cadet Corps: Aim and Objectives - Administrative and Organizational pattern - NCC flag and NCC song - Duties, Responsibilities and Conduct by NCC Cadets - Badges of ranks in NCC and Armed forces- Types of NCC camps - Eligibility conditions for writing B and C certificate examinations. Cadet welfare society and Career opportunities for NCC cadets.
DRILL AND WEAPON TRAINING
Drill: Aims of drill - Types of drill - Foot drill, Arms drill and Ceremonial drill. Word of commands, Guard of honour. Weapon training - Rifles used in NCC: Parts and Characteristics of 0.22 and INSAS - Stripping, Assembling and Cleaning of weapons.
NATIONAL INTEGRATION AND SOCIAL AWARENESS
National Integration: Introduction - Constitution of India- Importance and Necessity - Factors affecting National integration - Role of NCC in National integration. Social service and its need - Rural development programs - NGOs role and Contribution - Social Security schemes.

UNIT II **8 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

PERSONALITY DEVELOPMENT AND LEADERSHIP

Personality Development: Introduction - Factor influences in personality development. Leadership: Leadership traits and Skills - Indicator of good leader - Honour code concept - Type of leaders - Case studies of effective leader.

DISASTER MANAGEMENT AND FIRST AID

Disaster types - Natural and Manmade disasters. Role of NCC cadets in disaster management. Civil defence: Civil defence measures - Civil defence services. First aid: First aid kits and Equipments - First aid for snake bite, Sun stroke and Drowning - Respiration -Types of respiration.

Total: 20 Hours

Reference(s)

1. Cadets Hand book Common subject, DG NCC, New Delhi.
2. Cadets Hand book Special subject, DG NCC, New Delhi
3. Misra R.C and Sanjaykumar Mishra, A HAND BOOK OF NCC(English), Kanti Prakashan, 2016
4. Gupta R. K, NCC: Handbook of NCC Cadets for A, B and C Certificate Examinations (English) RPH Editorial Board, 2018.

18GE0XM NEW AGE INNOVATION AND ENTREPRENEURSHIP

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task of setting independent business units and on the various facets of running a business
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

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

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understanding entrepreneurship as an important career option
2. Concept and methodology of idea translation to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women
4. Overview of Indian trends in the start-up scene

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	2	-	-	2	-	-	-	-	-
2	-	-	-	-	-	2	-	-	2	-	-	-	-	-
3	-	-	-	-	-	2	-	-	2	-	-	-	-	-
4	-	-	-	-	-	2	-	-	2	-	-	-	-	-

UNIT I **15 Hours**

NEW AGE INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification ideation -MVPPositioning as an Entrepreneur Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business PlanMentoring Session with Investors- Legal and Ethical Foundation for Startup. Types of startups and licensing systems - MSME -Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for New Venture Growth - Talent Acquisition and Management for New Ventures - Valuation Challenge in Entrepreneurship - Intrapreneurship Sustainability - Exit strategies and Start-up trends in India.

Total: 15 Hours

Reference(s)

1. Kathleen R. Allen, Launching New Ventures, South-WesternCengage Learning, 6th Edition, 2012
2. Alex Osterwalder and Yves Pigneur, Business Model Generation, publishedby the authors, 2010
3. Branson. R. Business stripped bare, New York, Penguin books, 2011
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3 edition, Mason, Oh; CENGAGE/SOUTH WESTERN publisher, 2011.

18GE0XN DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task disruption led innovations.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing creativity based disruption strategy

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Course Outcomes (COs)

1. Understanding contemporary entrepreneurship as an important career option
2. Concept and methodology of creative disruption to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women with disruptive technology option
4. Overview of Indian trends with reference to disruptive innovation based start-ups

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	2	2	-	-	-	-	-	-
2	-	-	-	-	-	-	2	2	-	-	-	-	-	-
3	-	-	-	-	-	-	2	2	-	-	-	-	-	-
4	-	-	-	-	-	-	2	2	-	-	-	-	-	-

UNIT I **15 Hours**

DISRUPTIVE INNOVATION

Creativity linked innovation- Differences between Disruptive & incremental Innovations - Historical, theoretical, and practical evolution of disruptive innovation (DI). - Idea generation & communication of creativity leading to DI. Innovation management concepts in DI based entrepreneur generation - How do firms bring in new business models and get new products and services to the market? Investor preferences in core versus new or disruptive business models - disruptors and the disrupted frameworks for assessing company"s capabilities and rethinking product, market and strategy - Right customers for DI: strategy in a world that is changing so rapidly -Application of disruptive theories to complex problems and opportunities.

Total: 15 Hours

Reference(s)

1. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-5885.2005.00177.x
2. http://www.brinq.com/workshop/archives/2005/01/08/what-is-disruptive-innovation
3. https://hbr.org/2006/12/disruptive-innovation-for-social-change

18GE0XO SOCIAL PSYCHOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of social psychology.
- Defining psychological & physical changes during puberty age.
- To provide an awareness of various psychological problems and social problems.
- To explain social and work psychology of people and the need for mental health.

Programme Outcomes (POs)

f. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large
2. Understand the various psychological, physical, social problems and management skills.
3. Deal people effectively in their personal and social life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	2	2	-	1	-	-	-	-	-
2	-	-	-	-	-	1	2	-	1	-	-	-	-	-
3	-	-	-	-	-	2	2	-	3	-	-	-	-	-

UNIT I **7 Hours**

INTRODUCTION

Introduction - Ice breaker - Time Line - Tasks and Challenges of the age(Erik Erikson)Physical changes - Introduction to Reproductive Health - Reproductive Organs - Menstruation - Changes during Puberty - Abortions - Contraception - Difference between Sex and Gender - Introduction to the origins of Patriarchy - Gender.

UNIT II **8 Hours**

PSYCHOLOGY

Developmental changes - Attraction - Friendship - Differences and Similarities - Images of Beauty and Body Image -Introduction to Media-Feedback - Sexuality - Boundaries Relationships - Marriage - Love - Emotional Health - Sexual Abuse and Safety - Role of Media - Abortions, Contraception, Wrapping up the Course.

Total: 15 Hours

Reference(s)

1. Baron, R. A.,Branscombe.N.R.(2016).Social Psychology,14th Ed. New Delhi;Pearson Education
2. Morgan,C.T., King,R.A.,Weisz,J.R.,&Schopler,J.(1993). Introduction to Psychology,7th Ed.New Dehi:Tata McGraw Hill.

18GE0XP FM RADIO BROADCASTING TECHNOLOGY

1 0 0 1

Course Objectives

- The course focuses on community radio technology and various program productions techniques for FM Radio Broadcasting.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

Course Outcomes (COs)

1. Understand the hardware required for field recording and setting up a studio and carry out studio and field recording.
2. Examine the available options for telephony interfaces for radio.
3. Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3	2	-	-	-	-	-	-	-	-	-	-	-
2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
3	2	2	2	-	-	-	-	-	-	-	-	-	-	-

UNIT I **3 Hours**

INTRODUCTION TO AM/ FM RADIO

History of Radio-Types of Radio and its Reach- Entertainment Radio- Community Radio- Internet Radio-Satellite Radio. Evolution of Community Radio (CR) in India- principles behind setting up of FM/CR-policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

UNIT II **3 Hours**

STUDIO TECHNOLOGY

Use of Microphones-Console handling-OB Recordings & Live Shows-Properties and components of sound-difference between analogue and digital audio-hardware required for field recording and setting up a studio-fundamental principles for setting up an audio studio.

UNIT III **3 Hours**

AUDIO PRODUCTION

Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production-telephony interfaces for radio- audio Post Production. Voice Culture Exercise- Radio Production Techniques & Tools.

UNIT IV **3 Hours**

STUDIO OPERATIONS

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

UNIT V **3 Hours**

RADIO TRANSMISSION TECHNOLOGY

Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable-propagation and coverage of RF signals-FM transmitter setup- Radio audience -measurements systems.

Total: 15 Hours

Reference(s)

1. UNESCO (2001). Community Radio Handbook.
2. Vinod Pavarala, Kanchan K Malik, Other Voices: The Struggle for Community Radio in India, SAGE Publications India, 2007.
3. Steve Buckley, Mark Raboy, Toby Mendel, Kreszentia Duer, Monroe E. Price, Sean O Siochru, Broadcasting, Voice, and Accountability: A Public Interest Approach to Policy, Law, and Regulation, University of Michigan Press, 2008.
4. www.floridasound.com
5. www.mediacollege.com
6. www.mediacollege.com

18EEV01– ORCAD

Course Objectives

- To apply the concepts of s i m u l a t i o n t o o l to design and develop various converter topologies and customize engineering user interfaces for industrial system design using ORCAD.

ProgrammeOutcomes (POs)

a. An ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex Electrical and Electronics engineering problem.
b. An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics,natural sciences and engineering sciences.
c. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.
n. Apply **technology** to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society.

CourseOutcomes (COs)

- To develop a model of Electronic appliances using ORCAD software in the area of Electronics and Embedded systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	2	-	-	-	-	-	-	-	1	1

UNIT I
ORCAD

Introduction about Orcad software-Scope of PCB Designing-Market &Job Prospects of PCB Designing-Software Description about Orcad software-Introduction on Design circuit of Orcad PCB software-ARES(Proteus-7 Professional)-Examples based basic electronics circuit Schematic creation-Understanding schematics and symbols-Searching components footprints and symbols-Choosing the right components-SchematicLayout of Half wave rectifier-Editing symbol libraries-Board creation-Manual routing-Go through the SchematicLayout of Half wave rectifier-Component-placing-Practice via manual routing and auto routing on PCB-Design verification-3D image output verification-Go through the SchematicLayout of Full wave rectifier-Component-placing-Practice via manual routing and auto routing on PCB-Design verification-3D image output verification-Go through the SchematicLayout of Bridge rectifier-

Component-placing-Practice via manual routing and auto routing on PCB-Design verification-3D image output verification-Exercise & practice on SchematicLayout of ac to dc (7805) power supply-Component mounting-Practice via all routing techniques on PCB-3D image output verification-Exercise & practice on SchematicLayout of ac to dc (7812) power supply-Component mounting-Practice via all routing techniques on PCB-3D image output verification-Exercise & practice on SchematicLayout of ac to dc (7805 &7812) power supply with one board-Component mounting-Practice via all routing techniques on PCB-3D image output verification-Continuity test and proper installation-output analysis.

TOTAL : 30 Hours

Reference(s)

1. PSpice Simulation of Power Electronics Circuits: An Introductory Guide by E. Ramshaw, D.C. Schuurman
2. SPICE for Power Electronics and Electric Power by Muhammad H. Rashid.
3. https://www.orcad.com/resources/library
4. https://www.seas.upenn.edu/~jan/spice/PSpice_ReferenceguideOrCAD.pdf
5. https://www.ecadtools.com.au/documents/PSpice%2017.2%20Advanced%20Analysis%20User%20Guide%20(pspaugca).pdf

18EEV02 - HANDS ON TRAINING ON DESIGN OF CONTROLLERS OF POWER CONVERTER

Course Objectives

- To apply the concepts of Power Converters to develop and design converter topologies and customize engineering user interfaces for industrial system design using TI WEBENCH online simulation tool

Programme Outcomes (POs)

a. An ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex Electrical and Electronics engineering problem.
b. An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Design, **analyze**, and evaluate the performance of Electrical & Electronics systems usingcontemporary tools to provide effective solutions for real-world problems

Course Outcomes (COs)

- Apply the power converter design for industrial and controller applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	2	-	-	-	-	-	-	-	1	-

Introduction to Power Converters – Types, Power converters for renewable energy and industrial applications, design of controllers for different power converter topologies using WEBENCH TI-Simulation tool, Optimized design for foot print and efficiency, generate schematic and electrical analysis, generate layout and thermal analysis, Preparation of Bill of Materials (BOM) and Project reports

TOTAL : 30 Hours

Reference(s)

1. http://www.ti.com/design-resources/design-tools-simulation/webench-power-designer.html
2. https://webench.ti.com/power-designer/switching-regulator/select

18EEV03 IOT BASED SYSTEM DESIGN

Course Objectives

- To Understand the IoT concept and its impact
- To recognize various tools and platforms for implementing IoT.
- To Learn how to use Hardware's to perform varying and complex tasks.
- To understand advanced and emerging technologies.
- Develop skills to design and develop applications in different aspects.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

n.Apply technology to make a significant contribution in terms of Electrical Engineering Innovations and ethically supporting the sustainable development of the society

Course Outcomes (COs)

1.Explain the building blocks of Internet of Things and characteristics.
2.Assess the IoT architecture and protocols for designing an IoT environment.
3.Use the hardware and software platforms for IoT and develop an IoT product.
4.Analyze the role and implementation of microcontrollers in IoT.
5.Apply the state of art IoT based systems, suitable for real life and Industry applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	-	2	-	-	-	-	-	-	-	2	-
2	2	2	3	2	2	-	-	-	-	-	-	-	3	-
3	2		3	2	2	-	-	-	-	-	-	-	2	1
4	2	2	3	2		-	-	-	-	-	-	-	1	2
5	2	2	3	-	2	-	-	-	-	-	-	-	2	-

UNIT I **6 Hours**

INTRODUCTION TO IOT

Evolution of Internet of Things – Enabling Technologies – IoT Architectures, Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects - IoT Challenges and Issues

Activity: Identifying problem statement – Customer and Market Survey – Product Design approach

UNIT II **6 Hours**

IOT ARCHITECTURE AND COMPONENTS IN INTERNET OF THINGS

IoT Architecture: Node, Gateway, Network infrastructure and Cloud server – Components of IoT:Control Unit,Communication modules Bluetooth ZigbeeWifi GPS- IoT Protocols (IPv6, 6LoWPAN, RPL, CoAP), MQTT, Wired Communication

Activity: IoT Product Vision and Mission – Identifying target customer for an IoT product – Leancanvas

UNIT III **6 Hours**

IOT DEVELOPMENT HARDWARES AND TECHNOLOGIES BEHIND IOT

IoT Hardware Considerations – IoT programming Considerations – Open source hardware platforms, designing of Proprietary Hardware – IoT Cloud services – Four pillars of IoT paradigm,RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition), M2M - IOT Enabling Technologies - Embedded Systems

Activity: Developing working model of IoT product

UNIT IV **6 Hours**

PROGRAMMING THE MICROCONTROLLER FOR IOT

Working principles of sensors IoT deployment for Raspberry Pi /Arduino /Equivalent plat- form Reading from Sensors, Communication: Connecting microcontroller with mobile devices,communication through Bluetooth, wifi and USB

Activity: Demonstration of IoT product – Results and discussion

UNIT V **6 Hours**

IOT APPLICATIONS

Smart Farming: Weather monitoring, precision farming, Smart Greenhouse, Drones for pesticides, Energy Consumption Monitoring, Smart Energy Meters, Home automation, Smart Grid and Solar Energy Harvesting, Intelligent Parking

Total:30 Hours

Reference(s)

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.
2. CunoPfister, "Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to theCloud (Make: Projects)", Maker Media, 1st edition 2011
3. Vijay Madisetti and ArshdeepBahga, Internet of Things (A Hands-on-Approach), 1stEdition, VPT, 2014.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , The Internet of Things Key applications and Protocols, Wiley, 2012.
5. Designing the Internet of Things (Nov 2013) by Adrian McEwen & Hakim Cassimally.

18EEV04- ELECTRONIC CIRCUIT DESIGN

Course Objectives

- To understand the basic concepts and design in electronic circuits
- To design and analyze the circuits in Proteus and MULTISIM software
- To design the Printed Circuit Board for electronic circuits

Program Outcomes(POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

e.Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

m. Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems

Course Outcomes(COs)

1. Understand the basic electronic principles and simulate the circuits to build Printed Circuit Board using PROTEUS software
2. Build a schematic and evaluate circuit performance through interactive simulation using MULTISIM software

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	-	3	-	-	-	-	-	-	-	3	-
2	2	-	-	-	3	-	-	-	-	-	-	-	3	-

UNIT I

Electronics and Proteus **15 Hours**

Introduction to Electronic Components and Proteus Software - Basic Electrical Measuring Instruments (Analog & Digital) - Passive Components - Switches - Active Components - Semiconductor Diode - Zener diode - Power Supply (Converters) - Un Regulated Power Supply - Regulated Power Supply - Transistors - PNP Transistor & NPN Transistor - MOSFET - Industrial/Power Electronics - UJT - TRIAC - Circuit Ideas / Projects/R & D Technique - Communication Circuits - Timer Circuit - AC To DC Interfacing Circuits - Sensing Circuits Interconnection Techniques - SMD Technique - PCB Designing by Using Proteus Software

UNIT II

Multisim **10 Hours**

Introduction to MULTISIM: Toolbars and Components - Basic circuit laws simulation: Ohm's law, Kirchoff's laws, Voltage division, Current division - Diode circuits simulation: V-I characteristics of diode, Rectifier, clipper and clamper - Operational Amplifier circuits simulation: Introduction, Inverting Op-amp, Non-Inverting Op-amp, Differential Op-amp and Summing Op-amp - Digital logic circuits

Simulation: Logic gates and verification, Logic converter- Adders and subtractors - Multiplexers - Seven segment display- flip flops - 60 seconds stopwatch circuit.

Macro and Mini Projects **5 Hours**

Total:30 Hours

References:

1. Lambert M. Surhone, Miriam T. Timpledon, Susan F. Marseken, "PROTEUS (Design Software), VDM Publishing, 14-Jul-2010.
2. David Baez-Lopez, Felix Guerrero-Castro, "Circuit Analysis with Multisim", 2011.
3. Marc E. Herniter,"Schematic Capture with Multisim 7", 2004.
4. John Hackworth , "Digital Circuit Analysis with Multisim", 2018.
5. James W. Nilsson, Susan Riedel , "Introduction to Multisim for Electric Circuits, 2014.
6. https://www.theengineeringprojects.com/2013/03/a-complete-tutorial-on-how-to-use-proteus-isis-ares.html
7. https://labcenter.s3.amazonaws.com/downloads/Tutorials.pdf
8. https://www.circuitstoday.com/proteus-software-introduction

18EEV05 COMPUTER AIDED DESIGN AND ANALYSIS OF ELECTRICAL SYSTEM

Course Objectives

- To design the layout of Electrical power systems.
- To evaluate the various power system parameters.

Programme Outcomes (POs)

c.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.
d.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.
e.Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcomes (COs)

1. Design the layout of the electrical power system using E-CAD
2. Evaluate the electrical parameters of the power system using power world simulator

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	3	2	3	-	-	-	-	-	-	-	3	-
2	-	-	3	3	3	-	-	-	-	-	-	-	3	-

UNIT 1 **13 hours**

LAYOUT USING E-CAD

Basic design considerations – Electrical layout of power system single line diagram - distribution substation of 11kV and 66kV - multiple bus bar schemes - substation with protective devices and safety measures - wiring scheme in residential building –Industrial layout design-using E-CAD.

UNIT 2 **12 hours**

POWER SYSTEM PLANNING

Power system evaluation studies – Load flow analysis – Short circuit analysis – Power factor improvement – Contingency analysis – Congestion management – using Power world simulator

MACRO AND MINI PROJECT **5 hours**

Total : 30 Hours

Reference(s)

1. Hadi Saadat, Power System Analysis, PSA Publishers, New Delhi, 2013.
2. P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, Electrical Power Systems Analysis, Security and Deregulation, PHI Learning Private Limited, New Delhi, 2012.
3. I.J.Nagrath, D.P.Kothari, Power System Engineering, Tata McGraw Hill Ltd, New Delhi, 2017.
4. J.Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, Power System Analysis and Design, Cengage Learning India Private Limited, 2012.
5. Sham Tickoo, AutoCAD Electrical 2020: A Tutorial Approach, Cadcim Technologies, USA, 2020.
6. Gaurav Verma, Matt Weber, AutoCAD Electrical 2018 Black Book, BPB Publications, 2018.

18EEV06 DESIGN OF POWER CONVERTERS FOR ELECTRICAL MACHINES

Course Objective

- To design and analyse the performance characteristics of Rectifier using PSIM Software
- To design and analyse the characteristics of Choppers and regulators using PSIM Software
- To design and develop the inverter topology and its control techniques
- To design and analyse the electrical machines using Maxwell Software
- To analyse the Inverters and Controllers using MATLAB

Program Outcomes(POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyze electrical engineering problems forreaching substantiated conclusions using principles of Electric Circuits, Electronic Devices, Electrical Machines, and Power systems

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m.Design, analyze, and evaluate the performance of Electrical & Electronics systems using contemporary tools to provide effective solutions for real-world problems.

Course Outcome(COs)

- Analyse the rectifier circuits through simulation tool using PSIM
- Analyse the performance of Chopper and regulator converters using PSIM
- Analyse and evaluate the performance of Inverter using PSIM
- Design and analyse the performance of Electrical machines using Maxwell
- Design a power converter for rectification and inversion process using MATLAB.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	3	-	-	-	-	-	-	-	3	-
2	3	3	-	-	3	-	-	-	-	-	-	-	3	-

UNIT I
DESIGN OF RECTIFIERS USING PSIM

5 Hours

Diode Bridge Rectifier with and without Capacitor Filter – Single phase full converter with RL load – Three Phase Full Converter with RL load – Input current Harmonic Analysis for Rectifiers – SemiConverter with RL load – Source Inductor Effect in Three phase full converter

UNIT II
DESIGN OF CHOPPERS AND VOLTAGE REGULATORS USING PSIM

5 Hours

Pulse Generation using Comparator - Buck Converter – Boost Converter – Buck Boost Converter– Forward Converter for Battery Charging Circuit- Single phase AC to AC converter with R load – Three Phase converter with R load – Load Angle for RL load – Single phase converter with RL load

UNIT III
DESIGN OF INVERTERS USING PSIM

5 Hours

Single phase square wave Inverter – Sine Pulse width Modulation Techniques – Single phase SPWM Inverter – Three Phase SPWM Inverter – Three phase Induction Motor speed control - PID Controllers - Closed loop voltage control of Boost Converter - Closed Loop control of PWM rectifiers

UNIT IV

DESIGN OF ELECTRICAL MACHINES USING ANSYS MAXWELL SOFTWARE

5 Hours

Design of primary winding, secondary winding and transformer core - Design of stator and rotor of three phase induction motor and performance analysis - Design of stator and rotor of permanent magnet generators and performance analysis

UNIT V

DESIGN OF POWER CONVERTERS AND INVERTERS FOR ELECTRIC VEHICLE APPLICATIONS

5 Hours

Uncontrolled rectifiers-half wave rectifier-full wave rectifier, Controlled rectifiers-half wave rectifier-full wave rectifier, Analysis of inverters-single phase voltage source inverter-three phase voltage source inverter-current source inverter-z source inverters.

Reference(s) **TOTAL : 30 Hours**

1. Stanisław Szabłowski, Teaching Power Electronics: Simulation Studies using PSIM Software,New Delhi 2019.
2. Design of rotating Electrical Machines,Juha Pyrho¨ nen, Tapani Jokinen and ValeriaHrabovcova´© 2008 John Wiley & Sons, Ltd. ISBN: 978-0-470-69516-6
3. Power Electronics with MATLAB by L. Ashok Kumar, A. Kalaiarasi, Y. Uma Maheswari, Cambridge University Press,2017.
4. Practical Electrical Engineering by Makarov, Sergey, Ludwig, Reinhold, Bitar, Stephen J,Springer International Publishing, 2019.
5. MATLAB for Electrical Engineers and Technologists: MATLAB Tutorial with Practical Electrical Examples by Stephen Philip Tubbs, Stephen P. Tubbs, 2010.