SRI VENKATESWARA COLLEGE OF ENGINEERING

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Pennalur, Sriperumbudur – 602117

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATION 2018

CHOICE BASED CREDIT SYSTEM

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM AND SYLLABI

(I-VIII SEMESTERS)

SRI VENKATESWARA COLLEGE OF ENGINEERING, SRIPERUMBUDUR TK - 602 117
(An Autonomous Institution, Affiliated to Anna University, Chennai)
REGULATION – 2018 B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
Choice Based Credit System I-VIII Semesters CURRICULUM
SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C	Prerequisites	Fixed/ Movable
THEORY										
1.	HS18151	Communicative English (Common to all branches)	HS	3	3	0	0	3	NIL	F
2.	MA18151	Engineering Mathematics - I (Common to all branches except MR)	BS	4	3	1	0	4	NIL	F
3.	PH18151	Engineering Physics (Common to all branches)	BS	3	3	0	0	3	NIL	F
4.	CY18151	Engineering Chemistry (Common to all branches except MR)	BS	3	3	0	0	3	NIL	F
5.	IT18101	Programming for Problem Solving (Common to all branches except MR)	ES	3	3	0	0	3	NIL	F
6.	CM18151	Basic Civil and Mechanical Engineering(Common to BT, CH and EE)	ES	3	3	0	0	3	NIL	F
PRACTICAL										
7	IT18111	Programming for Problem Solving Laboratory (Common to all branches except MR)	ES	3	0	0	3	1.5	NIL	F
8	GE18161	Engineering Practices Laboratory (Common to all branches)	ES	3	0	0	3	1.5	NIL	F
TOTAL				**25**	**18**	**1**	**6**	**22**	-	-

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C	Prerequisites	Fixed/ Movable
THEORY										
1.	HS18251	Technical English(Common to all branches)	HS	3	3	0	0	3	NIL	F
2.	MA18251	Engineering Mathematics - II (Common to all branches except MR)	BS	4	3	1	0	4	NIL	F
3.	PH18252	Physics of Materials(Common to BT, EE and EC)	BS	3	3	0	0	3	NIL	F
4.	GE18151	Engineering Drawing (Common to all branches)	ES	5	3	0	2	4	NIL	F
5.	GE18251	Environmental Science and Engineering (Common to all branches)	BS	3	3	0	0	3	NIL	F
6.	EE18201	Electric Circuit Analysis	PC	4	3	1	0	4	NIL	F
PRACTICAL										
7.	PC18161	Physics and Chemistry Laboratory (Common to all branches)	BS	2	0	0	2	1	NIL	F
8.	EE18211	Electric Circuits Laboratory	PC	3	0	0	3	1.5	NIL	F
TOTAL				**27**	**18**	**2**	**7**	**23.5**		

SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C	Prerequisites	F/M
THEORY										
1.	MA18351	Engineering Mathematics – III (Common to BT, CH, CE, EE, EC and ME)	BS	4	3	1	0	4	NIL	F
2.	EE18301	Electron Devices and Circuits	PC	3	3	0	0	3	NIL	F
3.	EE18302	Electromagnetic Theory	PC	3	3	0	0	3	NIL	F
4.	EE18303	Electrical Machines – I	PC	4	3	1	0	4	EE18201	F
5.	EE18304	Control Systems	PC	4	3	1	0	4	NIL	F
PRACTICAL										
6.	EE18311	Electrical Machines - I Laboratory	PC	3	0	0	3	1.5	NIL	F
7.	EE18312	Measurements and Instrumentation Laboratory	PC	3	0	0	3	1.5	NIL	F
8.	HS18361	Communication and Soft Skills Laboratory	HS	3	0	0	3	2	NIL	F
TOTAL				**27**	**15**	**3**	**9**	**23**	-	-

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C	Prerequisites	F/M
THEORY										
1.	MA18451	Computational Methods (Common to CH,CE,EE,MR and ME)	BS	3	3	0	0	3	NIL	F
2.	EE18401	Electric Power System	PC	3	3	0	0	3	NIL	F
3.	EE18402	Digital Logic Circuits	PC	3	3	0	0	3	NIL	F
4.	EE18403	Electrical Machines - II	PC	4	3	1	0	4	EE18303	F
5.	EE18404	Analog Electronics	PC	3	3	0	0	3	EE18301	F
PRACTICAL										
6.	EE18411	Electrical Machines - II Laboratory	PC	3	0	0	3	1.5	NIL	F
7.	EE18412	Electronics Circuits Laboratory	PC	3	0	0	3	1.5	NIL	F
8.	EE18413	Control System Laboratory	PC	3	0	0	3	1.5	NIL	F
TOTAL				**25**	**15**	**1**	**9**	**20.5**	-	-

SEMESTER V

S.No.	COURSE CODE	Course Title	Category	Contact Periods	L	T	P	C	Prerequisites	F/M
THEORY										
1.	EE18501	Power System Analysis	PC	4	3	1	0	4	EE18401, E18403	F
2.	EE18502	Power Electronics	PC	4	3	1	0	4	NIL	F
3.	EE18503	Microprocessors and Microcontrollers	PC	3	3	0	0	3	EE18402	F
4.	CS18551	Programming and Data Structures	PC	3	3	0	0	3	NIL	F
5.	EE18505	Digital Signal Processing	PC	3	3	0	0	3	NIL	F
6.	*******	Professional Elective I	PE	3	3	0	0	3	NIL	M
PRACTICAL										
7.	EE18511	Power Electronics Laboratory	PC	3	0	0	3	1.5	NIL	F
8.	EE18512	Microprocessors and Microcontrollers Laboratory	PC	3	0	0	3	1.5	NIL	F
9.	CS18561	Programming and Data Structures Laboratory	PC	3	0	0	3	1.5	NIL	F
TOTAL				**29**	**18**	**2**	**9**	**24.5**	**-**	**-**

SEMESTER VI

S.No.	Course code	Course title	Category	Contact Periods	L	T	P	C	Prerequisites	F/M
THEORY										
1.	EE18601	Power System Operation and Control	PC	3	3	0	0	3	EE18403, EE18501	F
2.	EE18602	Electrical Drives	PC	4	3	1	0	4	EE18403, EE18502	F
3.	CS18403	Computer Networks (Common to CS and EE)	PC	3	3	0	0	3	NIL	F
4.	EE18603	Industrial Automation and Networking	PC	4	3	1	0	4	NIL	F
5.	*******	Professional Elective II	PE	3	3	0	0	3	NIL	M
6.	*******	Open Elective - I	OE	3	3	0	0	3	NIL	M
PRACTICAL										
7.	EE18611	Power System Simulation Laboratory	PC	3	0	0	3	1.5	NIL	F
8.	EE18612	Industrial Automation Laboratory	PC	3	0	0	3	1.5	NIL	F
TOTAL				**26**	**18**	**2**	**6**	**23**	-	-

SEMESTER VII

S.No.	Course code	Course title	Category	Contact Periods	L	T	P	C	Prerequisites	F/M
THEORY										
1.	GE18551	Principles of Management (Common to EC,AE,BT,EE and ME)	PC	3	3	0	0	3	NIL	F
2.	EE18701	Protection and Switch gear	PC	3	3	0	0	3	NIL	F
3.	EE18702	VLSI and Embedded Systems	PC	4	3	1	0	4	EE18503	F
4.	EE18703	Electric Vehicles	PC	4	3	1	0	4	NIL	F
5.	EE18704	Wind and Solar Energy Systems	PC	3	3	0	0	3	NIL	F
6	*******	Open Elective – II	OE	3	3	0	0	3	NIL	M
PRACTICAL										
7.	EE18711	Project Work I	EEC	6	0	0	6	3	NIL	F
8.	EE18712	Advanced Electrical Engineering Laboratory	PC	3	0	0	3	1.5	NIL	F
TOTAL				**29**	**18**	**2**	**9**	**24.5**	-	-

SEMESTER VIII

S.No.	Course code	Course title	Category	Contact Periods	L	T	P	C	Prerequisites	F/M
THEORY										
1.	*******	Professional Elective III	PE	3	3	0	0	3	NIL	M
2	*******	Professional Elective IV	PE	3	3	0	0	3	NIL	M
3	*******	Professional Elective V	PE	3	3	0	0	3	NIL	M
PRACTICAL										
4.	EE18811	Project Work II	EEC	20	0	0	20	10	NIL	F
TOTAL				**29**	**9**	**0**	**20**	**19**	-	-

Total Credits: 180

INTERNSHIP/TRAINING (MANDATORY) #

No. of Weeks	Credits
2	1
4	2

#Students should complete Internship/Training before 6th semester and must earn at least 1 credit.

PROFESSIONAL ELECTIVES (PE)

S.NO.	COURSE CODE	COURSE TITLE
PROFESSIONAL ELECTIVES (OFFERED IN ODD SEMESTER)		
1	EE18001	Biomedical Engineering
2	EE18003	Design of Electrical Apparatus
3	EE18005	Control Systems Design
4	EE18007	Solid State Devices
5	EE18009	Energy Management and Auditing
6	EE18011	IoT for Electrical Engineers
PROFESSIONAL ELECTIVES (OFFERED IN EVEN SEMESTER)		
7	EE18002	Computer Aided Design of Electrical Apparatus
8	EE18004	Smart Grid
9	EE18006	Advanced Electric Drives
10	EE18008	High Voltage Direct Current Transmission
11	EE18010	Power Quality and FACTS
12	EE18012	Power System De-regulation
13	EE18014	Power System Dynamics
14	EE18016	Special Electrical Machines
15	EE18018	Microelectronic Circuits
16	EE18020	Digital Control Systems
17	CS18401	Computer Architecture (Common to CS and EE)
18	EE18022	Advanced Power Electronics
19	EE18024	Nanoelectronics (Common to EE and EC)
20	EC18601	VLSI Design (Common to EC and EE)
21	EE18026	High Voltage Engineering
22	EE18028	MEMS Technology
23	EE18030	Power System Management
24	EE18032	Advanced Power system protection
25	EE18034	Control system design for Power Electronics
26	GE18054	Professional Ethics (Common to CE, CS, IT, EE, EC and MR)
27	GE18051	Intellectual Property Rights (Common to All Branches Except BT)
28	CS18052	Fundamentals of Artificial Intelligence (Common to EE and ME)
29	EE18036	FPGA Based System Design
30	EE18038	Engineering Design and Prototyping

PROFESSIONAL ELECTIVES (CAN BE CHOSEN WHENEVER OFFERED)		
31	SE18001	Mathematics for AI and ML (Common to All Branches except MR)
32	SE18002	Corporate Finance (Common to All Branches except MR)
33	SE18003	Financial Statement Analysis (Common to All Branches except MR)
34	SE18004	Managerial Economics (Common to All Branches except MR)
35	SE18005	Market Research (Common to All Branches except MR)
36	SE18006	Production Management (Common to All Branches except MR)
37	SE18007	Project Management (Common to All Branches except MR)
38	SE18008	Introduction to Securities Market (Common to All Branches except MR)
39	SE18009	Supply Chain Management (Common to All Branches except MR)

OPEN ELECTIVES

(Students can choose only Open Electives offered by other departments)

OPEN ELECTIVES OFFERED IN ODD SEMESTER*

Sl. No.	COURSE CODE	COURSE TITLE	Offering Department
1.	OE18101	Fundamentals of Automobile Engineering	AUT
2.	OE18103	Fundamentals of Automotive Air Conditioning	AUT
3.	OE18201	Introduction to Biofuels and Bioenergy	BIO
4.	OE18203	Basics of Environmental Biotechnology	BIO
5.	OE18205	Introduction to Bioinformatics and Computational Biology	BIO
6.	OE18207	Basics of Nanobiotechnology	BIO
7.	OE18209	Introduction to Biomaterials	BIO
8.	OE18301	Waste to Energy	CHE
9.	OE18303	Industrial Safety	CHE
10.	OE18305	Composite Materials	CHE
11.	OE18307	Industrial Waste Water Treatment	CHE
12.	OE18309	Fuel Cell Technology	CHE
13.	OE18401	Basic Civil Engineering	CVE
14.	OE18403	Fundamentals of Remote Sensing and GIS	CVE
15.	OE18405	Electronic Waste Management	CVE
16.	OE18407	Basics and Principles of Green Building Design	CVE
17.	OE18409	Principles of Vastu in Interior Design	CVE

18.	OE18501	Basic Operating Systems	CSE
19.	OE18503	Basics on Cyber Security and Ethical Hacking	CSE
20.	OE18505	Introduction to Internet of Things	CSE
21.	OE18507	Multimedia and Animation Techniques	CSE
22.	OE18509	Python Programming	CSE
23.	OE18601	Electrical Machines and Applications	EEE
24.	OE18603	Control system Engineering	EEE
25.	OE18605	Micro and Smart Grid	EEE
26.	OE18607	Electric Vehicle Technology	EEE
27.	OE18609	Nanotechnology	EEE
28.	OE18611	IoT and Machine Learning	EEE
29.	OE18701	Autotronics	ECE
30.	OE18703	Sensing Techniques	ECE
31.	OE18705	System Design using Microcontrollers	ECE
32.	OE18707	Fundamentals of Wireless Communication	ECE
33.	OE18801	IT essentials for engineers	INT
34.	OE18803	Internet of Everything	INT
35.	OE18805	Foundation on Mobile App Development	INT
36.	OE18901	Elements of Marine Engineering	MAR
37.	OE18903	Marine Propulsion	MAR
38.	OE18001	Basics of Mechanical Engineering	MEC
39.	OE18003	Elements of Mechanical Components	MEC
40.	OE18005	Industrial Engineering and Management	MEC
41.	OE18007	Basics of Energy Resources	MEC
42.	OH18001	Content Writing	HSS
43.	OH18003	Critical Thinking	HSS
44.	OH18005	Urban / Rural Development and Constitutional Provisions	HSS
45.	OC18001	Nanochemistry	ACH
46.	OC18003	Polymer Chemistry	ACH
47.	OM18001	Statistical Methods for Engineers	APM
48.	OM18003	Linear Programming	APM

OPEN ELECTIVES OFFERED IN EVEN SEMESTER*

Sl. No.	COURSE CODE	COURSE TITLE	Offering Department
1.	OE18102	Automotive Fault Diagnostics	AUT
2.	OE18104	Fundamentals of Automotive Pollution and Control Methods	AUT
3.	OE18106	Fundamentals of Automotive Safety and Maintenance	AUT
4.	OE18202	Introduction to Food Manufacturing	BIO
5.	OE18204	Testing of Biological Materials	BIO
6.	OE18206	Introduction to Tissue Engineering	BIO
7.	OE18208	Introduction to Cancer Biology	BIO
8.	OE18210	Basic Bio-pharmaceutical Technology	BIO
9.	OE18302	Industrial Pollution Prevention	CHE
10.	OE18304	Solid Waste Management	CHE
11.	OE18306	Plant Utilities	CHE
12.	OE18308	Green Energy	CHE
13.	OE18310	Energy Management	CHE
14.	OE18402	Integrated Solid Waste Management	CVE
15.	OE18404	Life Cycle Assessment	CVE
16.	OE18406	Air Pollution and Control Engineering	CVE
17.	OE18408	Water Pollution and its Management	CVE
18.	OE18502	Artificial Intelligence Basics	CSE
19.	OE18504	Database Systems and Applications	CSE
20.	OE18506	Internet Programming	CSE
21.	OE18508	Introduction to Cloud and Big Data Analytics	CSE
22.	OE18510	Introduction to Data Structures	CSE
23.	OE18602	Industrial Automation	EEE
24.	OE18604	MEMS and Nano Devices	EEE
25.	OE18606	Renewable Energy Systems	EEE
26.	OE18608	Indian Power Grid	EEE
27.	OE18610	Power Converters	EEE

28.	OE18612	Nanotechnology and Prototyping Laboratory	EEE
29.	OE18702	Consumer Electronics	ECE
30.	OE18704	Introduction to Communication Systems	ECE
31.	OE18706	Robotics Systems	ECE
32.	OE18802	Embedded and Real Time Systems	INT
33.	OE18804	Ethical Hacking and IT Security	INT
34.	OE18806	User Interface Design	INT
35.	OE18808	AI for Android	INT
36.	OE18902	Introduction to Marine Diesel Engines and Machineries	MAR
37.	OE18904	Marine Vehicles	MAR
38.	OE18002	Elements of Automation	MEC
39.	OE18004	Quality Concepts and Tools	MEC
40.	OE18006	Refrigeration and Air Conditioning Systems	MEC
41.	OE18008	Thermal Management of Electronics Devices	MEC
42.	OP18002	Sensors and Transducers	APH
43.	OP18004	Essential Properties for Selection of Materials	APH
44.	OP18006	Opto Electronics and Applications	APH
45.	OP18008	Basics of Environmental Safety	APH
46.	OH18002	Environmental Law, Policy and International Conventions	HSS
47.	OH18004	Climate Change and Vulnerability Assessment	HSS
48.	OH18006	Gender Sensitization and Social Impact	HSS
49.	OC18002	Fuel Cell Chemistry	ACH
50.	OC18004	Industrial Catalysis	ACH
51.	OM18002	Linear Algebra for Engineers	APM
52.	OM18004	Transform Techniques for Boundary Value Problems	APM

MANDATORY COURSE

(Course should be completed between 3rd and 6th semester)

S.NO.	COURSE CODE	COURSE TITLE	Credit
1.	MC18001	Indian Constitution and Society (Common to All Branches Except MR)	-

VALUE ADDED COURSES

(Course should be completed between 3rd and 6th semester and Students must earn at least 2 credits)

S.NO.	COURSE CODE	COURSE TITLE	No of Hours	Credit
1	VD18601	Hands on Training on Embedded C	30	2
2	VD18602	Nano device Manufacturing	30	2
3	VD18603	Modeling and simulation of Electrical Systems	30	2
4	VD18604	Electric Vehicle Design	30	2
5	VD18605	Hardware implementation of Power supply circuit	30	2
6	VD18606	Design Thinking and Innovation	30	2
7	VD18607	Robotics and Control	30	2
8	VC18001	Communicative German (Common to all branches)	30	2
9	VC18002	Communicative Japanese (Common to all branches)	30	2
10	VC18003	Communicative Hindi (Common to all branches)	30	2
11	VC18004	Design Thinking and Prototyping Laboratory (Common to all Branches)	30	2
12	VC18005	Basics of Entrepreneurship Development (Common to All Branches)	30	2
13	VC18006	Advance in Entrepreneurship Development (Common to All Branches)	30	2

ELECTRICAL AND ELECTRONICS ENGINEERING

Subject Area	Credits per Semester								Total	%
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
Humanities and Social Sciences (HS), including Management	3	3	2						8	**4.4**
Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology	10	11	4	3					28	**15.5**
Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required)		5.5	17	17.5	21.5	17	18.5		97	**53.8**
Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of, Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation	9	4							13	**7.22**
Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch					3	3		9	15	**8.33**
Open Subjects - Electives (OE), from other technical and/or emerging subject areas						3	3		6	**3.33**
Project Work, Seminar and/or Internship in Industry or Elsewhere (EEC)							3	10	13	**7.22**
Total Credits	**22**	**23.5**	**23**	**20.5**	**24.5**	**23**	**24.5**	**19**	**180**	100

HS18151	COMMUNICATIVE ENGLISH	L	T	P	C
	(Common to all Branches)	3	0	0	3

OBJECTIVES:

- To enable learners to interact fluently on everyday social contexts.
- To enable learners to engage in conversations in an academic/scholarly setting.
- To enable learners to overcome public speaking barriers.
- To develop learners' ability to take notes and in the process, improve their listening skills
- To develop learners' reading skill through reading text passages for comprehension and contemplation.
- To enable learners to write on topics of general interest and drafting correspondences for general purposes.

UNIT I **9**

Listening - short video clips - conversational scenes form movies, celebrities' speeches/interviews. Speaking - several ways of introducing oneself at several situations, introducing others at several situations, inviting people for several occasions, describing people and their places. Reading - short comprehension passages - making inferences, critical analysis. Writing - completing the incomplete sentences - developing hints from the given information. Grammar - Wh-Questions and Yes or No questions - Parts of speech. Vocabulary development - prefixes - suffixes - articles - countable / uncountable nouns.

UNIT II **9**

Listening - customer care voice files, short narratives - identifying problems and developing telephone etiquettes. Speaking - speaking over skype/whatsapp, making business calls, making self-recorded informative videos, inquiring about a concept/activity, describing a concept/activity. Reading - reading the headlines on news magazines - slogans and taglines from advertisements. Writing - free writing - writing - headlines , slogans and taglines individual inspirations. Grammar - conjunctions, idioms, phrases, quotes. Vocabulary development - guessing the meanings of words in various different contexts.

UNIT III **9**

Listening - courtroom scenes from movies, debates and talks from news channels, notes taking. Speaking - language and tone for arguments, discussion, deliberation, contemplation, expressing opinions, reacting to different situations in an alien country. Reading - language used in instruction manuals of household appliances, cookery and other basic instructions. Writing- understanding the structure of texts - use of reference words, discourse markers-coherence, rearranging the jumbled sentences. Grammar - adjectives - degrees of comparison, framing direct and indirect questions. Vocabulary development - concise approach, single word substitution.

UNIT IV **9**

Listening - Sports commentaries, advertisements with users' criticisms; Speaking - for social causes, for promoting a concept, negotiating and bargaining; Reading - review of a product, movie, movement or a system; Writing - writing for advertisements, selling a product; Grammar - Tenses -Simple Past, Present and Future, Continuous - Past, Present and Future; Vocabulary Development - synonyms, antonyms and phrasal verbs.

UNIT V **9**

Listening - video lectures, video demonstration of a concept; Speaking - presenting papers/concepts, delivering short speeches, discourses on health, suggesting natural home remedies, cleanliness, civic sense and responsibilities; Reading - columns and articles on home science; Writing - correspondences of requests, basic enquiry/observation and basic complaints; Grammar - modal verbs, perfect tenses - Vocabulary development - collocations.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Read articles and infer meanings from specific contexts from magazines and newspapers.
- Participate effectively in informal/casual conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English.
- Write short write-ups and personal letters and emails in English.
- Face job interviews with confidence.

REFERENCES:

1. Department of English, Anna University, Mindscapes : English for Technologists and Engineers. Orient Black Swan, Chennai, 2017.
2. Downes and Colm, "Cambridge English for Job-hunting", Cambridge University Press, New Delhi, 2008.
3. Murphy and Raymond, "Intermediate English Grammar with Answers", Cambridge University Press, 2000.
4. Thomson, A.J., "Practical English Grammar 1 and 2", Oxford, 1986.

Websites

1. http://www.usingenglish.com
2. http://www.uefap.com3
3. https://owl.english.purdue.edu/owl/
4. www.learnenglishfeelgood.com/esl-printables-worksheets.html

Software

1. Face 2 Face Advance – Cambridge University Press, 2014.
2. English Advance Vocabulary- Cambridge University Press.
3. IELTS test preparation – Cambridge University Press 2017.
4. Official Guide to the TOEFL Test With CD-ROM, 4th Edition.
5. CAMBRIDGE Preparation for the TOEFL TEST- Cambridge University Press, 2017.

MA18151	ENGINEERING MATHEMATICS I	L	T	P	C
	(Common to all Branches Except MR)	3	1	0	4

OBJECTIVES:

- To understand and apply matrix techniques for engineering applications.
- To make the student knowledgeable in statistical methods of analyzing and interpret the data for engineering problems.
- To familiarize the student with basic calculus including functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES 12

Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors - Statement and Applications of Cayley-Hamilton Theorem - Diagonalization of matrices - Reduction of a quadratic form into canonical form by orthogonal transformation - Nature of quadratic forms.

UNIT II STATISTICAL METHODS 12

Scatter diagram - Karl Pearson coefficient of correlation for raw data - Spermann rank correlation coefficient - lines of regression - Regression equation X on Y and Y on X- Curve fitting by Principle of least squares - Fitting a straight line $y = ax + b$ and a parabola $y = ax^2 + bx + c$.

UNIT III APPLICATION OF DIFFERENTIAL CALCULUS 12

Curvature in Cartesian co-ordinates - Centre and radius of curvature - Circle of curvature - Evolutes - Envelopes.

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 12

Limits and Continuity - Partial derivatives - Total derivatives - Differentiation of implicit functions - Jacobians and properties - Taylor's series for functions of two variables - Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers.

UNIT V MULTIPLE INTEGRALS 12

Double integrals in Cartesian and polar coordinates - Change of order of integration - Area enclosed by plane curves - Change of variables in double integrals - Triple integrals - Volume of solids.

TOTAL (L:45 + T:15) : 60 PERIODS

OUTCOMES:

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

- Develop the use of matrix algebra techniques which is needed for practical applications.
- Apply the skills in the area of infinite series and their convergence so that the students will be familiar with the limitations of using infinite series approximations for solutions arising in mathematical modelling
- Acquire the skills to evaluate the functions of several variables.
- Express proficiency in handling the concept of improper integrals of gamma, beta and error functions.

- Acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley, 1999.
2. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt. Ltd., 2011.
3. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

1. Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", S.Chand Private Ltd.,11th Edition, 2005.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
3. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning, 2012.
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, Pearson Publishing, 2011.

PH18151	ENGINEERING PHYSICS	L	T	P	C
	(Common to all Branches)	3	0	0	3

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology

UNIT I CRYSTAL PHYSICS 12

Unit cell - Bravais Lattices - Miller indices - Distance between Inter planar distance 'd' (derivation) - discussion of various crystal structures: calculation of Atomic radius, Coordination number, effective number of lattice points and Atomic Packing Factor for the SC, BCC, FCC, HCP, Diamond Cubic (derivation) - discussion about the NaCl, Graphite structures. Crystal defects **:** Zero dimensional, one dimensional, Two dimensional and Three dimensional defects. Diffraction of X-rays by crystal planes - Bragg's spectrometer - Powder Diffraction method.

UNIT II THERMAL PHYSICS 6

Modes of heat transfer: Newton's law of cooling - thermal conductivity - Lee's disc method (derivation and expt) - Radial heat flow - Rubber tube method - conduction through compound media (series and parallel).

UNIT III WAVE MECHANICS 9

Quantum principles: Black body radiation - Planck Hypothesis (qualitative), Compton's effect (derivation).Wave-particle duality - De-Broglie matter waves - Heisenberg's uncertainty principle - Wave function and its significance - Schrödinger's wave equation (time dependent and Time independent) (derivation) - Application of Schrodinger's wave equation - Particle in one dimensional box (derivation) - Degenerate and non-degenerate energy states.

UNIT IV ACOUSTICS AND ULTRASONICS 9

Acoustics: Classification of Sound - Characteristics of Musical Sound - Quality (Timbre), Pitch, Intensity of Sound - Units of Sound - decibel - Reverberation of sound - Reverberation time - absorption of sound energy by materials - Absorption coefficient - Sabine's Formula (derivation) - Factors affecting the acoustics of buildings - Remedies.

Ultrasonics **:** Introduction to ultrasonics - Properties of ultrasonic waves - Production of Ultrasonics - Magnetostriction method, Piezo electric method - detection of ultrasonics - Ultrasonic Acoustic grating - Applications of ultrasonic waves - SONAR, NDT, Sonogram.

UNIT V OPTOELECTRONICS AND FIBER OPTICS 9

Lasers: Basic properties of Lasers - Einstein's coefficients (Derivation) - Population inversion - Types of Lasers - Molecular Gas Lasers (CO_2 Laser) - Solid state Laser (Nd: YAG Laser) - Applications of Lasers in Engineering and Medicine.

Fibre optics: Introduction - Principle and structure of optical fibers - Acceptance angle-Numerical aperture-Types of optical fibers-Optical fiber communication system (block diagram) - Advantages and its applications.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Interpret the thermal properties of the materials
- Exhibit the ability to solve the problems pertaining to the behavior of sub-atomic particles using quantum mechanics.
- Learn to solve the issues related to defects in the buildings due to acoustic design
- Develop an understanding about photonics and Fiber Optic communication system
- Classify and demonstrate the fundamentals of crystals and their defects.

TEXT BOOKS:

1. Gaur R.K. and Gupta S.L, "Engineering Physics", Dhanput Publications, 2015.
2. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", Pearson, 2006.
3. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.
4. Arumugam M, "Materials Science", Anuradha Publications, 2015.

REFERENCES:

1. David Halliday, Robert Resnick Jearl Walker, "Principles of Physics", 10th Edition, Wiley, 2015.
2. Peter Atkins and Julio De Paula, "Physical Chemistry", 10th Edition., Oxford University Press, 2014.
3. Arthur Beiser, Shobhit Mahajan and Rai Choudhury S, "Concepts of Modern Physics", 7th Edition, McGraw Hill Education, 2017.
4. Raghavan V, "Materials Science and Engineering", PHI Learning Pvt. Ltd., 2010.

CY18151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and the water treatment techniques.
- To develop an understanding the principle, types and mechanism of corrosion and protective coatings.
- To acquaint the students with the basics of nanomaterials, their properties and applicants.
- To develop an understanding of the laws of photochemistry and basic spectral (UV and IR) analysis.
- To enable the students to understand the types of fuels, its calorific values and the significance flue gas analysis.

UNIT I WATER TECHNOLOGY 9

Sources, hard & soft water, estimation of hardness by EDTA method, boiler feed water, boiler problems, cause and preventive measures, softening of water, zeolite process & demineralization by ion exchangers, internal treatment methods, specifications for drinking water, BIS & WHO standards, treatment of water for domestic use, desalination - reverse osmosis & electrodialysis.

UNIT II CORROSION AND ITS CONTROL 9

Corrosion: Basic concepts - mechanism of chemical, electrochemical corrosion - Pilling Bedworth rule – Types of Electrochemical corrosion - galvanic corrosion - differential aeration corrosion - pitting corrosion – stress corrosion – factors influencing corrosion. Corrosion control: Cathodic protection – sacrificial anodic method - corrosion inhibitors. Protective coatings: surface preparation For metallic coatings - electro plating (copper plating) and electroless plating (Nickel plating) - chemical conversion coatings - anodizing, phosphating & chromate coating.

UNIT III NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. nanoparticles: nano cluster, nano rod, nanotube (CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation; Properties and applications of nanomaterials.

UNIT IV PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss - Draper law, Stark-Einstein law and Lambert Beer Law. Quantum efficiency - Photo processes - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence and Photo-sensitization. Spectroscopy: Electromagnetic spectrum - Absorption of radiation - Electronic, Vibrational and rotational transitions. UV-visible and IR spectroscopy - principles, instrumentation (Block diagram only) and applications.

UNIT V FUELS AND COMBUSTION 9

Fuel: Introduction - classification of fuels - calorific value - higher and lower calorific values - coal analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum- refining - manufacture of synthetic petrol (Bergius process) - knocking octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - producer gas - water gas. Combustion of fuels: introduction - theoretical calculation of calorific value - calculation of stoichiometry of fuel and air ratio - flue gas analysis by ORSAT Method.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Estimate the hardness of water, assess the boiler feed water requirement and related problems also identification of suitable water treatment methods.
- Differentiate the mechanisms of different types of corrosion and suggest suitable corrosion control techniques to mitigate the problem of corrosion including protective coatings.
- Compare the nano and bulk materials, their synthesis and its applications in various fields.
- Interpret the photochemical reactions and spectroscopic techniques.
- Assess the types and quality of fuels, its calorific values and significance of flue gas analysis,

TEXT BOOKS:

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010.
2. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010.
3. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2008.

REFERENCES:

1. Ozin G. A. and Arsenault A. C., "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.
2. B.R. Puri, L.R. Sharma, M.S. Pathania., "Principles of Physical Chemistry", Vishal Publishing Company, 2008.

IT18101	PROGRAMMING FOR PROBLEM SOLVING (Common to all Branches Except MR)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students should be made to:

- Learn the organization of a digital computer.
- Learn to think logically and write algorithms or draw flow charts for problems.
- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

UNIT I INTRODUCTION TO PROBLEM SOLVING 9

Simple model of a Computer - Hardware - Software - Data Representation, Introduction to Computer Networks and Internet, Problem Solving Techniques - Bottom up design and top down design - applications, Introduction to Algorithms and Flow Chart.

UNIT II C PROGRAMMING BASICS 9

Introduction to 'C' programming - structure of a 'C' program - compilation and linking processes. Conversion of simple algorithm to program.

Constants, Variables - Data Types - Expressions using operators in 'C' - Managing Input and Output operations - Decision Making and Branching - Looping statements - solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS 9

Arrays - Initialization - Declaration - One dimensional and Two dimensional arrays - String- String operations - Arrays of strings.

UNIT IV FUNCTIONS AND USER DEFINED DATA TYPES 9

Function - definition of function - Declaration of function - Pass by value - Pass by reference - Recursion - Enumerators - Structures - Unions.

UNIT V POINTERS AND FILES 9

Macros - storage classes - Pointers - Definition - Initialization - Pointers arithmetic - Double Pointers, Basic file operations - Example problems.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Apply various problem-solving techniques and represent solutions to problems in the form of algorithms and flow charts.
- Examine given problems, design solutions and write C programs using the constructs of C language.
- Apply the advanced constructs and string manipulation feature available in C programming language to solve problems.
- Demonstrate the use functions, structures and unions to create modularized applications in C language.
- Illustrate the dynamics of memory by the use of files and pointers.

TEXT BOOKS:

1. Pradip Dey and Manas Ghosh, "Programming in C", First Edition, Oxford University Press, 2018.
2. Byron S Gottfried, "Programming with C", Schaum's Outlines, Third Edition, Tata McGraw-Hill, 2010.

REFERENCES:

1. Kernighan B.W and Ritchie D.M, "The C Programming Language", Second Edition, Pearson Education, 2015.
2. Yashavant P. Kanetkar, "Let Us C", BPB Publications, 2011.
3. Paul J Deitel and Harvey M. Deitel, "C How to Program", Seventh Edition, Pearson Education, 2016.

CM18151 BASIC CIVIL AND MECHANICAL ENGINEERING L T P C
(Common to BT, CH and EE) 3 0 0 3

OBJECTIVES:

- To impart basic knowledge on Civil and Mechanical Engineering.
- To explain the materials used for the construction of civilized structures.
- To make understand the fundamentals of construction of structure.
- To enable the students to distinguish the components and working principle of power plants, IC engines and Refrigeration system.

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects - type - classification - principles - measurements of distances - angles - leveling - determination of areas - illustrative examples.

Civil Engineering Materials: Bricks - stones - sand - cement - concrete - steel sections.

UNIT II BUILDING FOUNDATION AND STRUCTURES 9

Foundations: Basic site investigation - Types of foundation - Bearing capacity - Requirement of good foundations.

Superstructure: Brick masonry - stone masonry - beams - columns - lintels - roofing - flooring - plastering - Mechanics - Internal and external forces - stress - strain - elasticity - Types of Bridges and Dams.

UNIT III POWER PLANTS 9

Classification of Power Plants - Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants - High Pressure Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps.

UNIT IV INTERNAL COMBUSTION ENGINES 9

Internal combustion engines as automobile power plant - Working principle of Petrol and Diesel Engines - Four stroke and two stroke cycles - Comparison of four stroke and two stroke engines. Hybrid Electric Vehicles.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 9

Principles of Refrigeration and Air Conditioning. Vapour compression and absorption systems - Layout of typical domestic refrigerator - Window and Split type room Air conditioner.

TOTAL : 45 PERIODS

OUTCOMES:

The students will be able to

- Gain basic knowledge in surveying and common civil engineering materials.
- Understand the building foundation, superstructures and bridges and dams.
- Gain knowledge of various power plants and their main components.
- Understand the working principles of two/four stroke internal combustion engines used in automotive vehicles.
- Have exposure to domestic refrigerator and air conditioners.

TEXT BOOK:

1. Shanmugam G and Palanichamy M.S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 2018.

REFERENCES:

1. Nag P.K, "Power Plant Engineering", Tata McGraw Hill Publishing Co., New Delhi, 2014.
2. Ganesan V, "Internal Combustion Engines", 4th edition, Tata McGraw Hill Publishing Co., New Delhi, 2012.
3. Arora C.P, "Refrigeration and Air Conditioning", Tata McGraw Hill Publishing Co, New Delhi, 2009.
4. Punmia B.C, Ashok Kumar Jain and Aru Kumar Jain, "Basic Civil Engineering", First Edition, Laxmi Publications, 2003.
5. Bhavikatti S.S, "Basic Civil Engineering and Engineering Mechanics", New Age International Publisher, 2011.

IT18111	PROGRAMMING FOR PROBLEM SOLVING LABORATORY	L	T	P	C
		0	0	3	1.5

(Common to all Branches Except MR)

OBJECTIVES:

The students should be made to

- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

LIST OF EXERCISES

1. Usage of Basic Linux commands
2. C Programming using Simple statements and expressions
3. Scientific problem solving using decision making and looping
4. Simple programming for one dimensional and two dimensional arrays
5. Solving problems using Strings
6. C Programming using Pointers
7. C Programming using user defined functions (Pass by value and Pass by reference)
8. C Programming using Recursion
9. C Programming using structures and union
10. C Programming using enumerated data types
11. C Programming using macros and storage classes
12. C Programming using Files

TOTAL: 45 PERIODS

OUTCOMES:

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

- Demonstrate the shell commands of Linux OS.
- Apply problem solving techniques using Basic 'C' constructs.
- Demonstrate various control structures and advanced constructs in C language.
- Demonstrate the use of functions, structures, unions and pointers in developing modularized applications.
- Experiment data handling and data processing using files in ‘C’ language.

REFERENCES:

1. Pradip Dey and Manas Ghosh, "Programming in C", First Edition, Oxford University Press, 2018.
2. Byron S Gottfried, "Programming with C", Schaum’s Outlines, Third Edition, Tata McGraw-Hill, 2010.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Description of Equipment	Qty
HARDWARE:		
1.	Computer	30
SOFTWARE:		
2.	Open Source Linux OS	30
3.	C compiler	30

GE18161	ENGINEERING PRACTICES LABORATORY	L	T	P	C
	(Common to all Branches)	0	0	3	1.5

OBJECTIVES:

- Impart hands on experience on various rudimentary engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

LIST OF EXPERIEMNTS

GROUP A (CIVIL and MECHANICAL)

I CIVIL ENGINEERING PRACTICE

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
b) Study of pipe connections requirements for pumps and turbines.
c) Preparation of plumbing line sketches for water supply and sewage works.
d) Hands-on-exercise:
Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.
e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

a) Study of the joints in roofs, doors, windows and furniture.
b) Hands-on-exercise:
Wood work, joints by sawing, planning and cutting.

II MECHANICAL ENGINEERING PRACTICE

Welding:

a) Preparation of arc welding of butt joints, lap joints and tee joints.
b) Gas welding practice

Basic Machining:

a) Simple Turning and Taper turning
b) Drilling Practice

Sheet Metal Work:

a) Forming & Bending:
b) Model making – Trays, funnels, etc.
c) Different type of joints.

Machine assembly practice:

a) Study of centrifugal pump
b) Study of air conditioner

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending.
Example – Exercise – Production of hexagonal headed bolt.
b) Foundry operations like mould preparation for gear and step cone pulley.
c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

GROUP B (ELECTRICAL and ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement and comparison of energy for resistive and LED load using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE

1. Identification of circuit components
    a) Resistor, capacitor, diode (PN & Zener),transistors.
    b) Soldering practice – Circuits – Using general purpose PCB.
2. Evaluating the parameters for DC power supply and AC power supply (peak-peak, rms, average, period, frequency) using function generator and CRO.
3. Study and implementation of logic functions using NAND, NOR, and NOT gates.
4. VI Characteristics of PN Junction diode.
5. VI Characteristics of Solar photovoltaic panel.
6. Design a 5V/12V Regulated Power Supply: using FWR rectifier and IC7805/IC7812.

TOTAL: 45 PERIODS

OUTCOMES:

- Fabricate carpentry components and to lay pipe connections including plumbing works.
- Use welding equipments to join the structures.
- Wiring of basic electrical system and measurement of electrical parameters.
- Study and implement the basic electronic components, circuits and solar photovoltaic panel.
- Design a basic regulated power supply.

REFERENCES:

1. Jeyachandran K., Natarajan S. & Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
2. Jeyapoovan T., Saravanapandian M. & Pranitha S., "Engineering Practices Lab Manual", Vikas Puplishing House Pvt.Ltd, 2006.
3. Bawa H.S., "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A. and Sarma P.M.M.S., "Workshop Practice", Sree Sai Publication, 2002.
5. Kannaiah P. & Narayana K.L., "Manual on Workshop Practice", Scitech Publications, 1999.
6. Mittle V.N, Arvind Mittal, "Basic Electrical Engineering", Tata McGraw Hill(India), Second Edition,2013.
7. Sedha R.S., "A Text Book of Applied Electronics", S. Chand & Co., 2014.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S. No.	Description of Equipment	Qty
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2.	Carpentry vice (fitted to work bench)	15 Nos.
3.	Standard woodworking tools	15 Sets.
4.	Models of industrial trusses, door joints, furniture joints	5 each
5.	Power Tools: (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	2 Nos
	MECHANICAL	
1.	Arc welding transformer with cables and holders	5 Nos.
2.	Welding booth with exhaust facility	5 Nos.
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5.	Centre lathe	2 Nos.
6.	Hearth furnace, anvil and smithy tools	2 Sets.
7.	Moulding table, foundry tools	2 Sets.
8.	Power Tool: Angle Grinder	2 Nos
9.	Study-purpose items: centrifugal pump, air-conditioner	1 each
	ELECTRICAL	
1.	Assorted electrical components for house wiring	15 Sets
2.	Electrical measuring instruments	10 Sets
3.	Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4.	Megger (250V/500V)	1 No.
5.	Power Tools: (a) Range Finder 2 Nos (b) Digital Live-wire detector	2 Nos.
6.	LED lamp 8 W & 16 W	2 Nos. each
	ELECTRONICS	
1.	Soldering guns	10 Nos.
2.	Assorted electronic components for making circuits	50 Nos.
3.	Small PCBs	10 Nos.
4.	Multimeters	10 Nos.
5.	Study purpose ICs: IC7805/IC7812	1 each
6.	Photovoltaic panel: 5 W/10 W	2 Nos.
7.	Light Source for PV panel	1 No.

HS18251	TECHNICAL ENGLISH (Common to all Branches)	L 3	T 0	P 0	C 3

OBJECTIVES:

To enable learners to define and understand technical communication and scientific writing

- To expose learners to nuances of seminar presentation, group discussion, and public speaking
- To expose learners to writing for scientific purposes
- To expose learners to drafting correspondences for business purposes
- To expose learners to writing for documenting purposes
- To enable students to have a holistic understanding of job interviews and recruiting process.

UNIT I **9**

Listening - AV files pertaining to manufacturing processes of products, scientific documentaries; **Speaking -** syllable division and word stress, intonation, sharing opinions; **Reading** - news articles related to science and technology; **Writing** - definitions, instruction, recommendation, data interpretation, resume; **Grammar** - tenses and their aspects, sentence connectors - discourse markers, sequential words, active and passive voice, subject-verb agreement.

UNIT II **9**

Listening - AV pertaining to marketing strategies, peer reading and pronunciation; **Speaking** - turn taking, sharing opinions; conducting and attending a meeting, understanding the nuances of spoken communication among internal audience and external audience; **Reading** - analytical documents, descriptive documents; **Writing** - fliers, brochures, resume - letter of application, checklists; **Grammar** - modal verbs, clauses - types and uses, conditional clauses, articles.

UNIT III **9**

Listening - AV related to how to use components, scientific description, **Speaking** - speaking for motivation and initiation, speaking at a seminar presentation; **Reading** - scientific journals, papers; **Writing** - Technical descriptions - process description, purpose and function, PowerPoint, Google forms, user manuals; **Grammar** - phrasal verbs, prepositions, technical and scientific affixes.

UNIT IV **9**

Listening - scientific debates, crisis management; **Speaking** - handling conflicts, speaking about the loss of benefits, progress or decline of business, identifying the connotative meanings, **Reading**- documented evidences of uses and functions of a product, review of a product, **Writing** - memos, follow-up letters, reports - proposal, project, progress reports, sales reports, reports on industrial visits, executive summary. **Grammar** - reported speech and tag questions, sentence structure - comparative, imperative, cause and effect, infinitive of result.

UNIT V **9**

Listening - AV of Group discussions, panel discussions, face to face interviews for recruitment purposes; **Speaking**- speaking at group discussions, interviewing a personality, answering at the interviews; **Reading** - WebPages of topnotch engineering companies, **Writing** - blogging, e-mails, letter of complaint, minutes of the meeting; **Grammar** - one word substitution, collocations, better word/sentence substitution (rephrasing the content/improvising ideas).

TOTAL: 45 PERIODS

Suggested Activities [task based] - case study, guest lectures as models, problem solving, understanding team work.

OUTCOMES:

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

- Understand the nuances of technical communication and scientific writing
- Present papers and give seminars
- Discuss in groups and brainstorm
- Draft business correspondences and write for documentation purposes
- Face job interviews with confidence

REFERENCES:

1. Department of English, Anna University. Mindscapes : English for Technologists and Engineers. Orient Blackswan, Chennai. 2012.
2. Downes, Colm, Cambridge English for Job-hunting, Cambridge University Press, New Delhi. 2008.
3. Murphy, Raymond, Intermediate English Grammar with Answers, Cambridge University Press 2000.
4. Thomson, A.J., "Practical English Grammar 1 & 2", Oxford, 1986.
5. Herbert A J, "The Structure of Technical English", Longman, 1965.

Websites

1. http://www.usingenglish.com
2. http://www.uefap.com3
3. https://owl.english.purdue.edu/owl/
4. www.learnenglishfeelgood.com/esl-printables-worksheets.html

Software

1. Face2Face Advance – Cambridge University Press, 2014
2. English Advance Vocabulary- Cambridge University Press
3. IELTS test preparation – Cambridge University Press 2017
4. Official Guide to the TOEFL Test With CD-ROM, 4th Edition

5 . CAMBRIDGE Preparation for the TOEFL TEST- Cambridge University Press, 2017

MA18251	ENGINEERING MATHEMATICS II	L	T	P	C
	(Common to all Branches Except MR)	3	1	0	4

OBJECTIVES:

- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS 12

Gradient, divergence and curl - Directional derivative - Irrotational and solenoidal vector fields - Vector integration - Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) - Simple applications involving cubes and rectangular parallelopipeds.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients - Method of variation of parameters - Cauchy's and Legendre's linear equations - Simultaneous first order linear equations with constant coefficients.

UNIT III LAPLACE TRANSFORM 12

Laplace transform - Sufficient condition for existence - Transform of elementary functions - Basic properties - Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions - Transform of periodic functions. Inverse Laplace transforms -Statement of Convolution theorem - Initial and final value theorems - Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IV ANALYTIC FUNCTION 12

Functions of a complex variable - Analytic functions: Necessary conditions - Cauchy-Riemann equations and sufficient conditions (excluding proofs) - Harmonic and orthogonal properties of analytic function - Harmonic conjugate - Construction of analytic functions - Conformal mapping - Translation, rotation and inversion ($w = z+c$, cz, $1/z$, z^2) - Bilinear transformation.

UNIT V COMPLEX INTEGRATION 12

Complex integration - Statement and applications of Cauchy's integral theorem and Cauchy's integral formula - Taylor's and Laurent's series expansions - Singular points - Residues - Cauchy's residue theorem - Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

TOTAL (L:45 + T:15) : 60 PERIODS

OUTCOMES:

- Interpret the fundamentals of vector calculus and be fluent in the use of Stokes theorem and Gauss divergence theorem.
- Express proficiency in handling higher order differential equations

- Determine the methods to solve differential equations using Laplace transforms and Inverse Laplace transforms.
- Explain Analytic functions and Categorize transformations.
- Solve complex integrals using Cauchy integral theorem and Cauchy's residue theorem.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley, 1999.
2. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt. Ltd., 2011.
3. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma, "Higher Engineering Mathematics", S.Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
3. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning, 2012.
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, Pearson Publishing, 2011.

PH18252	PHYSICS OF MATERIALS (Common to BT, EE and EC)	L 3	T 0	P 0	C 3

OBJECTIVES:

- Understand the physical properties of materials.
- Summarize the importance of free electrons in determining the properties of metals, semiconductors, and superconductors and understand the concept of Fermi energy.
- Describe the basic magnetic, superconducting and dielectric properties of materials.
- Ability to understand different types of modern engineering materials.

UNIT I CONDUCTING MATERIALS 9

Introduction - Classification of materials based on the electrical resistivity - Classical Free electron theory - Electrical and thermal conductivity of metal (derivation) - Wiedemann - Franz law - Lorentz number - Drawbacks of Classical Free electron theory - Quantum Free electron theory - Fermi distribution function - Effect of temperature of Fermi function - Density of energy states (derivation) - Carrier concentration in metals - Emission of electrons from metals - Thermionic emission - Photoelectric emission - Field emission.

UNIT II SEMICONDUCTING MATERIALS 9

Introduction - Classification of materials based on band theory (metals, semiconductors and insulators) - Intrinsic and extrinsic semiconductors - Carrier concentration in intrinsic semiconductor (derivation) - Effect of temperature on Fermi level - Compound semiconductors - Variation of electrical conductivity in intrinsic semiconductors with temperature - Band gap determination of intrinsic semiconductor (derivation and Expt) - Hall effect (derivation and experiment).

UNIT III DIELECTRIC PROPERTIES OF MATERIALS 9

Introduction to dielectric materials - Dielectric constant - Polarization of dielectric materials - Types of Polarization (Polarisability) - Equation of internal fields in solid (One- Dimensional) (Derivation) - Claussius - Mosotti Relation for elemental dielectric materials - Dielectric Breakdown - Frequency dependence of dielectric constant, Dielectric Losses - Important applications of dielectric material - Ferro and Piezo electricity (Qualitative).

UNIT IV MATERIALS AT LOW TEMPERATURE AND MAGNETIC PROPERTIES 9

Temperature dependence of resistivity in superconducting materials - Meissner effect - Properties of superconductors - Type I and Type II superconductors - BCS theory (Qualitative) - Low Tc and High Tc (alloy) superconductors - Ceramic superconductors (oxide superconductors) - LaBaCuO, YBaCuO, BiSrCaCuO - Josephson's effect (AC and DC) - SQUIDS - CRYOTRON - MAG LEV - Applications of Superconductors.

Dia, para and Ferro magnetic material - Domain theory for Ferro magnetic materials - Phenomena of Hysteresis and its applications - Ferrites and its structures.

UNIT V PHYSICS AT NANO SCALE AND SMART MATERIALS 9

Introduction to Nanomaterials- Basic principle of Nano science and technology, creation and use of Bucky balls, structure, properties and of Carbon nanotubes, Applications of nanotechnology in industrial pollution control.

Shape memory alloys - types of SMA - Properties of SMA - Pseudo elasticity - Shape Memory Effect - Hysteresis - Applications of SMA.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Comprehend the behavior of electrons in solids.
- Demonstrate an understanding of various properties of semiconducting materials and their internal structure.
- Students will get the exposure of the dielectric properties and material and its applications materials in various fields.
- Summarize basics of magnetism and superconductivity. Explore a few of their technological applications.
- Develop an understanding the applications of nano materials and new engineering materials in various fields.

TEXT BOOKS:

1. Arumugam M, "Materials Science", Anuradha Publications, 2015.
2. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2015.
3. Suresh R and Jayakumar V, "Materials Science", Lakshmi Publications 2003.
4. Palanisamy P.K, "Materials Science", SciTech publications, 2015.

REFERENCES:

1. Gaur R.K and Gupta S.L, "Engineering Physics", Dhanpat Publications, 2015.
2. Avadhnaulu M.N and Kshirsagar P.G, "A Textbook of Engineering Physics", S. Chand & Co., 2006.
3. Kittlel C, "Introduction to Solid State Physics", 7th Edition, Wiley Eastern Ltd, 2004.
4. Azaroff L.V. and Brophy J.J., "Electronic Processes In Materials", McGraw Hill.,1963.

GE18151	ENGINEERING DRAWING (Common to all Branches)	L 3	T 0	P 2	C 4

OBJECTIVES:

- This course will introduce students to Engineering Drawing and build their ability to read drawings and interpret the position and form of simple geometry, culminating into understanding of simple technical assemblies.

UNIT 0 ENGINEERING DRAWING FUNDAMENTALS (Not for Examination) 5

Drawing standard: BIS, Lettering, Dimensioning, Type of lines, Conventions, Geometrical constructions: Dividing a straight line into equal parts, Bisecting a given angle, Construction of polygon - Triangle, Square, Pentagon and Hexagon using drawing tools.

UNIT I CURVES AND PROJECTION OF POINTS AND LINES 15

Construction of Engineering Curves: Conic Sections - Ellipse, Parabola, Hyperbola using Eccentricity method, Cycloid, Involute of Circle and Pentagon.

Projection: Principal Planes, Projection of Points using Four Angles of Projection, Projection of Straight Lines - Lines parallel or inclined to one or both planes using Rotating Line Method in First Angle of Projection.

UNIT II PROJECTION OF PLANES AND SOLIDS 15

Projection of Plane Figures - Inclined to any one Principal Plane,

Projection of Solids - Simple Solids (Prisms, Pyramids, Cone and Cylinder) axis inclined to any one Principal Plane.

UNIT III SECTION OR SOLIDS & DEVELOPMENT OF SURFACES 15

Section of Solids - Sectional views of simple vertical solids cut by section plane inclined to any one Principal Plane.

Development of Surfaces - Development of lateral surfaces of truncated and frustum of simple solids.

UNIT IV PICTORIAL PROJECTION 15

Introduction to Pictorial Projection, Isometric Projection - Principle, Isometric Planes, Isometric Scales, Isometric Projection of simple solids and their combination.

Free Hand Drawing - Orthographic Projection - Orthographic views of simple blocks from their Isometric view, Isometric view of simple blocks from their Orthographic views.

UNIT V PERSPECTIVE PROJECTION 10

Perspective Projection of full solids in simple positions with respect to projection planes by visual ray and vanishing point method.

TOTAL: 75 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- Students will construct conic sections and curves and sketch the orthographic views of lines as per drawing standards.

- Obtain orthographic projections of plane surfaces and simple solids in various positions.
- Draw projections of sectioned solids and develop the lateral surfaces of simple solids.
- Draw isometric projections of simple solids and their combinations. Also perform free hand sketching of orthographic views of given objects.
- Draw perspective projections for the given objects in different positions.

TEXT BOOKS:

1. Bhatt N.D, Panchal Pramod V.M and Ingle R, "Engineering Drawing", Charotar Publishing House, 2014.

REFERENCES:

1. Venugopal K and Prabhu Raja V, "Engineering Graphics", New Age International (P) Limited, 2009.
2. Shah M.B and Rana B.C, "Engineering Drawing", Pearson Education, 2009.
3. Gopalakrishna K.R, "Engineering Drawing" (Vol. I & II), Subhas Publications, 2010.
4. Natrajan K.V, "A Textbook of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2006.
5. Gowri S and Jeyapoovan T, "Engineering Graphics", Vikas Publishing House Pvt. Ltd., 2011.

GE18251 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
(Common to all Branches) 3 0 0 3

OBJECTIVES:

- To study the nature and facts about environment.
- To study the interrelationship between living organism and environment.
- To implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of environment - need for public awareness - concept of an ecosystem - structure and function of an ecosystem - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems, Introduction to biodiversity definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity - Biodiversity at global, national and local levels - India as a mega-diversity nation - hot-spots of biodiversity - threats to biodiversity - man-wildlife conflicts - endangered and endemic species of India - conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people - Water resources: Use and over - utilization of surface and ground water, floods, drought, conflicts over water, dams - benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer - pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies - Land resources: Land as a resource - role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles.

UNIT III ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 10

Definition - causes, effects and control measures Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards - solid waste management: causes, effects and control measures of municipal solid wastes, e-Waste, risk related to e-Waste - role of an individual in prevention of pollution - pollution case studies - disaster management: floods, earthquake, cyclone and landslides, land degradation, man induced landslides, soil erosion and desertification.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development - urban problems related to energy - water conservation, rain water harvesting, watershed management - resettlement and rehabilitation of people; its problems and concerns, case studies - role of non-governmental organization- environmental ethics: Issues and possible solutions - Principles of green chemistry, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies - wasteland reclamation - consumerism and waste products - Environment protection act - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife protection act - Forest conservation act - central and state pollution control boards - Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations - population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS, Swine flu, Dengue fever - women and child welfare - role of information technology in environment and human health management - case studies.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the importance of ecosystems, biodiversity and its protection.
- Implement the knowledge which requires optimum use of various natural resources for the conservation of natural resources.
- Classify the different types of pollution, their effects and control measures. Also apply the knowledge gained for disaster management.
- Describe the sustainable development, social issues, role of NGO's and various laws available in the country for environmental protection.
- Recognize the importance of women and child welfare, prevention of HIV /AIDS and usage of technology for environmental management.

TEXT BOOKS:

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2012.
2. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2010.

REFERENCES:

1. Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2012.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, "Environmental Studies - From Crisis to Cure", Oxford University Press, 2011.
4. Tyler Miller. G and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2013.

EE18201 ELECTRIC CIRCUIT ANALYSIS L T P C
3 1 0 4

OBJECTIVES

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuits using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits.
- To impart knowledge on analysis of 3 phase circuits and its phasor diagrams

UNIT I BASIC CIRCUITS ANALYSIS 9+3

Ohm s Law – Kirchoff's laws – DC and AC Circuits – Resistors, Inductances and Capacitances in series and parallel – Mesh, Super mesh, Node and Super node method of analysis for D.C and A.C. circuits - Dependent voltage and current sources – Phasor Diagram – Power, Power factor and Energy.

UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUITS 9+3

Network reduction: Voltage and Current division, Source transformation – Star delta conversion, Thevenin and Norton Theorems – Superposition Theorem – Maximum power transfer theorem – Millman's theorem - Reciprocity Theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 9+3

Series and parallel resonance – Frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Singly tuned circuits – Laplace transform.

UNIT IV TRANSIENT RESPONSE FOR DC, AC CIRCUITS AND FILTERS 9+3

Transient response of RL, RC and RLC Circuits for DC input and A.C. with sinusoidal input – Characterization of two port networks in terms of Z, Y, h and transmission parameters - Low and High pass filters.

UNIT V THREE PHASE CIRCUITS 9+3

Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected, balanced & unbalanced loads – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits

TOTAL: (L: 45+ T: 15): 60 PERIODS

OUTCOMES:

- Analyze DC and single phase AC electrical circuits
- Simplify DC and AC electrical circuits using network theorems
- Study resonance phenomenon in electrical circuits and understand the effect of magnetic coupling between windings
- Perform transient analysis of electrical circuits and model circuits as two-port network.
- Analyze three phase AC electrical circuits

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers, 6th edition, New Delhi, 2003.

2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Second Edition, McGraw Hill, 2003
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, Tata McGraw-Hill, New Delhi, 2001

REFERENCES:

1. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, Tata McGraw Hill, 2007
2. Chakrabati A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999

PC18161	PHYSICS AND CHEMISTRY LABORATORY (Common to all Branches)	L	T	P	C
		0	0	2	1

PHYSICS LABORATORY

OBJECTIVES:

- To make the student to acquire practical skills in the determination of various physical properties of materials.

LIST OF EXPERIMENTS (Any 5 experiments to be conducted)**:**

1. Determination of compressibility of the liquid - Ultrasonic interferometer.
2. Determination of thickness of the given object by Air wedge method.
3. Determination of dispersive power of a prism by Spectrometer.
4. Determination of Young's modulus of wooden scale by Non-Uniform bending.
5. Determination of wavelength, particle size and numerical aperture of fibre using Lasers.
6. Lee's Disc – Thermal conductivity of the poor conductor.
7. Torsional Pendulum – Determination of Rigidity modulus and moment of inertia.

OUTCOMES:

The student will be able to

- Analyze the physical principle involved in the various instruments, also relate the principle to new application.
- Comprehend the Experiments in the areas of optics, mechanics and thermal physics to nurture the concepts in all branches of Engineering.
- Apply the basic concepts of Physical Science to think innovatively and also improve the creative skills that are essential for engineering.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Spectrometer, Mercury Vapour lamp, Lee's disc experimental setup, Travelling microscope, Ultrasonic interferometer, Sodium vapour lamp, Diode laser, Optical fiber kit.

CHEMISTRY LABORATORY

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometery.

LIST OF EXPERIMENTS (Any 5 experiments to be conducted)**:**

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Estimation of copper by EDTA.
3. Conductometric titration of a strong acid with a strong base
4. Estimation of iron content of the given solution using potentiometer.
5. Estimation of iron content of the water sample using spectrophotometer.
6. Determination of molecular weight of polymer using viscometer.
7. Determination of Alkalinity in water.

TOTAL: 60 PERIODS

OUTCOMES:

- Analyze the water quality parameters such as Hardness, alkalinity, copper and iron present in the given water sample.
- Acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis
- Decide whether, the water is fit for domestic and industrial applications

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Conductivity meter - 10 Nos
2. Spectrophotometer - 10 Nos
3. Ostwald Viscometer - 10 Nos
4. Potentiometer - 10 Nos
5. Electronic Balance - 2 Nos

Common Apparatus: Pipette, Burette, conical flask, iodine flask, porcelain tile, dropper (each 30 Nos.)

REFERENCES:

1. Rajendran V, "Engineering Physics", Tata McGraw Hill, 2009.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogels Textbook of Practical Organic Chemistry", 8th Edition, LBS Singapore, 2014

EE18211 ELECTRIC CIRCUITS LABORATORY L T P C
0 0 3 1.5

OBJECTIVES:

- To provide practical exposure in constructing and solving electrical circuits and verifying them with simulation.

LIST OF EXERCISES

1. Simulation and experimental verification of electric circuits by mesh and node analysis.
2. Simulation and experimental verification of Superposition and Millman's theorems.
3. Simulation and experimental verification of Thevenin, Norton and Maximum power transfer theorems.
4. Simulation and experimental verification of transient analysis of electric circuits.
5. Design, simulation and experimental verification of series resonant circuit.
6. Design, simulation and experimental verification of parallel resonant circuit.
7. Design, simulation and experimental verification of low pass and high pass filters.
8. Simulation of three phase, balanced and unbalanced, star and delta networks.
9. Experimental determination of power and power factor in three phase circuits by two-watt meter method.
10. Determination of Z & Y two port network parameters.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the electric circuit laws through simulations and experimental verification.
- Understand circuit theorems through simulations and experimental verification.
- Design, simulate and implement resonant and filter circuits.
- Measurement of power in a three-phase circuit and simulation of three phase networks.
- Measurement of two port network parameters.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Regulated Power Supply: 0 – 15V D.C: 20 Nos.
2. Function Generator (1 MHz): 10 Nos.
3. Oscilloscope (20 MHz): 15 Nos.
4. Resistive and Inductive load: 2 Nos. each.
5. Single Phase Wattmeter: 5 Nos.
6. Decade Resistance, Inductance, Capacitance Boxes: Each 10 Nos.
7. Circuit Connection Boards: 20 Nos.
8. Circuit Simulation Software (5 Users) (Pspice / Matlab /other Equivalent software Package) with PC (5 Nos.) and Printer (1 No.)
9. AC/DC - Voltmeters (20 Nos.), Ammeters (20 Nos.) and Multi-meters (15 Nos.)
10. Necessary Quantities of Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)

MA18351 ENGINEERING MATHEMATICS-III L T P C
(Common to BT, CH, CE, EE, EC and ME) 3 1 0 4

OBJECTIVES:

- To introduce Fourier series analysis this is central to many applications in engineering apart from its uses in solving boundary value problems.
- To understand the basic concepts of the Fourier transform techniques and its application in engineering.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients.

UNIT II FOURIER SERIES 9+3

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

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of PDE – Method of separation of variables - Solution of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV FOURIER TRANSFORMS 9+3

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction, long division method and residue technique) –Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL (L: 45+T: 15): 60 PERIODS

OUTCOMES:

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

- Express proficiency in handling higher order Partial differential equations.
- Acquire the skill in examining a signal in another domain rather in the original domain by handling Full and Half Range Fourier Series.
- Develop skills in classification, formulation, solution, and interpretation of PDE models.
- Develops the skill of conversion between time domain to frequency domain using the concept of Fourier Transforms.
- Apply the systematic method for finding the impulse response of LTI systems described by difference equations: partial fraction expansion.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt. Ltd.1998.

REFERENCES:

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2011.
3. Veerarajan. T., "Transforms and Partial Differential Equation", Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2012
4. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata Mc Graw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India pvt. Ltd. 7th Edition, New Delhi, 2012.

EE18301 ELECTRON DEVICES AND CIRCUITS L T P C
3 0 0 3

OBJECTIVES:

- Familiarize the theory, construction, and operation of basic electronic devices.
- Introduce the applications of various electron devices.

UNIT I SEMICONDUCTOR DIODES 9

PN junction diode – Static V-I characteristics and parameters – Current equation – Diode equivalent circuits – Space charge/Transition capacitance and Diffusion capacitance – Reverse recovery time – Temperature effects.

Applications of PN junction diode: Rectifiers: Single phase half wave and full wave rectifiers – clippers – clampers Voltage doubler and voltage tripler circuit

Zener and Avalanche breakdown mechanisms – Zener diodes – Forward and Reverse characteristics– Voltage regulation phenomenon.

Applications of Zener diode: Operation of basic Zener diode shunt regulator – Line and Load voltage regulations.

UNIT II BIPOLAR JUNCTION TRANSISTORS 9

Introduction to Bipolar Junction Transistor – Construction and operation of transistor-Transistor voltages and currents – Modes of operation – Different types of configuration-Input and Output characteristics – Thermal runaway and Stabilization – AC and DC load lines – Need for biasing a Transistor and various biasing techniques – BJT small signal model – Analysis of CE, CB, CC amplifiers –Determination of h parameters.

UNIT III FIELD EFFECT TRANSISTORS 9

Construction, Principle of operation of N channel and P channel JFET's – Drain and Transfer characteristics – Expression for drain current – Construction, Principle of operation of Enhancement type and Depletion type MOSFET's – Drain and Transfer characteristics – Handling precautions of MOSFET – Biasing circuits for JFET and MOSFET – VMOS and CMOS transistors – Small signal model of FET/MOSFET – Analysis of CS, CG and Source follower – Comparison of FET and BJT.

UNIT IV MULTISTAGE & FEEDBACK AMPLIFIERS 9

Two stage RC coupled amplifier –Analysis of Differential amplifier – Common mode, Differential mode & CMRR – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

Advantages of negative feedback – Analysis of Voltage / Current, Series, Shunt feedback Amplifiers using transistor

UNIT V OSCILLATORS AND OPTOELECTRONIC DEVICES 9

Positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

Construction, Operation and Characteristics of Optoelectronic devices: LED, LCD, Photo diode, Photo transistor, Opto-Coupler and Solar Cell.

TOTAL: 45 PERIODS

OUTCOMES

- Describe and analyse different types of PN devices.
- Describe and analyse different types of current and Voltage controlled devices.
- Analyse performance of devices using small signal model.
- Design and implementation of various electronic devices in circuits.

TEXT BOOKS

1. David A Bell, “Electronic Devices and Circuits”, Oxford university press, 2008.
2. Boylestead L R and Nashelsky L, "Electronic Devices and Circuit theory", Pearson Prentice Hall, New Delhi, 2009.

REFERENCES

1. Thomas L Floyd, "Electronic Devices", prentice hall of India, New Delhi, 2007.
2. Floyd, Buchla, “Fundamentals of Analog Circuits”, Pearson, 2013
3. Donald A Neamen, “Electronic Circuit Analysis and Design” Tata McGraw Hill, 3rd Edition, 2003.
4. G.K.Mithal, “Electronic devices and circuits”, Khanna Publishers, New Delhi, 2010.
5. Millman J, Christos C Halkias, SatyabatraJit, "Electronic devices and circuits", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2008.
6. Theodore F Bogart Jr, Jefffrey S Beasley, Guillermo Rico’ “Electronic devices and circuits”, Prentice Hall of India, New Delhi, 2004.

EE18302 **ELECTROMAGNETIC THEORY** **L T P C**

3 0 0 3

OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of electrostatics, electrical potential, energy density and their applications.
- To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
- To impart knowledge on the concepts of Faraday's law, induced emf and Maxwell's equations
- To impart knowledge on the concepts of electromagnetic waves and Poynting vector.

UNIT I ELECTROSTATICS – I **9**

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields – Gradient, Divergence, Curl – theorems and applications – Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

UNIT II ELECTROSTATICS – II **9**

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics – Dielectric polarization – Dielectric strength – Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT III MAGNETOSTATICS **9**

Lorentz force, magnetic field intensity(H) – Biot–Savart's Law – Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density(B) – Magnetic materials – Magnetization, Magnetic field in multiple media – Scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Self and mutual inductance - Inductance of a solenoid, Energy density, Applications.

UNIT IV ELECTRODYNAMIC FIELDS **9**

Magnetic Circuits – Faraday's law – Transformer and motional EMF – Displacement current – Maxwell's equations(differential and integral form) – Relation between field theory and circuit theory – Applications.

UNIT V ELECTROMAGNETIC WAVES **9**

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth – Poynting vector.

TOTAL: 45 PERIODS

OUTCOMES:

- Implement vector calculus in electromagnetic field.
- Understand the fundamentals of electrostatics & magnetostatics.
- Analyse electromagnetic fields and potentials.
- Derive different forms of Maxwell's equation.
- Solve electromagnetic wave equations and analyse electromagnetic paramaters.

TEXT BOOKS:

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 4th Edition ,Oxford University Press Inc.First India edition, 2009.
2. Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', PHI Learning Private Limited, New Delhi, Second Edition-2009.
3. K.A. Gangadhar, P.M. Ramanthan ' Electromagnetic Field Theory (including Antennaes and wave propagation', 16th Edition, Khanna Publications, 2007.

REFERENCES:

1. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill 8thRevised edition, 2011.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.
4. Rakhesh Singh Kshetrimayum, 'Electromagnetic Field Theory' Cengage Learning, 1st Edition, 2012.

EE18303 ELECTRICAL MACHINES – I L T P C
3 1 0 4

PREREQUISITES: Electric circuit Analysis

OBJECTIVES:

- To introduce techniques of magnetic-circuit analysis and introduce magnetic materials
- To familiarize the constructional details, principle of operation, prediction of performance, methods of testing of transformers and three phase transformer connections.
- To study the working principles of DC machines as generators, determination of their no load / load characteristics and starting and methods of speed control of dc motors.
- To estimate the various losses taking place in DC Motors and to study the different testing methods to arrive at their performance.

UNIT I MAGNETIC CIRCUITS AND MAGNETIC MATERIALS 9+3

Magnetic circuits – Laws governing magnetic circuits - Flux linkage, Inductance and energy – Statically & Dynamically induced EMF - Torque – Properties of magnetic materials, Hysteresis and Eddy Current losses - AC excitation, Introduction to permanent magnets - Transformer as a magnetically coupled circuit.

UNIT II TRANSFORMERS 9+3

Construction – Methods of Cooling – Principle of operation on no load and load – Equivalent circuit – Phasor diagram - Losses – Testing – Efficiency and Voltage regulation - All day efficiency - Sumpner test, Per unit representation – Inrush current - Three phase transformers - Connections – Scott Connection – Phasing of transformer –- Parallel operation of transformers - Auto transformer- Tertiary winding – Transformer standards and Specifications.

Features of tap changing transformers, Instrument transformers, Welding transformers, Dry type transformers

UNIT III ELECTROMECHANICAL ENERGY CONVERSION AND CONCEPTS IN ROTATING MACHINES 9+3

Energy in magnetic system – Field energy and co-energy - Force and torque equations – Singly and multiply excited magnetic field systems- MMF of distributed windings – Winding Inductances- Magnetic fields in rotating machines – Rotating mmf waves – Magnetic saturation and leakage fluxes.

UNIT IV DC GENERATORS 9+3

Construction & Components of DC Machines – Cooling, Mounting, Standards & Specifications, Principle of operation - Lap and wave windings - EMF equations– Circuit model – Armature reaction – Methods of excitation - Commutation and Interpoles - Compensating winding – Characteristics of DC generators - Parallel operation - Applications.

UNIT V DC MOTORS 9+3

Principle of operation - Types of DC Motors – Back EMF and Torque equations - Speed Torque Characteristics - Starting – Types of Starters - Speed control - Braking - Testing and efficiency – Retardation test - Swinburne's test and Hopkinson's test – Testing standards - Permanent magnet dc motors (PMDC) - Applications.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- Analyze a magnetic circuit and determine the performance parameters.
- Compute the performance parameters of a transformer and understand the function of the various special transformers.
- Derive the force and torque of an electro-mechanical conversion device and analyze the performance.
- Derive the characteristics and estimate the performance of DC generators.
- Understand the necessity of Starting, controlling, braking, and the performance of different types of DC motors.

TEXT BOOKS:

1. Nagrath I. J and Kothari D. P. "Electric Machines", Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2010.
2. M.N.Bandyopadhyay, "Electrical Machines Theory and Practice", PHI Learning Pvt Ltd., New Delhi, 2009.
3. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, "Electric Machinery", Sixth edition, Tata McGraw Hill Books Company, 2003.

REFERENCES:

1. P. C. Sen, "Principles of Electrical Machines and Power Electronics", John Wiley & Sons, 1997.
2. Deshpande M. V, "Electrical Machines" , PHI Learning Pvt. Ltd., New Delhi, 2011.
3. P.S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2003.
4. S.Sarma & K.Pathak, "Electric Machines", Cengage Learning India (P) Ltd., Delhi, 2011.
5. Richard C Dorf, "Electrical Power Engineering hand book", CRC Press, 1998.

EE18304	CONTROL SYSTEMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand the use of transfer function models for analysis of physical systems and introduce the control system components
- To provide adequate knowledge on the time response of systems and steady state error analysis
- To accord basic knowledge in obtaining the open loop and closed loop frequency responses of systems
- To introduce stability analysis and design of compensators
- To introduce state variable representation of physical systems and study the effect of state feedback

UNIT I SYSTEMS AND THEIR REPRESENTATION 12

Basic elements in control systems – Open and closed loop systems – Transfer function - Modelling of mechanical systems – Electrical analogy – Synchros – AC and DC servomotors - Modelling – Block diagram reduction techniques – Signal flow graphs Stability analysis – Simulation study.

UNIT II TIME RESPONSE 12

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Steady state error – Root locus technique – Effects of P, PI, PID modes of feedback control – Simulation study.

UNIT III FREQUENCY RESPONSE 12

Frequency response – Frequency domain specifications – Correlation between frequency domain and time domain specifications – Stability analysis - Bode plot – Routh Hurwitz criterion – Polar plot - Nyquist stability criterion – Simulation study.

UNIT IV STATE VARIABLE ANALYSIS 12

Concept of state variables – State models for linear and time invariant Systems – Different forms of state model – Solution of state equation in controllable canonical form – Controllability and observability – Simulation study.

UNIT V COMPENSATOR DESIGN 12

Effect of adding poles and zeros - Lag, lead and lag-lead networks – Lag, lead and lag-lead compensators design using Bode plot – Design of state feedback controller - Case study of electrical systems.

TOTAL (L: 45+T: 15): 60 PERIODS

OUTCOMES:

- Derive transfer functions for electrical and mechanical systems.
- Draw the root locus for a transfer function and interpret.
- Sketch Bode and Polar plots for a transfer function.
- Verify the stability of a system by Routh-Hurwitz and Nyquist criteria.
- Model a physical system with state variables and solve.
- Design a compensator using Root locus / Bode plots.

TEXT BOOKS:

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
2. Norman S Nise, "Control Systems Engineering", 7th Edition, Wiley, 2015.
3. Benjamin C. Kuo, "Automatic Control systems", Wiley, 2014.

REFERENCES:

1. M. Gopal, "Control Systems, Principles and Design", 4th Edition, Tata McGraw Hill, New Delhi, 2012.
2. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.
3. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Prentice Hall, 2012.
4. K. Ogata, "Modern Control Engineering", 5th edition, PHI, 2012.
5. S.Palani, Anoop K.Jairath, "Automatic Control Systems including MATLAB", ANE Books, 2013.
6. NPTEL Online Courses on " Control Engineering" and "Digital Control Systems".

EE18311 ELECTRICAL MACHINES LABORATORY – I L T P C
0 0 3 1.5

OBJECTIVES:

To familiarize the students with the operation of D.C. machines and Transformers and to equip them with experimental skills.

LIST OF EXPERIMENTS:

DC Machines:

1. Open circuit and Load characteristics of DC separately excited and self-excited shunt generator.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt, series and compound motor.
4. Swinburne's test.
5. Hopkinson's test on DC motor – generator set.
6. Study of Starters, Regenerative and Dynamic braking for DC motors.
7. Speed control of DC shunt motor and its 4 quadrant operation.

Transformers:

8. Load test on single-phase transformer and three phase transformers.
9. Open circuit and short circuit tests on single phase transformer.
10. Polarity Test and Sumpner's test on single phase transformers.
11. Parallel operation of single phase transformers.
12. Study of 3-phase transformer connections.

TOTAL: 45 PERIODS

OUTCOMES:

- Determine the characteristics of a dc machine operating as a motor or generator
- Estimate the performance parameters of a dc machine by Swinburne and Hopkinson tests.
- Vary the speed of a dc motor by armature and field control.
- Determine the characteristics of single and three phase transformers
- Share the loading between transformers operating in parallel

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. DC Separately excited generator coupled with DC Shunt Motor – 1 No.
2. DC Shunt generator Coupled with DC Shunt Motor – 1 No.
3. DC Shunt Motor Coupled with DC Compound Generator – 1 no
4. DC Shunt Motor with loading Arrangement – 3 nos
5. DC Series Motor with loading Arrangement – 1 no.
6. DC Compound motor with loading Arrangement – 1 no.
7. DC drive for 4 quadrant operation of dc motor: 1 no
8. Dynamic braking panel for dc motor: 1 no
9. Single Phase Transformer – 6 nos

10. Three phase transformer – 2 nos
11. Single Phase Resistive Loading Bank – 3 nos
12. Three Phase Resistive Loading Bank. – 2 nos
13. Tachometer -Digital/Analog – 8 nos
14. Single Phase Auto Transformer – 5 nos
15. Three Phase Auto Transformer – 1 No.
16. SPST switch – 3 nos
17. Wattmeter : 10 nos
18. Lamp loading arrangement – 3 nos.
19. Ammeters : 20 nos
20. Voltmeters :20 nos
21. Rheostats : 15 nos

EE18312 MEASUREMENTS AND INSTRUMENTATION LABORATORY **L T P C 0 0 3 1.5**

OBJECTIVE:

- Devise measurement techniques of various electrical quantities, instrumentation and calibration.
- Introduce various components of measurement systems.

LIST OF EXPERIMENTS

1. DC bridges.
   (a) Measurement of Low resistance using Kelvins Bridge
   (b) Measurement of Medium resistance using Wheatstone Bridge.
2. AC bridges.
   (a) Measurements of unknown Inductance using Anderson Bridge
   (b) Measurements of unknown capacitance using Schering bridge
3. Calibration of Measuring Instruments
   (a) Calibration of voltmeter
   (b) Calibration of ammeter
   (c) Calibration of Energy meter
4. Calibration of current transformer
5. Measurement of Three phase power and power factor.
6. Dynamics of sensors/Transducers
   (a)Temperature (b)Pressure (c)Displacement (d)Optical (e)Strain (f)Flow
7. Analog to Digital converters.
8. Digital to Analog converters.
9. Instrumentation Amplifier
10. Measurement of iron loss

TOTAL : 45 PERIODS

OUTCOMES

- Understand the basic concepts of bridge networks.
- Understand the working of various sensors/transducers and signal conditioning circuits.
- Calibrate various measuring instruments and current transformer.
- Understand the method of measuring iron loss in a magnetic material.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. DC Bridges

Equipment

1. Kelvin Double bridge kit – 1 No
2. Unknown resistance – 1 No
3. Multimeter – 1 No

Equipment

1. Wheat stone Bridge kit – 1 No
2. Unknown resistance – 1 No
3. Multimeter – 1 No

2. AC BRIDGES

Equipment

1. Anderson Bridge kit – 1 No
2. Multimeter – 1 No
3. Unknown inductance – 1 No

Equipment

1. Schering Bridge kit – 1 No
2. Multimeter – 1 No
3. Unknown capacitance – 1 No

4. Calibration of single-phase energy meter.

Equipment

1. Energy meter – 1 No
2. Wattmeter – 1 No
3. Stop watch – 1 No
4. M.I Ammeter – 1 No
5. M.I Voltmeter – 1 No

5. Calibration of current transformer.

Equipment

1. Current Transformer – 1 No
2. Lamp Load – 1 No
3. Voltmeter – 1 No
4. Ammeter – 1 No

6. Measurement of three phase power and power factor.

Equipment

1. 3 phase Auto transformer – 1 No
2. M.I Ammeter – 1 No
3. M.I Voltmeter – 1 No
4. Wattmeter – 1 No

8. A/D Converter

Equipment

1. IC 741 – 1 No
2. DC trainer kit – 1 No
3. RPS – 1 No
4. Resistor – 1 No
5. CRO – 1 No

9. D/A Converter

Experiment

1. IC 741 – 1 No
2. DC Trainer kit – 1 No
3. RPS – 1 No
4. Resistor – 1 No
5. CRO – 1 No

11. Measurement of iron loss.

Equipment

1. Maxwell bridge set up – 1 No
2. Ring specimen – 1 No
3. Ammeter – 1 No
4. Galvanometer – 1 No

HS18361 COMMUNICATION AND SOFT SKILLS LABORATORY

L	T	P	C
0	0	3	2

OBJECTIVES:

- To enable learners to build confidence and enhance their language proficiency.
- To expose learners to the use of professional English.
- To equip them with employability skills.

UNIT I LISTENING AND SPEAKING SKILLS **15**

Conversation skills – types - professional introductory talk, nuances of face-to-face and telephonic talks; formal and informal conversations in a professional setup – conversing with customers/clients/officials; group discussion – etiquette and dos and don'ts; turn-taking; mock interview – etiquette and dos and don'ts – audio-visual interface for enhancement of listening and speaking skills.

UNIT II ENGLISH FOR PROFESSIONAL EXAMINATIONS **15**

Understanding the structure of sentences, paragraphs and reading comprehension – vocabulary building – professional and technical terms – contextual meaning - making inferences from contexts – spelling – subject-specific words – usage and user-specific terminology – assembling real-life English skills and transferable skills required for academic study and employability.

UNIT III SOFT SKILLS **15**

Nuances of persuasive talk - product promotion, business appraisal, professional linguistics - denotation and connotation language; crisis management – problem solving and finding solutions; negotiation skills – persuading and convincing, briefing; stress management.

TOTAL : 45 PERIODS

TEACHING METHODS:

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for gaining proficiency and better participation in the class.

OUTCOMES

At the end of the course, learners should be able to

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews.

LAB INFRASTRUCTURE:

S.No	Description of Equipment (minimum configuration)	Qty Required
1	**Server** • PIV System • 1 GB RAM / 40 GB HDD • OS: Win 2000 server • Audio card with headphones • JRE 1.3	1 No
2	**Client Systems** • PIII or above • 256 or 512 MB RAM / 40 GB HDD • OS: Win 2000 • Audio card with headphones • JRE 1.3	60 No's
3	Handicam	1 No
4	CC TV + Microphone	2 Nos
5	Television 46"	1 No
6	Collar mike	1 No
7	Cordless mike	1 No
8	Audio Mixer	1 No
9	DVD recorder/player	1 No
10	LCD Projector with MP3/CD/DVD provision for Audio/video facility	1 No

EVALUATION:

Internal: 20 marks

Record maintenance: Students should write a. a Cover letter and a Resume or SoP, b. Project Proposal.

External: 80 marks

Online Test (IELTS, TOEFL, MCQs - 35 marks

Interview - 15 marks

Presentation - 15 marks

Group Discussion - 15 marks

Note on Internal and External Evaluation:

1. Interview – mock interview can be conducted on one-on-one basis.
   a. Speaking on a topic - extempore or predetermined, role play: convincing a customer to buy his product.
   b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
2. Presentation – should be extempore on simple topics.
3. Discussion – topics of different kinds; general topics, and case studies.

REFERENCES :

1. Business English Certificate Materials, Cambridge University Press.
2. Graded Examinations in Spoken English and Spoken English for Work downloadable materials from Trinity College, London.

3. International English Language Testing System Practice Tests, Cambridge University Press.
4. Allen, David. Getting Things Done. Penguin Books, New York, USA
5. Robert M. Sapolsky and Peter Berkrot., Why Zebras Don't Get Ulcers: The Acclaimed Guide to Stress, Stress-Related Diseases, and Coping. W. H. Freeman; 2 edition
6. Personality Development (CD-ROM), Times Multimedia, Mumbai.
7. Robert M Sherfield and et al. "Developing Soft Skills" 4th ed , New Delhi: Pearson Education, 2009.

MA18451 **COMPUTATIONAL METHODS** **L T P C**

(Common to CH, CE, EE, MR and ME) **3 0 0 3**

OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in Engineering and Technology.

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9

Solution of algebraic and transcendental equations – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Gauss Seidel iterative method - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method.

UNIT II INTERPOLATION AND APPROXIMATION 9

Interpolation with unequal intervals - Lagrange's interpolation – Inverse interpolation using Lagrange's method - Newton's divided difference interpolation – Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9

Single Step methods - Taylor's series method - Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations, second order equations and simultaneous first order equations - Multi step methods - Milne's and Adams- Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS 9

Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL : 45 PERIODS

OUTCOMES:

- Apply numerical technique to solve algebraic and transcendental equations.
- Apply the knowledge and skills of numerical methods to do interpolation and approximation.
- Develops the skill to evaluate differentiation and integration numerically.
- Acquire the skill to solve ordinary differential equation numerically.
- Acquire the skill to solve partial differential equation numerically.

TEXT BOOKS:

1. Grewal. B.S., and Grewal. J.S., Numerical methods in Engineering and Science, Khanna Publishers, 9th Edition, New Delhi, 2007.
2. Iyengar. S.R.K., and Jain. R.K, Numerical Methods, New Age International Publishers, New Delhi, 2012.

3. William Embleton OBE and Leslie Jackson, Reed's Mathematics for Engineers, Adlard Coles Nautical, London, 2011.(for Marine Engineers)

REFERENCES:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 7th Edition, Wiley, India, 2007.
2. Chapra. S.C., and Canale.R.P., Numerical Methods for Engineers, Tata McGraw Hill,5th Edition, New Delhi, 2007.
3. Brian Bradie. A friendly introduction to Numerical analysis, Pearson Education, Asia, New Delhi, 2007.
4. Sankara Rao. K., Numerical methods for Scientists and Engineers, Prentice Hall of India Private, 3rd Edition, New Delhi, 2007.
5. Gerald. C. F., and Wheatley. P. O., Applied Numerical Analysis, Pearson Education, Asia, 6th Edition, New Delhi, 2006.
6. Venkataraman. M.K. Numerical Methods in Science and Engineering, National Publishers, 1995.
7. Kandasamy. K., Thilagavathy. K., and Gunavathi. K., Numerical Methods, S. Chand & Company Ltd., New Delhi, 2008.

EE18401 **ELECTRIC POWER SYSTEM** **L T P C**
3 0 0 3

OBJECTIVES:

- Understand the structure of Power System and Indian Electricity Rules and Acts.
- Computation of transmission system parameters and analysis of voltage distribution in insulator strings and cables.
- Obtain the equivalent circuits of transmission lines and analyze its performance.
- Comprehend the configuration and components of AC distribution systems.
- Understand the structure and operation of substation and grounding.

UNIT I STRUCTURE OF POWER SYSTEM 9

Structure of Electric Power System: Generation, Transmission and Distribution – Qualitative treatment on Types of generation: Conventional (Thermal & Hydro Power Plant) and Non-conventional Energy Sources (solar and wind power plant) – Introduction to DC & AC and overhead & underground Transmission/Distribution systems – Overview on operation of Generation, Transmission & Distribution system in India – Indian Electricity (IE) Rules and Acts – Electrical Safety.

UNIT II TRANSMISSION SYSTEM PARAMETERS 9

Overhead lines-Inductance of single phase line – three phase symmetrical spaced line – three phase transposed line – three phase double circuit line of solid conductors – bundled conductors – Capacitance of single phase and three phase symmetrical transmission line – double circuit line of solid conductors – Skin and proximity effect – Corona discharge

Underground cables: Capacitance of Single-core cable – Grading of cables – Power factor and heating of cables – Capacitance of 3- core belted cables.

Insulators: Types – voltage distribution in insulator string – improvement of string efficiency – testing of insulators.

UNIT III PERFORMANCE OF TRANSMISSION LINES 9

Classification of lines – short line, medium line and long line – equivalent circuits, phasor diagram, Transmission efficiency and voltage regulation, real and reactive power flow in lines – Power - circle diagrams – Ferranti effect – Mechanical designs of transmission line : sag and tension calculations for different weather conditions – Tower spotting & Types of towers.

UNIT IV DISTRIBUTION SYSTEMS 9

Classification of 3 phase AC Distribution system – Types of primary & secondary distribution systems – Voltage drops in ac distributors (uniform and non-uniform loading), (Numerical) – Economic choice of conductor size (kelvins law) & AC transmission voltage – Distribution Feeders: Radial and Ring types of primary feeders, voltage levels, energy losses in feeders – O&M of Distribution & service lines – Distribution substation :Types, Layouts, single line diagram/equipments – Anti-theft measures – Demand side management (Qualitative)

UNITV SUB-STATION 9

Types: Generation sub-station, Grid sub-station, Gas Insulated s/s etc – Indoor/outdoor – Sub-station operation: Grid operation, communication with RLDC/SLDC etc – General arrangement and layout of substation/switchyard, switching schemes – Overview of

Equipment – Qualitative treatment on Grounding: Types of grounding, earth testing & treatment, earth mat design, step Potential, Neutral grounding reactor – Auxiliary facilities.

TOTAL : 45 PERIODS

OUTCOMES:

- Acquire knowledge on DC/AC and overhead/underground transmission and distribution systems.
- Calculate transmission line parameter calculations and their effect on power system.
- Model Overhead Transmission lines / Underground cables and analyse their performance.
- Understand the types, lay out and operation of substation.
- Learn Indian Electricity Rules and Acts, Electrical Safety. Anti-theft measures and Demand side management.

TEXT BOOKS:

1. D.P.Kothari , I.J. Nagarath, 'Power System Engineering', Tata McGraw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.
2. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009.
3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.
4. S. Rao, Testing Commissioning Operation and Maintenance of Electrical Equipment, Khanna publishers.

REFERENCES:

1. B.R.Gupta,, S.Chand, 'Power System Analysis and Design' New Delhi, Fifth Edition, 2008.
2. Luces M.Fualken berry ,Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
3. Hadi Saadat, 'Power System Analysis,' PSA Publishing; Third Edition, 2010.
4. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering',Newnes; Fourth Edition, 2012.
5. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013..
6. S.L.Uppal – Electrical Power – Khanna Publishers Delhi.

EE18402 DIGITAL LOGIC CIRCUITS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge on Boolean algebra, implement combinational sequential logic circuits and to have first hand knowledge on memory devices and digital logic families.

UNIT I BOOLEAN REDUCTION 9

Review of number systems, binary codes – Boolean Algebra and laws – Simplification of Boolean expressions- Introduction to sum of products (SOP) & product of sums (POS) – Logic Minimization using K-map and their realisation using logic gates.

UNIT II COMBINATIONAL CIRCUITS 9

Combinational logic – simplification and implementation; Code converters, adders, BCD adder, subtractors, multiplexers and demultiplexers, encoders, decoders, parity generator and checker.

UNIT III SEQUENTIAL CIRCUITS 9

Sequential logic – SR, JK, D and T flip flops – level triggering and edge triggering – counters – asynchronous and synchronous type – Modulo counters – Shift registers – Sequence generator – Design of synchronous sequential circuits – Moore and Melay models- state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Design of Asynchronous sequential circuits – Transition table, flow table – race conditions, hazards and errors in digital circuits; Analysis of asynchronous sequential logic circuits. Introduction to VHDL coding – Simple coding examples of adder, multiplexers, counters (structural, dataflow and behavioral model)

UNIT V MEMORY DEVICES AND DIGITAL LOGICAL FAMILIES 9

Implementation of combinational logic circuits using ROM, PLA, PAL – Introduction to FPGA – Digital Logic Families: Logic gates using TTL, ECL and MOS families – operation, characteristics of digital logical family.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand various aspects of Boolean algebra.
- Design and evaluation of combinational logic circuits.
- Design and evaluation of sequential logic circuits.
- Design and analysis of asynchronous sequential logic circuits through VHDL.
- Comprehend the operation and characteristics of memory devices and digital logic families.

TEXT BOOKS:

1. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education,2013.
2. John M.Yarbrough, 'Digital Logic, Application & Design', Thomson, 2002.Mandal "Digital Electronics Principles & Application, McGraw Hill Edu,2013.

REFERENCES:

1. Charles H.Roth,Jr,Lizy Lizy Kurian John, 'Digital System Design using VHDL, Cengage, 2013.
2. William Keitz, Digital Electronics-A Practical Approach with VHDL,Pearson,2013.
3. Floyd and Jain, 'Digital Fundamentals', 8th edition, Pearson Education, 2003.
4. Anand Kumar, Fundamentals of Digital Circuits,PHI,2013.
5. Gaganpreet Kaur, VHDL Basics to Programming, Pearson, 2013.
6. Salivahanan, Arivazhagan, 'Digital Circuits & Design', Vikas Publishing.

EE18403 ELECTRICAL MACHINES – II L T P C

3 1 0 4

PREREQUISITES: Electrical Machines – I

OBJECTIVES:

- To impart knowledge on construction, principle of operation, performance analysis and control of three phase & single phase induction motors and synchronous motors.
- To instruct on the construction, principle of operation, analysis of regulation and parallel operation of alternators

UNIT I THREE PHASE INDUCTION MOTOR 12

Constructional details – Types of rotors – Enclosures –- Principle of operation – Slip – Equivalent circuit – Torque-Slip characteristics – Condition for maximum torque – Three phase windings – Cogging and crawling – Losses and efficiency – No load and blocked rotor tests – Circle diagram – separation of losses –Double cage induction motors – Linear Induction motors – Magnetic levitation – Induction Generator.

UNIT II STARTING, BRAKING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 12

NEMA and BIS Standards – Need for starting – Types of starters – DOL, Rotor resistance, Auto transformer and Star-delta starters – Speed control – Voltage control, Frequency control and Pole changing – Cascaded connection – V/F control – Slip power recovery scheme – Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT III SINGLE PHASE INDUCTION MOTORS & SPECIAL MACHINES 12

Constructional details – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods – Capacitor- start & run Induction motor – Shaded pole induction motor – AC series motor – Hysteresis motor – Synchronous reluctance motor – Stepper motor – BLDC motor – Switched reluctance motor

UNIT IV SYNCHRONOUS GENERATOR 12

Constructional details – Types of rotors – Brushless excitation – Cooling – Winding factors – EMF equation – Synchronous reactance – Armature reaction – Phasor diagram – Voltage regulation – EMF, MMF, ZPF and A.S.A methods – Synchronization – Synchronizing torque – Change of excitation and mechanical input – Steady state power angle characteristics – Parallel operation – Two reaction theory – Slip test – Transient reactance

UNIT V SYNCHRONOUS MOTOR 12

Principle of operation – Torque equation – Operation on infinite bus bars – V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed – Hunting – frequency of oscillation – damper windings – Synchronous induction motors – Synchronous condenser.

TOTAL : 60 PERIODS

OUTCOMES:

- Determine the performance parameters of a 3 phase induction motor by suitable tests.
- Evaluate different types of starters and classify the speed control schemes of 3 phase induction motors.
- Characterise different types of single phase induction motors and special machines.
- Predict the regulation of an alternator by different methods.
- Describe the operation and characteristics of synchronous motors.

TEXT BOOKS:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, 'Electric Machinery', Tata Mc Graw Hill publishing Company Ltd, 2003.
2. D.P. Kothari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2002.
3. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.
4. Theodore Wildi, 'Electrical Machines, Drives and Power systems', Pearson New International Edition, 2014.
5. K. Venkataratnam , 'Special Electrical Machines', Universities Press, 2014.

REFERENCES:

1. M.N.Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.
2. Charless A. Gross, "Electric /Machines, "CRC Press, 2010.
3. K. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2002.
4. M G Say, 'Performance and Design of Alternating current machines', CBS publishers and distributors, 2005.

EE18404 ANALOG ELECTRONICS L T P C
3 0 0 3

PREREQUISITE: Electron devices and circuits

OBJECTIVES

- Introduction of electron devices fabrication in integrated circuits and to introduce operational aspects of Op Amp and to explore its various applications.

UNIT I IC FABRICATION 9

Monolithic IC technology–Basic planar processes Fabrication of Monolithic transistors, FET, Monolithic diodes, Integrated resistors, Integrated capacitors, and PV cell

UNIT II INTRODUCTION TO OPERATIONAL AMPLIFIERS 9

Op-Amp block diagram and its ideal characteristics– DC characteristics –CMRR, Slew rate and frequency response of op amp and circuit stability – Basic applications – Op amp as a DC amplifier – Inverting amplifier, Non inverting amplifier, Differential amplifier, voltage follower ,Scale changer, inverter, Summer, Subractor, Differentiator and Integrator

UNIT III APPLICATIONS OF OPAMP 9

V/I & I/V converters, Instrumentation amplifier and its applications for transducer Bridge Log and Anti-Log amplifiers, Analog multiplier & Divider ,Comparators, Clippers, Clampers, Peak detector, S/H circuit, multivibrators, waveform generators – First and Second order active filters – D/A converter (R-2R ladder and weighted resistor types)–A/D converter (Dual slope, successive approximation and flash types).

UNIT-IV SPECIAL IC'S 9

555 Timer circuit – Functional block, characteristics, monostable and astable modes of operation; Phase locked loop-Block diagram –Operation of PLL – 566-voltage controlled oscillator circuit; 565-phase locked loop circuit functioning and Applications – AD633 Analog multiplier ICs.

UNIT-V APPLICATION IC'S 9

IC voltage regulators –LM78XX, 79XX– Fixed and adjustable three terminal regulators, Block diagram of 723 general purpose voltage regulator, Circuit configurations, Current limiting schemes, Output current boosting, Switching regulators. SMPS–LM 380 power amplifier– ICL 8038 function generator IC –AD623 Instrumentation Amplifier and its application

TOTAL: 45 PERIODS

OUTCOMES

- Comprehend IC fabrication techniques of electron devices.
- Understand the basic concept of operational amplifier and its basic applications.
- Analyze the use of Op Amp in various analog circuit applications.
- Comprehend operation and applications of 555 timer and 565 PLL IC's.
- Analyze the operation of IC based regulators and instrumentation amplifier.

TEXT BOOKS:

1. David A.Bell, 'Op-amp & Linear ICs', Oxford, 2013.
2. D.RoyChoudhary, SheilB.Jani, 'Linear Integrated Circuits', II edition, New Age, 2003.
3. RamakantA.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003 / PHI. 2000.

REFERENCES:

1. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2003.
2. Robert F.Coughlin, Fredrick F. Driscoll, 'Operational amplifier and linear integrated circuits",Prentice Hall of India 2003.
3. Floyd ,Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.
4. Sedra and smith, "Microelectronic Circuits" Oxford University Press, 2004.

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EE18411 ELECTRICAL MACHINES-II LABORATORY L T P C
0 0 3 1.5

OBJECTIVES:

- To familiarize the students with the operation of synchronous machines and induction machines and equip them with experimental skills.

LIST OF EXPERIMENTS:

1. Regulation of three phase alternator by EMF and MMF methods.
2. Regulation of three phase alternator by ZPF and ASA methods.
3. Regulation of three phase salient pole alternator by slip test.
4. V and Inverted V curves of Three Phase Synchronous Motor.
5. Load test on single phase and three phase induction motor (Cage & Slip ring).
6. Equivalent circuit parameters of three-phase induction motor by no load and blocked rotor tests.
7. Equivalent circuit parameters of single-phase induction motor by no load and blocked rotor tests.
8. Study of braking methods of three phase induction motor.
9. Speed control of Induction motor by different methods
10. Study of Induction generator (Stand-alone and Grid-connected)

TOTAL: 45 PERIODS

OUTCOMES:

- Determine the characteristics of single and three phase induction motors.
- Obtain equivalent circuit parameters and estimate the performance of single and three phase induction motors
- Vary the speed of an induction motor by various methods
- Estimate the regulation of an alternator (cylindrical and salient pole) by various methods.
- Determine the characteristics of a synchronous motor for varying excitation

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. DC Shunt Motor Coupled with Three phase cylindrical rotor alternator – 2 nos
2. DC Shunt Motor Coupled with Three phase salient-pole alternator – 1 no
3. DC Shunt Motor Coupled with Three phase cage induction motor– 1 no
4. Synchronous Induction motor – 1 No.
5. Single Phase Induction Motor with Loading Arrangement – 2 nos
6. Three Phase cage Induction Motor with loading Arrangement – 4 nos
7. Three phase slip ring induction motor with loading arrangement – 2 nos
8. Rotor resistance panel for slip ring induction motor – 1 no
9. AC drive for speed control of induction motor – 1 no
10. Static Kramer drive – 1 no
11. Dynamic braking panel – 1 no
12. Tachometer -Digital/Analog – 12 nos
13. Single Phase Auto Transformer – 2 nos
14. Three Phase Auto Transformer – 5 nos
15. Single Phase Resistive Loading Bank – 2 nos
16. Three Phase Resistive Loading Bank – 3 nos

17. Three phase Capacitor Bank – 2 nos.
18. Three phase Inductive load – 1 no
19. TPDT switch – 2 nos.
20. Wattmeter – 12 nos
21. Rheostats – 15 nos
22. Ammeters – 20 nos
23. Voltmeters – 20 nos

EE18412 ELECTRONICS CIRCUITS LABORATORY L T P C
0 0 3 1.5

OBJECTIVES:

- Design , Simulation and Experimentation of digital and analog circuits.

LIST OF EXPERIMENTS:

1. Differential amplifiers using FET
2. Design and testing of RC phase shift, LC oscillators
3. Astable and Monostable multivibrators using transistors
4. Implementation of Code Converters- (BCD to 7 Segment code, Binary to Gray Code and Gray to binary) using logic gates.
5. Design and Simulation of Adder/ Subtractor circuits
6. Design and Simulation of boolean functions using multiplexer and demultiplexer
7. Design and Simulation of Shift Registers.
8. Design and simulation of Ripple counter and Mod - n Synchronous Counter.
9. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
10. Timer IC application: Study of NE/SE 555 timer in Astable, Monostable operation.
11. Study of VCO and PLL ICs:
    I. Voltage to frequency characteristics of NE/ SE 566 IC.
    II. Frequency multiplication using NE/SE 565 PLL IC.

TOTAL : 45 PERIODS

OUTCOMES:

- Design and implement various sinusoidal and non-sinusoidal oscillators.
- Design and implementation of combinational and sequential logic circuits
- Design and implement applications of OP-AMP.
- Comprehend application of timer and PLL ICs.
- Design combinational and sequential logic circuits and to analyze their performance using verilog simulation tool.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

(3 per Batch)

S. No.	Name of the equipments / Components	Quantity required (Minimum)	Remarks
1	NPN Transistors, JFET, Diodes	25	
2	Resistors, Capacitors and inductors	25	Various ranges
3	IC 741/ IC NE555/566/565	25	
4	Digital Logic ICs	25	
5	Function Generators 10	10	1MHz
6	Regulated 3 output Power Supply 5, ± 15V Dual, (0-30V) variable Power Supply	10	
7	CRO	10	30MHz

8	Storage Oscilloscope	1	
9	Bread boards	10	
10	Digital Multimeter	10	
11	IC Tester	2	
12	PC (PSPICE / Xilinx / ModelSim)	5	
13	Single strand wire		

EE18413 **CONTROL SYSTEM LABORATORY** **L T P C**
0 0 3 1.5

OBJECTIVES:

- To understand the different ways of system representations such as Transfer function representation and state space representations and to assess the system dynamic response
- To assess the system performance using time domain analysis and methods for improving it
- To assess the system performance using frequency domain analysis and techniques for improving the performance
- To design various controllers and compensators to improve system performance

LIST OF EXPERIMENTS:

1. Synchro transmitter and receiver.
2. Transfer function of DC motor by
   a) Field control method.
   b) Armature control method
3. Transfer Function of DC Generator.
4. a) Simulation and experimental verification to draw the speed – torque characteristic of A.C. servomotor.
   b) Simulation and experimental verification to draw the speed - torque characteristic of a D.C. servomotor.
5. Simulation and Experimental Verification of Time response of Second order system.
6. Simulation and Experimental Verification to study the effect of P, PI, PD and PID controller on the step response of a feedback control system (using control engineering trainer).
7. Stability analysis (Bode Plot/root locus) of Linear Time Invariant system using simulation software.
8. Design of Lead-Lag compensator (Bode Plot/root locus) for the given system using simulation software.
9. State space model for classical transfer function and determination of controllability and observability using simulation software.
10. Simulation and experimental verification of temperature measurement system in open loop and closed loop mode.
11. Simulation of level process using PID controller.

TOTAL: 45 PERIODS

OUTCOMES:

- Improve the system performance by selecting a suitable controller and/or a compensator for a specific application.
- Apply various time domain techniques to assess the system performance.
- Apply various frequency domain techniques to assess the system performance.
- Test system controllability and observability using state space representation and applications of state space representation to various systems.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. PID kit – 1 No.
   DSO – 1 No.
   CRO Probe – 2 nos.
2. Personal computers.
3. DC motor – 1 No.
   Generator – 1 No.
   Rheostats – 2 nos
   Ammeters
   Voltmeters
   Connecting wires (3/20)
4. CRO 30MHz – 1 No.
   2MHz Function Generator – 1No.
5. Position Control Systems Kit (with manual) – 1 No.,
   Tacho Generator Coupling set.
6. AC Synchro transmitter & receiver – 1No.
   Digital multi meters.

REFERENCE BOOKS

1. K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.

EE18501 **POWER SYSTEM ANALYSIS** **L T P C**
3 1 0 4

PREREQUISITES: Electric Power System, Electrical Machines - II

OBJECTIVES:

- Develop power system models under steady state conditions and apply iterative solution methods to solve power flow problems.
- Model and analyze the power system under faulted conditions (quasi steady state).
- Model and analyze the stability of power system when subjected to a fault.

UNIT I INTRODUCTION **12**

Electric industry structure – Vertically integrated structure – Single line representation – Per phase and per unit analysis – Synchronous machine - transformer – transmission line and load modeling for different power system studies - Primitive network - Construction of bus admittance (Y-bus) matrix using inspection and singular transformation methods.

UNIT II POWER FLOW ANALYSIS **12**

Importance of power flow analysis in planning and operation of power systems - statement of power flow problem - classification of buses - development of power flow model in complex variables form - iterative solution using Gauss-Seidel method - Q-limit check for voltage controlled buses – power flow model in polar form - iterative solution using Newton-Raphson method - iterative solution using Fast Decoupled method – Comparison of various power flow iterative solution methods – acceleration of convergence – digital computer studies of load flow

UNIT III FAULT ANALYSIS – BALANCED FAULTS **12**

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 – significance of current limiting reactors in fault analysis

UNIT IV FAULT ANALYSIS – UNBALANCED FAULTS **12**

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 - Open conductor fault.

UNIT V STABILITY ANALYSIS **12**

Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability – Single Machine Infinite Bus (SMIB) system: Development of swing equation - equal area criterion - determination of critical clearing angle and time– solution of swing equation by modified Euler method and Runge-Kutta fourth order method - system security concepts - Introduction to multi-machine stability analysis.

TOTAL: 60 PERIODS

OUTCOMES:

- Develop the equivalent model of power system and construct the admittance and impedance matrices.
- Formulate the steady-state power flow problem and apply numerical solution algorithms for analysis.
- Compute short circuit capacity (SCC) of power system using matrix building algorithm under balanced fault.
- Compute short circuit capacity (SCC) of power system using symmetrical components under various faults.
- Formulate power system stability problem under large disturbance and apply numerical solution algorithms for analysis.

TEXT BOOKS:

1. Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition, 2011.
2. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', Tata McGraw-Hill, Sixth reprint, 2010.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

REFERENCES:

1. Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
2. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
3. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, ' Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
4. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2012.
5. C.A.Gross, "Power System Analysis," Wiley India, 2011.
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.

EE18502 POWER ELECTRONICS L T P C
3 1 0 4

OBJECTIVES:

- To acquire knowledge about Power Semiconductor Devices
- To acquire knowledge about Power Converter circuits.
- To study the advanced Converters and Switching techniques implemented in recent technology.
- To acquire knowledge about application of Power Electronic Converters in Power Control applications.

UNIT I POWER SEMI-CONDUCTOR DEVICES 15

Study of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT-Static and dynamic characteristics - Triggering and commutation methods for SCR- design of driver and snubber circuit.

UNIT II PHASE-CONTROLLED CONVERTERS 12

1-pulse, 2-pulse, 3-pulse and 6-pulse converters with R. R-L and R-L-E loads- performance parameters- detailed analysis –Effect of source inductance –gate circuit schemes for phase control–dual converters - design of converter for DC motor speed control.

UNIT III DC TO DC CONVERTER 12

Step-down and step-up chopper-control strategy- non-isolated dc-dc converters: buck, boost, buck-boost converters – operations in CCM and DCM, Isolated dc-dc converters: flyback and forward topologies - design of converter for SMPS topologies.

UNIT IV INVERTERS 12

Single phase and three phase voltage source inverters (both120°mode and180°mode)–Voltage & harmonic control-PWM techniques: Sinusoidal PWM, modified sinusoidal PWM – multiple PWM –Current source inverter- Introduction to Multilevel Inverters - Design of Capacitor filter.

UNIT V AC TO AC CONVERTERS 9

Single phase and three phase AC voltage controllers– Control strategy- Power Factor Control –Multistage sequence control - single phase and three phase cycloconverters –Introduction to Matrix converters - Design of AC voltage controller.

TOTAL: 60 PERIODS

OUTCOMES:

- Acquire knowledge about fundamental concepts and techniques used in Power Electronics.
- Ability to identify basic requirements for Power Electronics based design applications.
- Develop skills to build and troubleshoot Power Electronics circuits.
- Ability to understand the use of Power Converters in Commercial and Industrial applications.

TEXT BOOKS:

1. M.H. Rashid, ‘Power Electronics Circuits, Devices and Applications’, Pearson Education, PHI Forth Edition, New Delhi, 2017
2. Dr. P.S.Bimbhra “Power Electronics” Khanna Publishers, Sixth Edition, 2018.
3. L. Umanand, “ Power Electronics Essentials and Applications”, Wiley, 2010.

REFERENCES:

1. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6thReprint, 2013.
2. Ashfaq Ahmed Power Electronics for Technology Pearson Education, Indian reprint, 2003.
3. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.
4. Ned Mohan, Tore. M. Undel and, William. P. Robbins,' Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2003.
5. Daniel.W.Hart, "Power Electronics", Indian Edition, Mc Graw Hill, 3rd Print, 2013.
6. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2013.
7. R. Erickson and D. Maksimovic, " Fundamentals of Power Electronics," 2nd Edition 2001, Springer International Edition.
8. Simon Ang and Alejandro Oliva,"Power – Switching Converters",2nd Edition Taylor & Francis Group.

EE18503 MICROPROCESSORS AND MICROCONTROLLERS L T P C
3 0 0 3

PREREQUISITES: Digital Logic Circuits

OBJECTIVES:

- To introduce the rudiments of architecture of microprocessor and microcontroller.
- To address the various programming aspects of microprocessor.
- To impart in depth knowledge on functional aspects of 8051 microcontroller.
- To develop programming skills of 8051 microcontroller with interfacing and to explore applications of 8051 microcontroller.
- To impart in depth knowledge on functional aspects of ARM microcontroller.

UNIT 1 8085 PROCESSOR AND ITS PERIPHERAL INTERFACING 9

8085: Functional block diagram –- Signals – Memory interfacing – I/O ports and data transfer concepts – Timing Diagram – Interrupts - Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8254 Timer/ Counter.

UNIT II PROGRAMMING OF 8085 9

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing –Look up table - Subroutine instructions - stack.

UNIT III 8051 MICRO CONTROLLER 9

Hardware Architecture, pin-outs – Functional Building Blocks of Controller – Memory organization –I/O ports and data transfer concepts– Timing Diagram –Interrupts-Timer-Serial communication - Peripheral Interfacing

UNIT IV 8051 MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Instruction sets and addressing modes- Simple programming exercises-Keyboard and display interface –Temperature monitoring and control – Traffic light control – Frequency Measurement – Waveform generation-Closed loop control of servo motor- stepper motor control –Washing Machine Control.

UNIT V ARM MICROCONTROLLER 9

ARM Architecture overview - Processor modes – Data types – Registers – Program status registers – ARM Instruction Set – Thumb Instruction Set – Simple programs.

TOTAL: 45 PERIODS

OUTCOMES:

- Acquire knowledge on the architecture and instruction sets of 8085 microprocessor.
- Programming of 8085 microprocessor.
- Acquire knowledge on the architecture and instruction set of 8051microcontroller.
- Programming of 8051 microcontroller and comprehend the applications of 8051 microcontroller.
- Acquire knowledge on the architecture, instruction set and programming of ARM microcontroller.

TEXT BOOKS:

1. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Applications with 8085', Penram Intl. Publishing, 6th Edition, 2013.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay 'The 8051 Microcontroller and Embedded Systems using Assembly and C', Prentice Hall Publications, 2nd Edition, 2008.
3. William Hohl and Christopher Hinds, "ARM Assembly Language Fundamentals and Techniques", CRC Press, second edition, 2015.

REFERENCES:

1. Sencer Yeralan, Helen Emery, 'Programming and Interfacing the 8051 Microcontroller', Addison- Wesley Publications, 1st Edition, 2000.
2. Krishna Kant, 'Microprocessors and Microcontrollers, Architecture, Programming and System Design - 8085, 8086, 8051, 8096', Prentice Hall India Ltd Publications, 1st Edition, 2010

CS18551 **PROGRAMMING AND DATA STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVES:

- To comprehend the fundamentals of object oriented programming, particularly in C++.
- To use object oriented programming to implement data structures.
- To introduce linear data structures and their applications.
- To introduce non-linear data structures and their applications.
- Learn to implement sorting and searching algorithms.

UNIT I **DATA ABSTRACTION & OVERLOADING** **9**

Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static Class Members – Proxy Classes – Overloading: Function overloading and Operator Overloading.

UNIT II **INHERITANCE & POLYMORPHISM** **9**

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes – Implicit Derived – Composition Vs. Inheritance – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding

UNIT III **LINEAR DATA STRUCTURES** **9**

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists –Polynomial Manipulation - Stack ADT – Evaluating arithmetic expressions- Queue ADT – Circular Queue implementation.

UNIT IV **NON-LINEAR DATA STRUCTURES** **9**

Trees – Binary Trees – Binary tree representation and traversals - The Search Tree ADT - Binary Search Trees- – Application of trees – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search- Dijkstra's shortest path algorithm.

UNIT V **SORTING and SEARCHING** **9**

Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search –Binary Search

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Apply the basic concepts of Object-Oriented Programming to solve computational problems.
- Apply Inheritance and Polymorphism concepts for real world problems
- Implement abstract data types for linear data structures.
- Apply non-linear data structures to solve various problems.
- Implement sorting and searching algorithms.

TEXT BOOKS:

1. Deitel and Deitel, “C++, How To Program”, Tenth Edition, Pearson Education, 2017.
2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, 2nd Edition, Pearson Education, 2017.

REFERENCES:

1. Bhushan Trivedi, “Programming with ANSI C++, A Step-By-Step approach”, Oxford University Press, 2012.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, Second Edition, Wiley. 2011.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, MIT Press, 2009.
4. Bjarne Stroustrup, “The C++ Programming Language”, 4th Edition, Pearson Education, 2018.
5. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, “Fundamentals of Data Structures in C++”, Galgotia Publications, Second Edition,2008

EE 18505 DIGITAL SIGNAL PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To classify the signals and systems and learn about the mathematical representation, Analog to Digital conversion techniques.
- To understand the representation of discrete time systems and apply z-transform techniques to evaluate the frequency response and stability analysis.
- To study various transformation techniques and their computation.
- To study about the structural realization of FIR, IIR Digital filters and their design.
- To impart knowledge about the programmable digital signal processors and applications.

UNIT I INTRODUCTION 9

Classification of Systems, Classification of Signals, Mathematical representation of signals, Analog to Digital conversion Techniques – Sampling, Nyquist rate, Aliasing effect - Quantization techniques, Truncation and Rounding, Quantization error – Coding.

UNIT II DISCRETE TIME SYSTEMS 9

Linear Convolution, Circular Convolution, Correlation – Z-transform and properties, Inverse Z-transform; Difference equation – Solution by Z-transform, Application to discrete time systems -Frequency response - Stability analysis.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 9

Discrete Fourier Transform and properties, Magnitude and Phase representation – Fast Fourier Transform, Computation of DFT and IDFT using radix-2 FFT algorithms– DIT & DIF Butterfly structure.

UNIT-IV DESIGN OF DIGITAL FILTERS 9

FIR & IIR filter realization - Cascade & Parallel forms, FIR design: Windowing Techniques – Need and Choice of windows – Linear Phase characteristics – IIR filter design – Butterworth and Chebyshev approximations, Digital design using Impulse Invariant and Bilinear transformation – Warping, pre-warping.

UNIT-V DIGITAL SIGNAL PROCESSORS 9

Introduction to DS processors – Architecture – Features - Addressing Formats – Functional modes – Motor control application using DS Processor.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the fundamental aspects of digital signal processing.
- Acquire knowledge on various discrete-time signals and systems.
- Analyze domain specific discrete time systems and evaluate frequency response and stability analysis.
- Design and realize FIR and IIR filters.
- Apply the knowledge on the basic architectures of commercial digital signal processors to electrical and electronics engineering.

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and applications', Pearson Education, New Delhi, PHI. 2003.
2. S.K. Mitra, 'Digital Signal Processing–A Computer Based Approach', McGraw Hill Edu, 2013.
3. Robert Schilling & Sandra L. Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning, 2014.
4. Sen. M. Kuo, Woon-Seng S Gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson, 2013.

REFERENCES:

1. Poorna Chandra. S, Sasikala.B, Digital Signal Processing, Vijay Nicole, Tata McGraw Hill, 2013.
2. B.P. Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010.
3. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Matlab', CRC Press, 2009.
4. Dimitris G.Manolakis, Vinay K.Ingle, Applied Digital Signal Processing, Cambridge, 2012.
5. P. Ramesh Babu, Digital Signal Processing, Scitech Publications (India) Pvt. Ltd.
6. S. Salivahanan, A. Vallavaraj and C. Gnanapriya, Digital Signal Processing, Tata McGraw Hill.

EE18511 POWER ELECTRONICS LABORATORY L T P C
0 0 3 1.5

OBJECTIVES:

- To learn and experiment on power electronics switching devices characteristics and the power converter circuits.
- To learn the design, simulation and implementation of power semiconductor devices in different applications.

LIST OF EXPERIMENTS:

1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT.
3. AC to DC half & fully controlled converter.
4. IGBT based single phase PWM inverter.
5. IGBT based three phase PWM inverter.
6. Design of AC Voltage controller.
7. Design of Switched mode power converter.
8. Simulation of 1Φ & 3Φ semi and full converters.
9. Simulation of buck and boost DC – DC converter.
10. Simulation of AC voltage controller, 1Φ sine wave inverter and 3Φ Inverter with 180 and 120 degree mode of operation.
11. Design, simulation and implementation of DC/DC chopper for battery charging applications.
12. Design, simulation and implementation of inverter for UPS applications.

TOTAL: 45 PERIODS

OUTCOMES:

- Experiment the performance characteristics of power semiconductor devices.
- Understand the operation of various power converter circuits by simulation and hardware implementation.
- Design the converter, inverter and chopper for various applications such as battery charger, SMPS and UPS.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

- Device characteristics (for SCR, MOSFET, TRIAC and IGBT kit with built-in / discrete power supply and meters) - 2 each
- Single phase SCR based half controlled converter and fully controlled converter along with built-in/separate/firing circuit/module and meter – 2 each
- IGBT based single phase PWM inverter module/Discrete Component – 2
- IGBT based three phase PWM inverter module/Discrete Component – 2
- Switched mode power converter module/Discrete Component – 2
- SCR &TRIAC based 1 phase AC controller along with lamp or rheostat load – 2
- Cyclo-converter kit with firing module – 2
- VSI fed three phase induction motor drive (AC motor Drive) – 1
- MOSFET based Driver circuit for 3Φ Inverter -2

- MOSFET switches - 10, Driver circuits - 5, Opto-couplers - 10, PCB board - 10, bread board - 10
- Dual regulated DC power supply with common ground
- Digital Storage Oscilloscope –10
- Isolation Transformer – 5
- Single phase Auto transformer –3
- Components (Inductance, Capacitance) 3 set for each
- Multi-meter – 5
- LCR meter – 3
- Rheostats of various ranges – 2 sets of 10 value
- Work tables – 10
- DC and AC meters of required ranges – 20
- Component data sheets to be provided

REFERENCE BOOKS

1. Muhammad H. Rashid, 'Power Electronics: Circuits, Devices and Applications', 3rd edition, Pearson, 2012.

EE18512 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY **L T P C 0 0 3 1.5**

OBJECTIVES:

- Introduce ALP concepts and features.
- Write ALP for arithmetic and logical operations in 8085 and 8051.
- Interface different I/Os with 8085 microprocessor and 8051 microcontroller.
- Interface PC with 8051 microcontroller using UART.
- Introduce design and development of a simple application using 8051 microcontroller.

LIST OF EXPERIMENTS:

1. Simple arithmetic operations: addition / subtraction / multiplication / division using 8085 and 8051
2. Programming with control instructions using 8085(i) Ascending / Descending order, Maximum / Minimum of numbers.(ii) Programs using Rotate instructions.(iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments with 8051(i) A/D Interfacing (ii) D/A Interfacing.
4. Traffic light controller using 8051
5. I/O Port / Serial communication using 8051
6. Programming Practices with Simulators/Emulators/open source.
7. Read a key and display it using 8051
8. Programming I/O Port 8051 - study on interface with DC & AC motor.
9. Interfacing 16 X 2 LCD with 8051.
10. Establishing Communication between 8051 microcontroller and PC using UART.
11. Mini project development with Microcontroller.

TOTAL: 45 PERIODS

OUTCOMES:

- Work out basic binary math operations using the 8085 and 8051.
- Demonstrate programming proficiency using the various addressing modes and data transfer instructions using 8085 microprocessor and 8051 microcontroller.
- Execute programs using the stack, the program counter, and the status register.
- Establish connections between different I/Os and 8051 microcontroller.
- Implementing interface between PC and 8051 microcontroller via UART

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No	Description of Equipment	Quantity required
1.	8085 Microprocessor Trainer with Power Supply	15
2.	8051 Micro Controller Trainer Kit with power supply	15
3.	8255 Interface board	5
4.	8251 Interface board	5
5.	8259 Interface board	5
6.	8279 Keyboard / Display Interface board	5
7.	8254 timer counter	5
8.	ADC and DAC card	5
9.	AC & DC motor with Controller	5
10.	Traffic Light Control System	5
11.	Personal Computer	5

CS18561 PROGRAMMING AND DATA STRUCTURES LABORATORY L T P C
0 0 3 1.5

OBJECTIVES:

- Be familiar with C++ programming language.
- Learn to implement linear and non linear data structures.
- To implement various applications using different data structures.
- Learn to implement sorting and searching algorithms.

LIST OF EXPERIMENTS:

1. Basic Programs for C++ Concepts
    i. Prime Number Generation
    ii. Leap Year Checking
    iii. Factorial with and without Recursion
    iv. Swapping of two numbers using pointers.
    v. Find length of the string without using library function.
    vi. Bank Account using structures.
    vii. Function overloading
    viii. Static data member and member Function.
    ix. Friend Functions.
    x. Area and perimeter of a circle using class.
2. Array implementation of List Abstract Data Type (ADT)
3. Linked list implementation of List ADT
4. Cursor implementation of List ADT
5. Stack ADT - Array and linked list implementations
6. The next two exercises are to be done by implementing the following source files
    i. Program source files for Stack Application 1
    ii. Array implementation of Stack ADT
    iii. Linked list implementation of Stack ADT
    iv. Program source files for Stack Application 2
    v. An appropriate header file for the Stack ADT should be included in (i) and (iv)
7. Implement any Stack Application using array implementation of Stack ADT (by implementing files (i) and (ii) given above) and then using linked list
8. Implementation of Stack ADT (by using files (i) and implementing file (iii))
9. Implement another Stack Application using array and linked list implementations of Stack ADT (by implementing files (iv) and using file (ii), and then by using files (iv) and (iii))
10. Queue ADT – Array and linked list implementations
11. Search Tree ADT - Binary Search Tree
12. Implement an interesting application as separate source files and using any of the searchable ADT files developed earlier. Replace the ADT file alone with other appropriate ADT files. Compare the performance.
13. Implementation of Linear Search and Binary Search.
14. Quick Sort

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course: The students will be able to

- Design and implement stacks, queues, and linked lists using C++ programs.
- Develop recursive programs to implement trees and graphs
- Apply good programming design methods for program development.
- Select suitable data structures for solving real world problems.
- Develop sorting and searching programs.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos. (or)
Server with C++ compiler supporting 30 terminals or more.

EE18601 POWER SYSTEM OPERATION AND CONTROL L T P C
3 0 0 3

PREREQUISITES: Electrical Machines – II, Power System Analysis

OBJECTIVES

- Characterization of electrical power demand and understand load forecasting techniques.
- Understand power-frequency and power-voltage dynamics and implement real power-frequency control and reactive power-voltage control.
- Comprehend economic operation of power system and introduce computer control.

UNIT I INTRODUCTION 9

Structure of Indian power grid - power system load variation - load characteristics - load curves and load-duration curve - load factor - diversity factor - Importance of load forecasting and quadratic and exponential curve fitting techniques of forecasting – Overview of power system operation and control - plant level and system level controls - equipment and stability constraint in system operation.

UNIT II REAL POWER - FREQUENCY CONTROL 9

Basics of speed governing mechanism and modeling - speed-load characteristics – load sharing between two synchronous machines in parallel - control area concept - LFC control of a single area system - static and dynamic analysis of uncontrolled and controlled cases - two-area system – modeling - static analysis of uncontrolled case - tie line with frequency bias control – state variable model - integration of economic dispatch control with LFC-Frequency control with distributed generation.

UNIT III REACTIVE POWER–VOLTAGE CONTROL 9

Generation and absorption of reactive power - basics of reactive power control – excitation systems – modeling - static and dynamic analysis - stability compensation - methods of voltage control: tap changing Transformer, SVC and STATCOM – Principle of Operation, V-I characteristics and secondary voltage control - voltage control with distributed generation.

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH 9

Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve – coordination equations without and with loss (No derivation of loss coefficients) - solution by direct method and λ-iteration method - statement of unit commitment problem, Constraint in unit commitment problem, unit commitment solution method – priority-list method – forward dynamic programming approach - Unit commitment in deregulated environment.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Need for computer control of power systems - concept of energy control center - functions – system monitoring - data acquisition and control - system hardware configuration – SCADA and EMS functions - network topology – state estimation – WLSE - Contingency Analysis – state transition diagram showing various state transitions and control strategies.

TOTAL: 45 PERIODS

OUTCOMES

- Apply the load forecasting techniques and identify suitable power controls at system and plant levels.
- Model load frequency dynamics and analyze real power - frequency control.
- Model voltage dynamics and analyze reactive power - voltage control.
- Formulate and solve unit commitment and economic dispatch problems.
- Ascertain the structure and functionalities of Energy Management System.

TEXT BOOKS

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2003.
3. Abhijit Chakrabarti, Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

REFERENCES

1. Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition, 2011.
2. Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
4. N.V.Ramana, "Power System Operation and Control," Pearson, 2011.
5. C.A.Gross, "Power System Analysis," Wiley India, 2011.

EE18602 **ELECTRICAL DRIVES** **L T P C**
3 1 0 4

PREREQUISITES: Electrical Machines – II, Power Electronics

OBJECTIVES:

- To impart knowledge on the steady state and transient condition of motor
- To able to know about converter/chopper fed DC drive.
- To study and know about the design of controller of closed loop drive
- Ability to know the performance of Induction and synchronous motor drives
- Understand the features of traction application.
- Choose and design a drive for different applications.

UNIT I DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motors–Energy efficient operation.

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

Steady state analysis of the single and three phase converter fed separately excited DC motor drive–continuous and discontinuous conduction– Time ratio and current limit control – 4 quadrant operations of converter / chopper fed drive –battery powered drives.

UNIT III DESIGN OF CONTROLLERS FOR DRIVES 12

Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback–armature voltage control and field weakening mode – Design of controllers; current controller and speed controller- converter selection and characteristics – PLL and Microcontroller based drives.

UNIT IV AC MOTOR DRIVES 15

Induction motor drive: Stator voltage control – energy efficient drive – v/f control–constant air gap flux – field weakening mode – voltage / current fed inverter – closed loop control – Introduction to Vector control.

Synchronous motor drive: Permanent magnet motor –V/f control and self control of synchronous motor–load commutated thyristor inverter – Margin angle control and power factor control – permanent magnet ac motor drive – brush less dc motor drives.

UNIT V TRACTION & DRIVE APPLICATIONS 15

Electric traction merits – Requirements of traction system – supply system – mechanics of train movement – speed time curve – tractive effort - electric braking - traction motor control - track equipment and collection gear – Drive schematic and control for steel mills, paper mills, cement mills, textile mills, machine tools, lifts and cranes

TOTAL: 60 PERIODS

OUTCOMES:

- Select the type and rating of motor for a known load characteristic.
- Select, design and analyze a converter for a DC drive.
- Model DC and AC Electric Drives and design a controller.
- Learn the distinctive features of traction schemes.
- Choose and design a drive for industrial applications.

TEXT BOOK:

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa; Second Edition, 2010
2. Bimal K.Bose, Modern Power Electronics and AC Drives, Prentice Hall of India, 2005
3. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson Education India; 1 edition (2015)
4. J.B.Gupta, "Utilisation Electric power & Electric Traction", S.K.Kataria and Sons, 2000.

REFERENCES:

1. S.K.Pillai, A First course on Electrical Drives, New Age International publishers, Third edition, 2012.
2. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier 2012.
3. Shaahin Filizadeh, "Electric Machines and Drives", CRC Press, 2017.
4. G.C.Garg, 'Utilization of Electric Power and Electric Traction', Khanna Publishers, Ninth Edition 2009.

CS18403 **COMPUTER NETWORKS** **L T P C**
3 0 0 3

OBJECTIVES:

The learner should be made to:

- Understand the concepts of computer network and Internet.
- Be familiar with real time applications of networks.
- Learn the Transport Layer, flow control and congestion control algorithms.
- Be exposed to various addressing schemes and routing protocols.
- Understand the link, physical layers and error detection-correction of data.

UNIT I INDRODUCITON TO COMPUTER NETWORK & INTERNET 9

What is Internet - The Network Edge - The Network Core - Delay, Loss, and Throughput in Packet Switched Networks - Protocol Layers and Their Service Models - Networks Under Attack- History of Computer Networking and the Internet.

UNIT II APPLICATION LAYER 9

Principles of Network Applications- The Web and HTTP- File Transfer: FTP- Electronic Mail in the Internet- DNS—The Internet‘s Directory Service- Peer-to-Peer Applications- Socket Programming: Creating Network Applications.

UNIT III TRANSPORT LAYER 9

Introduction and Transport - Layer Services - Multiplexing and De-multiplexing - Connectionless Transport: UDP- Principles of Reliable Data Transfer - Connection-Oriented Transport: TCP - Principles of Congestion Control- TCP Congestion Control.

UNIT IV NETWORK LAYER 9

Introduction- Virtual Circuit and Datagram Networks- What‘s Inside a Router- The Internet Protocol (IP): Forwarding and Addressing in the Internet- Routing Algorithms- Routing in the Internet- Broadcast and Multicast Routing

UNIT V DATALINK & PHYSICAL LAYERS 9

Introduction to the Link Layer- Error-Detection and -Correction Techniques- Multiple Access Links and Protocols- Switched Local Area Networks- Link Virtualization: A Network as a Link Layer- Wireless Links and Network Characteristics- Wireless LANs- Physical Layer: Digital Transmission – Multiplexing and Spread Spectrum - Transmission Media.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Understand the concepts of computer networks and Internet.
- Categorize different application layer level protocols based on user’s request.
- Apply the knowledge of addressing scheme and various routing protocols in data.
- Examine the flow of information from one node to another node in the network.
- Distinguish the link, physical layers and error detection-correction of data

TEXT BOOKS:

1. James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Seventh Edition, Pearson Education, 2017.

REFERENCES:

1. Behrouz A. Forouzan, “Data Communications and Networking”, Fourth Edition, McGrawHill, 2011.
2. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach” Fifth Edition, Morgan Kaufmann Publishers, 2011.
3. Andrew S. Tanenbaum; David J. Wetherall, “Computer Networks”, 5th Edition, Prentice Hall publisher, 2010.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.

EE18603 INDUSTRIAL AUTOMATION & NETWORKING L T P C
3 1 0 4

OBJECTIVES:

- Recapitulate the working of sensors and signal conditioning process
- Study of components and circuits associated with pneumatics and hydraulics
- Learn the operation and programming of PLCs and human machine interfaces.
- Obtain an overview of distributed control systems and CNC machines
- Familiarize with the interconnection and data exchange between PLCs, field devices and supervisory units with different bus structures.

UNIT I SENSOR & MEASUREMENT SYSTEMS 12

Introduction to Industrial Automation – Architecture - Sensors and measurement systems for position, temperature, pressure, force, displacement, speed, acceleration, flow and level - Signal conditioning & Processing - Errors and Calibration - Smart sensors - Servo & Stepper motor drives – Basics of Industry 4.0 and IoT for plant automation.

UNIT II PNEUMATICS & HYDRAULICS 12

Qualitative study of **Pneumatics**: Introduction to Fluid power – classification of air actuators & its types, selection of actuators, control valves for direction, pressure and flow. Compressor – types, air reservoir. Electro pneumatics - components, relay ladder diagram. Vacuum - ejectors, suction pad, selection. **Hydraulics**: Pumps and motors, servo and proportional valves. Power pack. Selection of cylinders & valves. **Circuit design** - symbols, schematic, travel step diagram, control modes. Sequence control - Cascade method, KV mapping and Step counter method.

UNIT III PLCs **12**

Introduction - Advantages, capabilities & architecture. Scan cycle, Types of I/O modules, Analog Scaling, Configuring a PLC, PLC Wiring, installation of PLC and maintenance, Selection criteria for PLC, PLC Communication with PC and software. Types of Programming. Bit instructions, Arithmetic functions, timers, counters, data transfer, PWM, PID, Case studies.

UNIT IV HMI, DCS and CNC 12

Qualitative study of **HMI**: Necessity and Role, Text display - operator panels, touch panels - Panel PCs – Integrated displays. Introduction to SCADA.**DCS**: Architecture, local control unit, programming language, communication facilities, operator interface, engineering interfaces. **CNC**: Features, drive systems for CNC machine tools, Control of machine tools.

UNIT V NETWORKING 12

IEEE Standards - Networking of sensors, actuators and controllers - Introduction to Field bus communication and its Protocols - Field bus, CAN bus, PROFI bus, Ethernet, MOD bus, Ethernet, OSI/ISO, ICCPDTE, DCE and RTU

Introduction to Robotics, Work volume, End Effectors, Robotic sensors and application in industries.

TOTAL: 60 PERIODS

OUTCOMES:

- Choose and design a suitable measurement system
- Configure a pneumatic / hydraulic circuit as per requirements
- Design and program a PLC system for an application
- Control a PLC through human-machines interfaces and learn basic concepts of DCS, CNCs, IoT and Robotics
- Network PLCs with field devices and supervisory control systems

TEXT BOOKS:

1. S. Mukhopadhyay, S. Sen and A. K. Deb, "Industrial Instrumentation, Control and Automation", Jaico Publishing House, 2013.
2. Frank D Petruzella "Programmable Logic Controllers ", McGraw Hill Inc, 2005
3. Michael P. Lukas, "Distributed Control systems", "Van Nostrand Reinfold Company"1995.

REFERENCES:

1. Kelvin T Erikson, "Programmable Logic Controllers ", Dogwood Valley Press, 2005
2. S. R. Deb and S. Deb, 'Robotics Technology and Flexible Automation', Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Steve Mackay, "Practical Industrial data networks: Design, Installation and Troubleshooting", Elsevier Newnes, 2004.
4. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey "Industrial Robotics technology, programming and application", Tata McGraw- Hill Edition
5. William C. Dunn, "Fundamentals of Industrial Instrumentation and Process control", McGraw Hill, 2005.
6. Anthony Esposito, "Fluid power with applications", Pearson New International Edition, 2014.

EE18611 POWER SYSTEM SIMULATION LABORATORY L T P C
0 0 3 1.5

OBJECTIVES

- Develop models of power system networks and analyze various methods of steady state load flow solution.
- Perform transient and small signal stability analysis for various faults in power systems using different methods.
- Develop load frequency control model for single area and two-area systems and perform static and dynamic analysis for various cases.
- Understand power system unit commitment and economic dispatch problem and solution methodologies.

LIST OF EXPERIMENTS

1. Computation of Transmission Line Parameters.
2. Modeling and performance analysis of transmission lines.
3. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
4. Load Flow Analysis - I : Solution of load flow and related problems using Gauss-Seidel
5. Method.
6. Load Flow Analysis - II: Solution of load flow and related problems using Newton Raphson.
7. Load Flow Analysis - III: Solution of load flow and related problems using Fast Decoupled Method.
8. Fault analysis using Thevenin's theorem and Z bus building algorithm.
9. Transient and Small Signal Stability Analysis.
10. Electromagnetic Transients in Power Systems – simulation using PSCAD/ETAP.
11. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems.
12. Economic Dispatch in Power Systems.
13. Solution for Unit Commitment problem using Priority List method.
14. Simulation study of any one of above analysis for Standard Test System.

TOTAL: 45 PERIODS

OUTCOMES

- Model the transmission lines, power system network and evaluate the numerical algorithms for the solution of steady state power flow problem.
- Compute the short circuit capacity of power system and examine the stability conditions for various faults.
- Design and analyze a load frequency controller of the power system with/without tie-line.
- Formulate and solve economic dispatch problem with/without losses.
- Understand the electromagnetic transient phenomenon in power systems caused due to switching and faults.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Personal Computers (Intel i3 Processor, 500GB HDD, 4GB Ram) – 25 Nos
2. Printer HP Laser Jet 1020 Plus- 1 No.
3. Server (IBM X 3300 M4 Server & Fedora 14) – 2 No.
4. Software: any power system simulation software - 5 licenses
5. Compliers: C, C++, Java - 25 users

EE 18612 INDUSTRIAL AUTOMATION LABORATORY L T P C
0 0 3 1.5

OBJECTIVES:

- Learn the automation of machines in a plant and their networking.

LIST OF EXPERIMENTS:

1. Design and implement the logic for the given pneumatic circuit in hardware and with simulation software.
2. Design and simulation of hydraulic circuit for a given sequential logic.
3. Design and implement the logic in PLC for the given pneumatic circuit in hardware and with simulation software.
4. Design and implement in PLC the given logic comprising arithmetic, timer and counters operations.
5. Interfacing of an Transducer with a HMI and PLC for monitoring the Process variables such as Temperature, Pressure, level, weight and flow etc.
6. Water level control by using PLC
7. Traffic light control by using PLC
8. Bottle filling system by using PLC
9. Speed control of DC motor by using PLC
10. Servo motor Position control by using PLC
11. Star delta starter for induction motor with PLC control.

TOTAL: 45 PERIODS

OUTCOMES:

- Design and develop control logic for process automation using sensors and actuators.
- Implement Timer/counter logic in PLCs and Interface PLCs with HMI systems.
- Design and implement process automation control techniques for industrial applications.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Pneumatic trainer kit – 2 nos
PLC based pneumatic trainer kit – 2 nos
PLC trainer kit – 4 nos
PCs for interconnection with PLCs and for simulation – 7 nos
Automation software for simulation - 5 sets
DC drive for PLC control - 1 no
AC drive for PLC control - 1 no
Servo motor – 1 no
Stepper motor – 1 no
HMI software – 2 sets
Transducers – 1 set
Trainer kit for signal conditioning – 1 set
Starter for DC motor with PLC control
DOL Starter for induction motor with PLC control – 2nos
Star delta starter for induction motor with PLC control – 2 nos
PLC application modules - 1 set

GE18551	PRINCIPLES OF MANAGEMENT	L	T	P	C
	(COMMON TO EC, AE, BT, EE & ME)	3	0	0	3

OBJECTIVES :

- To enable the students to study the evolution of management, functions and principles of management and to learn the application of management principles in an organization.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management –Nature of Management-Management as Science or Art-Management and Administration-Evolution of Management-Contribution of Taylor and Fayol– types of managers - managerial roles and skills - Organization Culture – Dimensions, strong and weak culture –External Environment -.specific and general environment – Understanding the global environment.

UNIT II PLANNING 9

Nature and purpose of planning – Steps Involved in planning process – Types of plans – management by objectives – Strategic management process– types of corporate strategies - Planning Tools and Techniques-Forecasting – Benchmarking - Decision making steps and process

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization — Line and staff authority – delegation of authority – departmentalization by different strategies - centralization and decentralization –span of control- Human Resource Management – External factors - HR Planning - Recruitment and Decruitment - selection – selection tools – Orientation – Employee training - Employee Performance Management – Appraisal methods - Compensation and benefits.

UNIT IV DIRECTING 9

Foundations of individual and group behavior – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication.

UNIT V CONTROLLING 9

Types of control systems: Market, Bureaucratic, Clan- Importance of control - process of controlling – Types of control: Feed forward, Concurrent, Feedback -Qualities of effective control system – Factors affecting control – controlling for organizational performance – control techniques -budget - Program evaluation and review technique – Information technology in controlling: opportunities and challenges.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Apply managerial approaches and practice managerial roles as demanded by the current environment of the organization.
- Develop planning process and apply strategies, planning tools and techniques to attain organizational objectives.
- Effectively organize activities in the organization and execute human resource management tasks.
- Execute the appropriate motivational and leadership techniques and effectively utilize communication methods in the organization
- Apply control techniques to monitor the progress of activities and to take corrective measures accordingly.

TEXT BOOKS:

1. Stephen P. Robbins, Mary Coulter and Agna Fernandez, "Management", 14th Edition, Prentice Hall (India) Pvt. Ltd., 2019.
2. Stephen A. Robbins, David A. Decenzo, Sanghamitra, Bhattacharyya, Madhushree Nanda Agarwal "Fundamentals of Management" 6th Edition, Pearson Education, 2011.

REFERENCES :

1. Harold Koontz & Heinz Weihrich "Essentials of management" 10th edition, Tata Mc Graw Hill, 2015.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
3. Heinz Weihrich, Mark V Cannice, and Harold Koontz "Management: A Global, Innovative and Entrepreneurial Perspective", 15th Edition, McGrawHill, 2019.

WEB RESOURCES

1. https://nptel.ac.in/courses/110105069/
2. https://nptel.ac.in/courses/122108038/
3. https://nptel.ac.in/courses/110/102/110102016/

EE18701 PROTECTION AND SWITCHGEAR L T P C
3 0 0 3

OBJECTIVES:

- Realize the causes of abnormal operating conditions of the power system.
- Understand the operating characteristics and functions of electromagnetic, static and numerical relays.
- Comprehend the schemes of apparatus protection.
- Design and selection of circuit breakers.

UNIT I PROTECTION SCHEMES 9

Principles and need for protective schemes – nature and causes of faults – types of faults – fault current calculation using symmetrical components – Methods of Neutral grounding – Zones of protection and essential qualities of protection – Protection schemes for distributed generation – Microgrid protection - IEEE standards for power system protection.

UNIT II ELECTROMAGNETIC RELAYS 9

Operating principles of relays – Universal torque equation – R-X diagram - Electromagnetic Relays – Over current, Directional, Distance, differential, Negative sequence and Under frequency relays.

UNIT III APPARATUS PROTECTION 9

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, busbar and transmission lines.

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION 9

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Overcurrent protection, transformer differential protection, distant protection of transmission lines – Microcontroller based overcurrent protection – Introduction to application of Artificial Intelligence to power system protection.

UNIT V CIRCUIT BREAKERS 9

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of restriking voltage - current chopping - interruption of capacitive currents - resistance switching - Types of circuit breakers – Oil, SF_6 and vacuum circuit breakers – Rating and selection of Circuit breakers

TOTAL: 45 PERIODS

OUTCOMES:

- Interpret the faults in power system and essential qualities of protection.
- Understand the operation of various electromagnetic relays.
- Analyze the protection schemes for power system apparatus.
- Synthesize various relays using static comparators and microcontroller.
- Analyze the circuit breaker arcing phenomenon and understand the functioning of various types of circuit breakers

TEXT BOOKS:

1. Badri Ram, B.H.Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw Hill Education Pvt. Ltd., Second Edition 2011.
2. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International Publishers, First Edition 2011.
3. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, 'A Text Book on Power System Engineering', Dhanpat Rai & Co., 2016.

REFERENCES:

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, 2008.
2. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2010
4. Ravindra P.Singh, ' Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.
5. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2011
6. C37 series of IEEE standards for power system protection

EE18702 VLSI AND EMBEDDED SYSTEMS L T P C
3 1 0 4

PREREQUISITES: Microprocessors and Microcontrollers

OBJECTIVES:

- To introduce VLSI design development and its characteristics
- To educate in VLSI logic design using MOS transistor
- To introduce the building blocks of embedded system
- To educate in various embedded development strategies
- To introduce bus communication in processors, Input/output interfacing.

UNIT I VLSI DESIGN AND ITS ELECTRICAL PROPERTIES 12

VLSI design process - Architectural design - Logical design - Physical design - Layout styles - Full custom - Semicustom approaches. MOS transistor - Threshold voltage equations - Basic DC equations - Second order effects - MOS models - Small signal AC characteristics - NMOS inverter - Depletion mode and enhancement mode pull ups – CMOS inverter - DC characteristics - Inverter delay - Pass transistor - Transmission gate.

UNIT II LOGIC DESIGN 12

Switch logic - Pass transistor and transmission gate based design - Gate logic - Inverter - Two input NAND gate - NOR gate - Other forms of CMOS logic – Dynamic CMOS logic - Clocked CMOS logic - Precharged domino CMOS logic - Structured design - Simple combinational logic design examples - Parity generator – Multiplexers.

UNIT III INTRODUCTION TO EMBEDDED SYSTEMS 12

The build process for embedded systems- Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT IV EMBEDDED NETWORKING 12

Introduction, I/O Device Ports & Buses– Serial Bus communication protocols -RS232 standard – RS422 – RS485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – need for device drivers.

UNIT V RTOS BASED EMBEDDED SYSTEM DESIGN 12

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance

TOTAL: 60 PERIODS

OUTCOMES:

- Learn about the VLSI design process and its properties.
- Acquire knowledge to design combinational circuits using MOS.
- Acquire knowledge about embedded system and processors and their applications.
- Learn about the networking protocols and its applications.
- Understand the concepts of RTOS in embedded system.

TEXT BOOKS:

1. Kamran Eshraghian, Douglas A Pucknell and Sholeh Eshraghian, “Essentials of VLSI Circuits and Systems”, Prentice Hall of India, New Delhi, 2013.
2. Rajkamal, ‘Embedded System-Architecture, Programming, Design’, Mc Graw Hill, 2013.

REFERENCES:

1. Wayne Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufman Publishers, 2008.
2. Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013.
3. Neil H E West and Kamran Eshranghian, "Principles of CMOS VLSI Design: A System Perspective", Addision-Wesley, 2004.
4. Wayne Wolf," Modern VLSI Design: Systems on Chip Design”, Pearson Education Inc., Indian Reprint, 2007.

EE18703 ELECTRIC VEHICLES L T P C
3 1 0 4

OBJECTIVE:

- Introduce the architecture of electric vehicles and the technologies used.
- Impart knowledge on the design of electric vehicle subsystems and familiarize battery charging and energy management systems.

UNIT I ARCHITECTURE AND SUB-SYSTEMS 12

Introduction to Electric and Hybrid Electric Vehicles: History of hybrid and electric vehicles, Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT II PROPULSION UNITS 12

Configuration, modelling and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Brushless DC motor drives and Switched Reluctance Motor drives- Modes of operation - drive system efficiency

UNIT III ENERGY STORAGE SYSTEM 12

Energy storage technologies in electric and hybrid electric vehicles – battery, flywheel, fuel cell, ultra capacitors- comparison of different energy storage technologies- Hybridization of different energy storage devices.

UNIT IV DRIVE SYSTEM SIZING 12

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT V BATTERY CHARGING AND MANAGEMENT STRATEGIES 12

Different charging technologies: Normal, fast and opportunity charging – Different charging algorithms: CCCV, Multistage charging , Pulse charging – Wireless power transfer - Effect of EV charging on grid – V2G technology – Peak shaving and coordinated charging.
Battery management system: Battery parameters – SoC measurement – Battery cell balancing.

TOTAL: 60 PERIODS

OUTCOMES:

- Acquire knowledge on the architecture of Electric Vehicles.
- Analyze different propulsion technology used for electric vehicle application.
- Analyze different energy storage technology used for electric vehicle application.
- Design the subsystems of an electric vehicle.
- Acquire knowledge on energy management strategies and charging technologies in EVs

TEXT BOOK:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, Second edition, 2011.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, Third edition 2018.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, Second edition 2012.

REFERENCES:

1. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
2. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001.
3. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles and Applications With Practical Perspectives, Wiley Publication, 2011.
4. NPTEL lecture on “Electric Vehicles Part 1”.

EE18704 WIND AND SOLAR ENERGY SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To understand the basic concepts of Wind and Solar Energy Systems
- To understand the concepts of fixed speed and variable speed, wind energy conversion systems
- To learn basics of Solar PV systems and its Applications
- To provide knowledge about stand alone and grid connected renewable energy systems

UNIT I INTRODUCTION 9

Wind: Power in the Wind – Types of Wind Turbines – Basic Components of WECS (Wind Energy Conversion Systems) – WECS Schemes, Aerodynamics of blade and rotor.
Solar: Various Methods of using Solar energy –Photothermal, Photovoltaic, Photosynthesis.
Impacts of wind and solar energy generation on environment - Review of reference theory fundamentals.

UNIT II FIXED SPEED WIND ENERGY SYSTEMS 9

Power-Wind speed characteristics - Model of wind speed - Constant speed constant frequency systems - Drive train model – Generators: Induction and synchronous generators - Steady state modelling.

UNIT III VARIABLE SPEED WIND ENERGY SYSTEMS 9

Need of variable speed systems - Variable speed constant frequency systems - Variable speed variable frequency systems – Generators: DFIG and PMSG - Steady state modeling

UNIT IV SOLAR PV SYSTEMS 9

Basic Principle of photovoltaic conversion – Types of Solar cells, I-V Characteristics, maximum power point tracking. Selection of inverter, battery sizing and array sizing. Applications: Battery charging, Lighting, Solar PV pumps, Space Telecommunications and Solar energy storage options.

UNIT V ANALYSIS OF WIND AND PV SYSTEMS 9

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system - Grid connection Issues - Grid codes - Low-voltage ride through (LVRT), Grid integrated SCIG, DFIG and PMSG Based WECS, grid integrated solar system.

TOTAL: 45 PERIODS

OUTCOMES:

- Realize the need and structure of wind and solar energy based generation.
- Model fixed and variable speed wind energy conversion systems.
- Design and apply solar PV system for electrical applications.
- Analyze the standalone and grid connected operation of solar PV and wind energy conversion systems.

TEXT BOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press 2005.
2. B.H.Khan, "Non-conventional Energy sources", Tata McGraw Hill Publishing Company, New Delhi, 2009

REFERENCES:

1. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
2. Gray, L. Johnson, "Wind energy system", prentice hall Inc, 1995
3. L. L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.
4. Solanki C.S., "Renewable Energy Technologies", PHI Learning Pvt. Ltd., 2015.
5. Rashid M. H "Power Electronics Hand book", Academic Press, 2001.
6. S.Heir "Grid Integration of WECS", Wiley 1998.

EE18711 **PROJECT WORK I** **L T P C**
0 0 6 3

PREREQUISITE:

Knowledge of core subjects in Electrical and Electronics Engineering.

OBJECTIVE:

The main objective of the project work is the culmination of the knowledge gathered in the field of Electrical and Electronics Engineering through its application to the diagnosis of the real world problems and to formulate solutions with the implementation of new technologies.

GUIDELINES

Expectations and Assessment:

Project work I involves modeling, simulation and analysis by utilizing the technical knowledge acquired. The progress is assessed through three internal reviews and an end semester examination with the submission of Project work I report.

General:

- A problem can be identified in one of the thrust areas of Electrical & Electronics Engineering through in-depth survey and critical study of published literature.
- A team with three members in it can be identified with a supervisor who is an expert in the domain from among the faculty of the department assigned as mentor of the team.
- The identified problem can be segmented into modules to encourage individual contribution.
- Students are expected to model/formulate the problem, design appropriate solution methodology, test in the suitable simulation tool and analyze the results.

Industry Projects:

- The team is also encouraged to carry out the project work in industry that can inculcate in them the spirit of research and development and technical leadership while working with practical real time problems.
- The supervisor from industry reviews and finalizes the approach to solve the identified problem through field investigation.
- A permission letter, student periodical attendance report and project completion certificate provided by the industry, are to be submitted to faculty supervisor in the department

COURSE OUTCOME

- Identify and formulate the problem and develop the design solutions.
- Evolve the methodology to execute the project through its various phases.
- Design the circuit/system with the proper components available in the market as per the requirements.
- Apply the simulation tools, algorithms to obtain the solution of the identified problem.
- Compile the findings and conclude with written report and oral presentation.

EE18712 ADVANCED ELECTRICAL ENGINEERING LABORATORY L T P C
0 0 3 1.5

OBJECTIVE:

- To analyze the performance of Advanced Electric drive systems incorporating special electrical machines
- To analyze and design a digital system using microcontrollers.
- To perform electrical Characterization of Micro fabricated Devices using DC Probe Station.
- To simulate wind energy conversion systems.
- To design and implement PID controller for motor application

LIST OF EXPERIMENTS:

GROUP 1: ELECTRICAL MACHINES AND CONTROL

1. DSP based speed control of Switched Reluctance Motor
2. Performance analysis of standalone and grid connected Induction generator.
3. Simulation of permanent magnet synchronous motor fed by PWM.
4. Speed control of BLDC motor.
5. Closed loop Speed control of DC Motor using PID controller

GROUP 2 : POWER SYSTEMS

6. Modelling and Performance evaluation of Fixed and variable speed WTGs.
7. Load Frequency Control with wind energy conversion systems
8. Simulation of Electric Vehicle Drive System.
9. Simulation of Microgrid.
10. Simulation of Photovoltaic power system

GROUP 3 : EMBEDDED AND NANOTECHNOLOGY

11. Design and Implementation of Digital Thermometer using 8051 microcontrollers.
12. Implementation of white line following Firebird V robot.
13. Electrical Characterization of solar cell using DC Probe Station.
14. Electrical Characterization of Photodetector.
15. Electrical Characterization of Thin film transistor.

LIST OF EQUIPMENT:

1. SRM motor-0.5 HP, PIC DSP/TMS DSP Processor, speed sensor, Power module, Display meter, DSO – 1 set
2. Capacitor bank, Induction generator, Prime mover, Voltmeter and Ammeter
3. 8051 microcontroller kit
4. LM34 (Temperature Sensor)
5. ADC0804 (Analog to Digital Converter).
6. Firebird V robot
7. WIN AVR, Atmel Studio 6.0, AVR Boot loader, Serial Port Driver
8. DC probe station
9. Source measuring unit

10. Power module, BLDC motor (0.5HP) Controller circuit, sensor circuit, display meter, DSO – 1 set
11. Simulation tool : MATLAB
12. Operational amplifiers, Capacitors, Resistors, Variable resistance (Pot), Connecting Wires, CRO/ DSO with probes, Bread board, DC Power supply unit, 30V DC Shunt Motor, Speed sensor

TOTAL: 45 PERIODS

OUTCOMES:

- Identify and analyze the performance of special electrical machines for drive applications.
- Identify and analyze a PWM technique for power electronic converters of electric drives.
- Apply and Analyze load frequency control of power system including wind energy conversion systems.
- Obtain and analyze electric vehicle characteristics.
- Analyze the performance of micro-grid.
- Analyze the performance of Photovoltaic power system.
- Design and debugging of embedded programming control.
- Analyze the electrical characteristics of microelectronic devices.

EE18811 **PROJECT WORK II** **L T P C**
0 0 20 10

OBJECTIVE:

The main objective of the project work is the culmination of the knowledge gathered in the field of Electrical and Electronics Engineering through its application to the diagnosis of the real world problems and to formulate solutions with the implementation of new technologies.

GUIDELINES

General Guidelines can be referred from EE18711 Project work I.

Expectations:

- Project work II is the validation of simulation through the design, development and implementation of the prototype.
- The software based project work has to be validated through application development/practical system.

Assessment:

- Assessment involves three reviews to ensure the project progress and an end semester examination with the Project work II report submission.
- Students are highly encouraged to publish their outcome in peer reviewed conferences, journals and to apply for patent to enrich the research milieu of the department
- The findings of the project work have to be analyzed, consolidated and can be presented as a final product.

COURSE OUTCOME

On Completion of the project work students will be able to

- Conduct feasibility study, market analysis and design standardization for project implementation.
- Selection of suitable hardware and assemble /identify and extend software solution for real-time problem.
- Develop a device/prototype/solution, test and characterize.
- Validate the prototype/real time problem solution/characterization through performance analysis under different system conditions.
- Analyze the findings, propose the suitable solution and conclude with a report / oral presentation.

PROFESSIONAL ELECTIVES
(ODD SEMESTER)

EE18001 BIO MEDICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To learn the various physiological systems and transducers to build a biomedical system.
- To gain knowledge about the various parameters both electrical and non electrical and the methods of recording and imaging analysis.
- To study about the various assist devices and recently developed diagnostic and therapeutic techniques.

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals – Cardiovascular systems – Respiratory systems. Basic components of a biomedical system– Physiological signals and transducers – Transducers – Selection criteria – Piezo electric, ultrasonic transducers – Temperature measurements – Fiber optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure – Cardiac output – Heart rate – Heart sound – Pulmonary function measurements – Spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analyzers, pH of blood – Measurement of blood pCO2, pO2, finger-tip oximeter – ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Basic electrode theory – Micro electrodes, Skin surface electrodes, Needle electrodes – Equivalent circuit – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier – ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms – Electrical safety in medical environment, shock hazards – leakage current.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

X-ray machine – Computer radiography – Computer tomography – Magnetic resonance imaging – Nuclear medicine – Single photo emission computer tomography – Positron emission tomography – Ultrasonography – Endoscopy – Thermography.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialyzers – Lithotripsy – Therapeutic Devices – Infant Incubators – Surgical Instruments – Nano Robots – Robotic surgery.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand fundamental aspects of Biomedical Engineering.
- Comprehend measurement and processing of physiological parameters.
- Comprehend the electrodes, electronic circuits of biomedical instrumentation system and analyze operation of critical biomedical equipment and understand importance of electrical safety in medical field.
- Acquire knowledge on operation of various imaging medical equipment.
- Comprehend the application of life assisting, therapeutic and robotic devices.

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, 4 th edition New York, 2009.
2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 3rd edition, New Delhi, 2014.
2. Arumugam M, "Biomedical Instrumentation", Anuradha Agencies Publishers, Chennai, 2010.
3. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", 2nd edition, Boca Raton, CRC Press LLC, 2000.
4. Joseph J. Carr and John M. Brown," Introduction to Biomedical Equipment Technology", John Wiley and sons, 4th edition, New York, 2000.

EE18003 DESIGN OF ELECTRICAL APPARATUS L T P C
3 0 0 3

OBJECTIVES:

- To determine rating of various types of electrical machines.
- To design armature and field systems for D.C. machines.
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines.
- To design stator and rotor of synchronous machines.

UNIT I INTRODUCTION 9

Major considerations in Electrical Machine Design- Electrical Engineering Materials – Design of Magnetic circuits–Magnetizing current–Calculation of MMF–Rating of machines – Standard specifications

UNIT II DC MACHINES 9

Output Equations – Main Dimensions – Choice of Specific Electric and Magnetic Loading – Magnetic Circuits Calculations - Carter's Coefficient - Net length of Iron –Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes

UNIT III TRANSFORMERS 9

Output Equations – Main Dimensions - kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.

UNIT IV INDUCTION MOTORS 9

Output equation of Induction motor – Main dimensions – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing current - Short circuit current – Operating characteristics- Losses and Efficiency.

UNIT V SYNCHRONOUS MACHINES 9

Output equations – choice of Electrical and Magnetic Loading – Design of salient pole machines –Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field mmf –Design of field winding – Design of turbo alternators – Rotor design.

TOTAL: 45 PERIODS

OUTCOMES:

- Design dc machines for the given set of specifications.
- Design transformers for the given set of specifications.
- Design Induction motors for the given set of specifications.
- Design synchronous machines for the given set of specifications.

TEXT BOOKS

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 2016.
2. M.V.Deshpande “Design and Testing of Electrical Machine Design” Wheeler Publications, 2010.

REFERENCES

1. A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
2. R.K.Agarwal “ Principles of Electrical Machine Design” S K Kataria and Sons; Reprint 2012 edition (2012).
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006

EE18005 CONTROL SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES :

- To gain knowledge on feedback control system design with compensators and controllers.
- To educate on the concepts of optimal control and filtering for linear systems in continuous and discrete domain.

UNIT I FEEDBACK CONTROL SYSTEM DESIGN 9

Introduction – Design Specifications in Continuous Domain – Limitations – Cascade Compensator Design – Lead, Lag synthesis by Phase Margin Assignment; Pole Placement Design Algorithm.

UNIT II CLASSICAL PID CONTROLLER DESIGN 9

PID Structure – Empirical Tuning – Ziegler-Nichols (Z-N) Oscillation Method – A Modified Ziegler-Nichols Formula – Reaction Curve based Methods – PID synthesis – Constraints: Wind-Up, Anti-Wind-up Scheme, State Saturation – Design in Continuos and Discrete Domain.

UNIT III STABILITY ANALYSIS 9

Concept of Stability – Positive/Negative Definite, Positive/Negative Semi-Definite Functions – Equilibrium Points – Lyapunov's Stability Theorems – Lyapunov's Direct Method for LTI Systems – Lyapunov's Method for Non-linear Systems – Krasovski's Theorem on Lyapunov Function.

UNIT IV OPTIMAL CONTROL 9

Classical control and optimization – Problem Formulation – Performance Measures – Optimal State Regulator Design on Continuous System (Linear Quadratic Regulator) – Solution of Ricatti's Equation – Application Examples.

UNIT V OPTIMAL FILTER 9

Filtering – Linear system and estimation – System noise smoothing and prediction – Qualitative Analysis on Discrete State Regulator (Linear Quadratic Guassian) – Optimal Observer (Kalman Filter) – Solution to Continuous and Discrete Systems – Design Examples.

TOTAL : 45 PERIODS

OUTCOMES:

- Design compensators on feedback control system to achieve given performance specifications.
- Apply classical PID controller design methods in continuous and discrete domain.
- Analyse the stability of linear and non-linear systems.
- Apply optimal control and filtering concepts to linear systems in continuous and discrete domain.

REFERENCES

1. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado “Control system Design”, PHI, 2003
2. G. F. Franklin, J. D. Powell and M Workman, “Digital Control of Dynamic Systems”, PHI, 2002.
3. M.Gopal, “Digital Control and State variable methods” Mcgraw hill 4th edition, 2012.
4. Benjamin C. Kuo “Digital control systems”, Oxford University Press, 2004.
5. M. Gopal, “Modern control system Theory”, New Age International, 2005.
6. K. P. Mohandas, “Modern Control Engineering”, Sanguine, India, 2006.

EE 18007 SOLID STATE DEVICES L T P C
3 0 0 3

OBJECTIVES:

- Understand the fundamental concepts of materials used in semiconductor industry
- Acquire the knowledge on formation, working and characteristics PN junction

UNIT I INTRODUCTION TO QUANTUM THEORY OF SOLIDS 9

Principles of Quantum Mechanics–Schrodinger's Wave Equation and its application– Extensions of Wave Theory to Atoms – Allowed and forbidden Energy bands–Electrical Conduction in solids– Density of State functions.

UNIT II SEMICONDUCTORS IN EQUILIBRIUM 9

Charge Carriers in Semiconductors–Dopant atoms and Energy Levels–Dopant Atoms and Energy levels-Extrinsic Semiconductor–Statistics of Donors and Acceptors– Charge Neutrality–Position of Fermi Energy Levels.

UNIT III CARRIER TRANSPORT 10

Carrier Drift– Carrier Diffusion–Graded Impurity Distribution– Hall Effect–Carrier Generation and Recombination–Characteristics of Excess Carrier–Amipolar Transport –Quasi –Fermi Levels–Excess Carrier Lifetime.

UNIT-IV PN JUNCTIONS 9

Basic Structure of the PN Junctions – PN Junction Under Zero Applied Bias, Forward Bias and Reverse Bias–Junction Capacitance–One sided pn Junction–Non-uniformly Doped Junctions-PN junction current – Small signal model of the pn Junction – Diode current equation – Junction Breakdown.

UNIT V FABARICATION AND APPLICATIONS OF PN JUNCTIONS 8

Fabrication of Discrete Planar pn Junction Diodes–Applications: Voltage regulator–Variable Capacitor–Tunnel diode–Solar cells –Photo diode –Photo Detector–Light Emitting Diode and Lasers.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the principles of quantum theory of solids.
- Analyze semiconductors in equilibrium state
- Comprehend carrier transport phenomenon in semiconductors.
- Comprehend the electrical behavior of PN junction.
- Acquire knowledge on fabrication techniques of PN junctions and it's Applications.

TEXT BOOKS:

1. Semiconductor Physics and Devices", Donald.A.Neamen, fourth edition, McGraw Hill,2012
2. Semiconductor Devices Modelling and Technology, Nandita Das Gupta, Amitava Das Gupta, Prentice Hall of India Private Ltd, 2011.
3. Solid State Electronic Devices, B.G. Streetman and S. Banerjee, 6th edition, PHI Learning, 2009.

REFERENCES:

1. Semiconductor devices: Physics and Technology, S.M. Sze, 2nd edition, Wiley, 2008.
2. Device Electronics for Integrated Circuits, Richard muller, Theodore I.Kamins, Mansunchan, 3rd edition John Wiley,2003.
3. M. S. Tyagi, "Introduction to Semiconductor Materials and Devices", John Wiley, 2004

EE18009 ENERGY MANAGEMENT AND AUDITING L T P C
3 0 0 3

OBJECTIVES:

- To understand the need for energy auditing.
- To understand of various loads involved based on power consumption for auditing.
- To Know about different audit instruments used in practice.

UNIT I INTRODUCTION 9

Need for energy management - energy basics- designing and starting an energy management program – energy accounting -energy monitoring, targeting and reporting- energy audit process.

UNIT II ENERGY COST AND LOAD MANAGEMENT 9

Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- cost of electricity-Loss evaluation- Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy management-Economic justification.

UNIT III ENERGY MANAGEMENT FOR MOTORS, SYSTEMS, AND ELECTRICAL EQUIPMENT 9

Systems and equipment- Electric motors-Transformers and reactors-Capacitors and synchronous machines.

UNIT IV METERING FOR ENERGY MANAGEMENT 9

Relationships between parameters-Units of measure-Typical cost factors- Utility meters - Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements- Metering techniques and practical examples.

UNIT V LIGHTING SYSTEMS & COGENERATION 9

Concept of lighting systems - The task and the working space -Light sources - Ballasts - Luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards Cogeneration: Forms of cogeneration - feasibility of cogeneration- Electrical interconnection.

TOTAL: 45 PERIODS

OUTCOMES:

- Acquire the background required for engineers to meet the role of energy managers and to acquire the skills and techniques required to implement energy management.
- Learn about basic concepts of economic analysis and load management.
- Understand the energy management on various electrical equipment.
- Knowledge on the concepts of metering and factors influencing cost function.
- Learn about the concept of lighting systems, light sources and various forms of cogeneration

REFERENCE:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T.D & Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, 1990.
3. Reay D.A, "Industrial Energy Conservation", 1st edition, Pergamon Press, 1977.
4. "IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities", IEEE, 1996
5. Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 2003.

EE18011 IoT FOR ELECTRICAL ENGINEERS L T P C
3 0 0 3

OBJECTIVES :

- To understand basic concept of IoT architecture and various IoT sensors
- To demonstrate typical applications of Embedded system enabled with IoT in automation.

UNIT I BASIC CONCEPTS OF IoT 9

Introduction and evolution of IoT from internet, IOT Physical Devices & Endpoints - Basic building blocks and Exemplary IOT Device: Raspberry Pi, Linux on Raspberry Pi , Raspberry Pi Interfaces - Serial , SPI , I2C , Programming Raspberry Pi with Python - Controlling LED with Raspberry Pi , Interfacing an LED and Switch with Raspberry Pi , Interfacing a Light Sensor (LDR) with Raspberry Pi , Other IoT Devices - Arduino with embedded C, Intel Galileo, pcDuino , BeagleBone Black , Cubieboard.

UNIT II HOME AND BUILDING AUTOMATION 9

Adaptive lighting- Wireless and internet-enabled lights – control by web and mobile applications- control and management of smart appliances-systems for detecting and responding to intrusions-surveillance systems-Detection systems for smoke and gas - Video, audio, and projector control in the home.

UNIT III INDUSTRIES 9

connecting sensors, actuators, control systems, and machines to optimize production and supply chain networks in manufacturing- automation of process controls in process industries- service information systems, and operator tools to increase productivity and safety. Impact of IoT : real time monitoring and controlling operations- deploying intelligent equipment, sensors, and controllers - Automation and control.

UNIT IV ENERGY 9

Smart grid - automation, distribution, and monitoring- Advanced Infrastructure for Measuring – SCADA- Smart Inverters- Remote operation of devices that use energy- connecting solar panels, rainwater harvesters, smart roof, and windows in one system-Observable, automated, and controllable green energy using Iot sensors - IoT solutions in renewable energy power production

UNIT V ELECTRIC VEHICLE 9

Intelligent smart controllers - EV charging station locator- Smart charging stations - Battery monitoring and management - Vehicular traffic and smart parking.

TOTAL: 45 PERIODS

OUTCOMES

- Articulate the main concepts, key technologies of IoT.
- Apply IoT in Home & Building automation.
- Apply IoT in Industrial automation.
- Apply IoT in smart grid & Energy Management.
- Apply IoT in Electric Vehicle.

TEXT BOOKS

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things : A hands on approach”, First Edition, Universities Press, 2015.

2. Honbo Zhou,“The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.

3. Dieter Uckelmann Mark Harrison; Florian Michahelles, “Architecting the Internet of Things “, Springer, 2011.

REFERENCES

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
2. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

PROFESSIONAL ELECTIVES
(EVEN SEMESTER)

EE18002 COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS L T P C
3 0 0 3

OBJECTIVES:

- To refresh the fundamentals of Electromagnetic Field Theory.
- To provide foundation in formulation and computation of Electromagnetic Fields using analytical and numerical methods.
- To impart in-depth knowledge on Finite Element Method in solving Electromagnetic field problems.
- To introduce the concept of mathematical modeling and design of electrical apparatus.

UNIT I INTRODUCTION 9

Review of basic field theory – Maxwell's equations –Constitutive relationships and Continuity equations– Laplace, Poisson and Helmholtz equation– principle of energy conversion–force/torque calculation.

UNIT II BASIC SOLUTION METHODS FOR FIELD EQUATIONS 9

Limitations of the conventional design procedure, need for the field analysis based design, problem definition, boundary conditions, solution by analytical methods-direct integration method– variable separable method–method of images, solution by numerical methods-Finite Difference Method.

UNIT III FORMULATION OF FINITE ELEMENT METHOD (FEM) 9

Variation Formulation–Energy minimization– Discretization –Shape functions–Stiffness matrix– and 1D and 2D planar and axial symmetry problems.

UNIT IV COMPUTATION OF BASIC QUANTITIES USING FEM PACKAGES 9

Basic quantities–Energy stored in Electric Field–Capacitance–Magnetic Field–Linked Flux Inductance– Force–Torque –Skin effect–Resistance.

UNIT V DESIGN APPLICATIONS 9

Design of Insulators–Cylindrical magnetic actuators–Transformers –Rotating machines

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the basic concepts of electromagnetic field theory.
- Formulate an electromagnetic field problem and various analytical solution methods.
- Comprehend the philosophy of finite element analysis.
- Application of finite element method in the computation of field quantities.
- Design and analyze various electrical apparatus through finite element method.

TEXT BOOK:

1. Nicola Biyanchi, "Electrical Machine analysis using Finite Elements", Taylor and Francis Group, CRC Publishers, 2005.
2. S.J.Salon,"FiniteElementAnalysisofElectricalMachines"KluwerAcademicPublishers,London, 1995, distributed by TBH Publishers & Distributors, Chennai, India

REFERENCES

1. Matthew. N.O. Sadiku,"Elements of Electromagnetics", Fourth Edition, Oxford University Press, First Indian Edition 2007
2. K.J.Binns, P.J.Lawrenson, C.WT row bridge, "The analytical and numerical solution of Electric and magnetic fields", John Wiley &Sons, 1993.
3. Nicola Biyanchi, "Electrical Machine analysis using Finite Elements", Taylor and Francis Group, CRC Publishers, 2005.
4. NathanIda, Joao P.A.Bastos "Electromagnetics and calculation of fields" ,Springer Verlage,1992.
5. S.J.Salon,"FiniteElementAnalysisofElectricalMachines"KluwerAcademicPublishers,London, 1995, distributed by TBH Publishers & Distributors, Chennai, India
6. Silvester and Ferrrai, "Finite Elements for Electrical Engineers" Cambridge University press,1983.

EE18004 **SMART GRID** **L T P C**
3 0 0 3

OBJECTIVES

- To learn the smart grid technologies.
- To introduce the concept of smart metering and advanced metering infrastructure.
- To address the power quality management issues in smart grid.
- To develop the high performance computing system for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID **9**

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, Functions, opportunities, challenges and benefits, Difference between conventional & smart Grid, National and International Initiatives in Smart Grid.-Implementation of smart grid technologies in India.

UNIT II SMART MEASURING DEVICES **9**

Phasor Measurement Unit (PMU), Limitations of RTU, GPS Time Synchronization, Location & Placement, Features - Wide Area Monitoring Systems (WAMS) - Sub-station Automation Systems (SAS) - Distribution Automation Systems (DAS).

UNIT III SMART METERING INFRASTRUCTURE **9**

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits,AMI protocols, standards and initiatives, AMI needs in the smart grid and Phasor Measurement unit, Simulation study of implementation of AMI in smart grid environment.

UNIT IV PERFORMANCE INDICES MEASUREMENT TOOLS OF SMART GRID DESIGN **9**

Introduction to Load Flow Studies - Challenges to Load Flow in Smart Grid - Load Flow for Smart Grid Design - Static Security Assessment (SSA) and Contingency Studies for the Smart Grid - Case Study on state estimation for smart grid environment using Power World Simulator.

UNIT V HIGH PERFORMANCE COMPUTING **9**

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN),Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Types of cyber-attacks in smart grid, Prevention of cyber-attacks by means of cyber security in smart grids.

TOTAL: 45 PERIODS

OUTCOMES

- Analyze challenges and benefits of smart grids and its present developments.
- Understand Smart measuring devices
- Acquire knowledge on advanced metering infrastructure and analyzing hardware implementation.
- Design of smart grid power system
- Understand LAN, WAN and Cloud computing for Smart grid applications.

TEXT BOOKS:

1. Stuart Borlase, ―Smart Grid: Infrastructure, Technology and Solutions‖, CRC Press 2012.
2. James Momoh, ―Smart Grid Fundamentals of Design and Analysis‖, IEEE Press, 2012.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, ―Smart Grid: Technology and Applications ‖, Wiley & Sons Ltd., February 2012.
4. Ali Keyhani and Muhammad Marwali, ―Smart Power Grids 2011‖, Springer Publications, 2011.
5. Christine Hertzog, ―Smart Grid Dictionary‖, Springer publications, 2009.
6. Tony Flick, Justin morehouse, ―Securing the smart grid: Next generation power grid security, Elsevier, 2010.

REFERENCES:

1. Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey", IEEE Transaction on Smart Grids.

EE18006 ADVANCED ELECTRIC DRIVES L T P C
3 0 0 3

OBJECTIVES:

- To understand Modern Electrical drive system and drive dynamics.
- To understand the Modeling and control of DC Motor.
- To understand the Modeling and control of AC machines.
- To study Basic and importance special electric machines drive circuit.

UNIT I MODERN ELECTRICAL DRIVES AND PRINCIPLES 9

Introduction, Drive Technology Trends, Electrical Machines, Power Converter, Embedded Control and Communication, Drive Design Methodology.

ITF and IRTF Concepts- Electromagnetic Torque Control Principles- DC Machine- Synchronous Machine- Induction Machine- Drive Dynamics- Linear and Rotational Motion- Rotational to Translational Transmission- Gear Transmission- Dynamic Model of a Drive Train- Shaft Speed Control Loop Design Principles

UNIT II MODELING AND CONTROL OF DC MACHINES 9

Separately Excited, Current-Controlled DC Machine -Symbolic Model of the DC Machine - Generic Model DC Machine -Field-Oriented Machine Model -Control of Separately Excited DC Machines-Controller Concept - Operational Drive Boundaries - Use of Current Source IRTF Based Model - Use of a Voltage Source with a Model Based Current Control.

UNIT III MODELING AND CONTROL OF SYNCHRONOUS MACHINE DRIVES 9

Non-salient Machine- Symbolic and Generic Model- Rotor-Oriented Model: Non-salient Synchronous Machine- Steady-State Analysis- Salient Synchronous Machine- Generic Model- Rotor-Oriented Model of the Salient Synchronous Machine- Steady-State Analysis.

Performance equations of operation from a voltage source – Power factor control and V curves – starting and braking, self-control – Load commutated Synchronous motor drives – Brush and Brushless excitation.

UNIT IV MODELING AND CONTROL OF INDUCTION MACHINE DRIVES 9

Steady state and Dynamic model of Induction Machine-V/f control-Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation – Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.

UNIT V SPECIAL ELECTRICAL MOTOR DRIVES 9

Introduction -Constructional features –Principle of operation –Torque equation-Drive circuit of stepper motor, Switched reluctance motor, Brushless Permanent DC motor, and Synchronous Reluctance motor.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand the concept of Electric drive system.
- Ability to Model and Control of Induction and Synchronous motor.
- Ability to understand special electrical machines principle and its drive circuit.

REFERENCES:

1. Rik De Doncker, Duco W.J. Pulle, André Veltman, "Advanced Electrical Drives - Analysis, Modeling, Control", Springer 2011.
2. Ned Mohan, "Advanced Electric Drives-Analysis, Control, and Modeling Using MATLAB/Simulink", Wiley 2014.
3. P.C. Krause, O. Wasynczuk, and S. D. Sudhoff, "Analysis of Electric Machinery", McGraw-Hill Book Company, 1986.
4. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall.2002.
5. P. S. Bhimbra, "Generalized Theory of Electric Machines", Khanna Publication.2006.
6. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2011.
7. E.G. Janardanan, 'Special Electrical Machines', PHI learning Private Limited, Delhi, 2014.
8. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press,Oxford, 1989.
9. Vedam Subramanyam, "Electric Drives – Concepts and Applications", Tata McGraw Hill, 1994.

EE18008 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the concept, planning of DC power transmission and comparison with AC power transmission.
- To analyze HVDC converters.
- To learn about the HVDC system control.
- To analyze harmonics and design of filters.
- To model and analysis the DC system under steady state.

UNIT I INTRODUCTION **9**

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

UNIT II ANALYSIS OF HVDC CONVERTERS **9**

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number –Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.

UNIT III CONVERTER AND HVDC SYSTEM CONTROL **9**

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

UNIT IV REACTIVE POWER AND HARMONICS CONTROL **9**

Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM –Generation of harmonics – Design of AC and DC filters – Active filters.

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS **9**

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis– case study.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Understands the principle and types of HVDC system.
- Identify and Analyze suitable converters for HVDC system.
- Analyze the methodologies for control of HVDC converters.
- Conduct Harmonic analysis on HVDC power system.
- Model HVDC system and run power flow analysis.

TEXT BOOKS:

1. Padiyar, K. R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition, 2010.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.

REFERENCES:

1. Kundur P., "Power System Stability and Control", McGraw-Hill, 1993.
2. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.
4. S. Kamakshaiah, V. Kamaraju, 'HVDC Transmission', Tata McGraw Hill Education Private Limited, 2011.

EE18010 POWER QUALITY AND FACTS L T P C
3 0 0 3

OBJECTIVES

- To understand the power quality terms, international standards and monitoring power quality issues using expert systems
- To realize the power quality issues arising of a DG-Utility System interface
- To apply the instantaneous power theory for power conditioning
- To understand the basic FACTS concepts and application of FACTS controllers
- To apply Emerging FACTS controllers for power quality improvement

UNIT I ELECTRICAL POWER SYSTEMS QUALITY 10

Power Quality – Terms and definitions – International standards of power quality – IEEE – IEC and CBEMA curve – Harmonic Distortion – Harmonic Indices – Harmonic sources from commercial and industrial loads – Locating harmonic sources – Power Quality Monitoring: Monitoring Considerations, Power quality measurement equipment - harmonic/spectrum analyzer – flicker meters – disturbance analyzer. Applications of expert systems for power quality monitoring.

UNIT II DISTRIBUTED GENERATION AND POWER QUALITY 6

Introduction – Resurgence of DG – DG Technologies – Interface to the Utility System - Power Quality Issues – Operating Conflicts – Interconnection Standards - Industry Standards Efforts, Interconnection Requirements, A Simple Interconnection and A Complex Interconnection

UNIT III INSTANTANEOUS POWER THEORY AND APPLICATION TO POWER CONDITIONING 10

Applications of the p-q Theory to Power Electronics Equipment – Basic Principles of Harmonic Compensation – The Instantaneous Power Theory: Basics of the p-q Theory, The p-q Theory in Three-Phase Three-Wire Systems – Three-Phase Three-Wire Shunt Active Filter – Basic Series Active Filter

UNIT IV FACTS CONTROLLERS 10

FACTS concept – Basic Type of FACTS Controllers – Concepts of SVC voltage control: Advantages of slope in the SVC dynamic Characteristic, Design of the SVC voltage regulator – SVC applications: Increase in Steady state Power-Transfer Capacity, Prevention of Voltage Instability – The TCSC: Modes of Operation – TCSC Applications: Improvement of System-Stability limit, Voltage-Collapse Prevention – Coordination of FACTS Controllers

UNIT V EMERGING FACTS CONTROLLERS 9

The STATCOM – Dynamic Compensation – A Selective Harmonic-Elimination Modulation (SHEM) Technique – The SSSC – SSR mitigation – Combined Series and Shunt Power Conditioners: The UPFC, The UPQC and The UPLC – Future direction of FACTS technology – Application of FACTS controllers for power quality improvement in distribution system.

TOTAL: 45 PERIODS

OUTCOMES

- Understand the power quality terms, standards and application of expert systems to monitor power quality issues
- Analyze the power quality issues arising from DG-Utility System interface and related interconnection requirements.
- Design harmonic compensators by applying the concepts of instantaneous power theory.
- Identify suitable FACTS controllers and apply for power system control.
- Understand the emerging FACTS technology and its application in electrical power system for power quality improvement.

TEXT BOOKS

1. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, Electrical Power Systems Quality‘ McGraw Hill, 2012
2. R .Mohan Mathur and Rajiv K.Varma , Thyristor-based FACTS controllers for Electrical transmission systems‘, IEEE press, Wiley Inter science , ISBN no . 0-471-20643-1,2002.

REFERENCES

1. Arrillaga.J, Watson.N.R and Chen.S, "Power System Quality Assessment", John Wiley & Sons Ltd., England, 2000.
2. N.G.Hingorani, L.Gyugyi, Understanding FACTS - Concepts and Technology of flexible ac transmission system‘, IEEE Press New York, 2000.
3. Math H.J.Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", IEEE Press, New York, 2000.
4. Barry W.Kennedy, ―Power Quality Primer‖, McGraw-Hill, New York, 2000.
5. K.R.Padiyar, _FACTS controllers for transmission and Distribution systems‘ New Age international Publishers, 2007.

EE18012 POWER SYSTEM DEREGULATION L T P C
3 0 0 3

OBJECTIVES

- Understanding the main objective of deregulation: to enhance competition and bring new choices and economic benefits.
- Calculate Transmission Transfer Capability and Available Transfer Capability.
- Studying methods for congestion management and transmission pricing.
- Aware of Indian Power market Current scenario and Regulations.

UNIT I FUNDAMENTALS OF RESTRUCTURED POWER SYSTEM 9

Need for deregulation, Components of Deregulation, Technical, economic & regulatory issues involved in deregulation of power industry - Fundamental of Restructured Power Market - Restructuring Models - Market Power- Power exchange (PX) and pool markets-Independent System Operator (ISO)– components- role of ISO -Market Clearing Price (MCP) - Market operations: Day-ahead and Hour-Ahead Markets, Elastic and Inelastic Markets - Stranded costs.

UNIT II TRANSMISSION TRANSFER CAPABILITY 9

Transmission expansion in the New Environment–Introduction–Role of transmission planning– Transmission Capacity–Total Transfer Capability (TTC) – Computational procedure - Margins– Available transfer capability (ATC)–Principles–Constraints-Methods to compute ATC- Method based on multiple load flow and continuation power flow - Method based on optimization power flow- Method based on linear sensitivity factors.

UNIT III CONGESTION MANAGEMENT AND ANCILLARY SERVICES 9

Concept of Congestion Management– congestion management methods: An overview: Cluster/zone based method-– Locational Marginal Pricing–Financial Transmission Right-Developments in international transmission pricing- Security management in deregulated environment, scheduling of spinning reserves, interruptible load options for security management- congestion management in deregulation, economic instruments for handling congestion- Ancillary Services

UNIT IV TRANSMISSION PRICING ISSUES 9

Introduction-power wheeling –Wheeling Transactions-Transmission open access- Types of Transmission services in open access – cost components in transmission – Pricing of power transactions – Embedded cost based Transmission pricing - Postage stamp method - contract path method-MW Mile method- MVA mile.

UNIT V INDIAN POWER MARKET 9

Current Scenario– Regions–Salient features of Indian Electricity Act 2003–Regulatory and Policy- development in Indian power Sector–Availability based tariff–Necessity–Working Mechanism– Unscheduled Interchange Rate– Operation of Indian Power Exchange.

TOTAL: 45 PERIODS

OUTCOMES

- Acquire knowledge on restructuring process, new entities in power market and benefits.
- Determine available transfer capability in restructured environment.
- Analyze congestion management for conventional and deregulated power systems.
- Describe transmission services in open access and pricing of power transactions.
- Comprehend Indian power system, issues, regulatory and policy developments and acts

TEXT BOOKS

1. Kankar Bhattacharya Maath H.J. Bollen and Jaap E.Daalder, ―Operation of restructured power systems‖, Kluwer academic publishers, USA, first edition, 2001.
2. Loi Lei Lai, ―Power system Restructuring and regulation‖ John Wiley sons, 2001.
3. M.Shahidepour, Hatim Tamin and Zuyi Li, ―Market operations in electric power system forecasting, scheduling and risk management‖, John Wiley sons, 2002.

REFERENCES:

1. Daniel Kirschen and Goran Strbac, Fundamentals of power system economics‖, John Wiley sons, 2004.
2. P.Venkatesh, B.V.Manikandan, S.Charles Raja and A.Srinivasan , ― Electrical power systems analysis, Security and Deregulation‖, PHI 2012.
3. M.Shahidehpour and M.Alomoush,"Restructuring Electrical Power Systems", Marcel Decker Inc., 2001.

EE18014 POWER SYSTEM DYNAMICS L T P C
3 0 0 3

OBJECTIVES:

- Modeling of synchronous machines with excitation system, Power system stabilizer and speed-governing controllers.
- Analyze transient and small signal stability behavior of power system.

UNIT I SYNCHRONOUS MACHINE MODELLING 9

Introduction to Dynamic Modeling & Analysis - Conceptual Importance of power system transient and dynamic stability in the operation and design- Synchronous machine - flux linkage equations - Park's transformation - per unit conversion - normalizing the equations - equivalent circuit - current space model - flux linkage state space model - Sub-transient and transient inductances - time constants - Steady state equations and phasor diagrams.

UNIT II MODELLING OF EXCITATION SYSTEM 9

Simplified models of Synchronous machine (one axis and constant flux linkage) - Basic concepts and definitions of Exciter and voltage regulators - Elements, types & Function of excitation system- State space representation of IEEE type 1 excitation system - saturation function - stabilizing circuit.

UNIT III MODELLING OF SPEED GOVERNORS 9

Function of speed governing systems - Block diagram and state space representation of IEEE mechanical hydraulic governor and electrical hydraulic governors for hydro turbines and steam turbines. Modeling & analysis of Synchronous machine with Excitation system and speed governor using simulation package.

UNIT IV TRANSIENT STABILITY 9

Modeling of multi machine power system with one axis machine model – Inclusion of excitation system and speed governing system- power system stabilizer- Assumptions made in stability studies- Transient stability analysis simulation using R-K method of fourth order (Gill's technique) - For all simulations, the algorithm and flow chart have to be discussed.

UNIT V DYNAMIC STABILITY 9

System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - linearization of the load equation for the one machine problem – simplified linear model - effect of excitation on dynamic stability - approximate system representation - supplementary stabilizing signals –small signal performance measures.

TOTAL: 45 PERIODS

OUTCOMES

- Develop dynamic model of synchronous machines under sub-transient and transient conditions.
- Develop dynamic model of synchronous machine's exciter.
- Develop dynamic model of synchronous machine's speed governor.
- Analyze stability conditions of synchronous machine with excitation system and speed governor for large disturbances.
- Analyze stability conditions of synchronous machine with excitation system and speed governor for small disturbances.

TEXT BOOKS

1. R.Ramanujam, "Power System Dynamics – Analysis and Simulation", PHI, 2009.
2. Prabha Kundur, "Power System Stability and Control", Tata McGraw Hill,USA 2006.
3. M.A.Pai and W.Sauer, "Power System Dynamics and Stability", Pearson Education Asia, India, 2002.
4. P.M. Anderson and A.A.Fouad, "Power System Control and Stability", Galgotia Publications, NewDelhi, 2003

REFERENCES

1. James A.Momoh, Mohamed. E. EI-Hawary. "Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition, 2000.
2. C.A.Gross, "Power System Analysis," Wiley India, 2011.
3. B.M.Weedy, B.J.Lory, N.Jenkins, J.B.Ekanayake and G.Strbac," Electric Power Systems", Wiley India, 2013.
4. K.Umarao, "Computer Techniques and Models in Power System," I.K. International, 2007.

EE18016 SPECIAL ELECTRICAL MACHINES L T P C
3 0 0 3

OBJECTIVES:

- Learn the construction, principle of operation, performance characteristics, control and applications of stepper motors, synchronous reluctance motors, switched reluctance motors, permanent magnet brushless-dc motors and permanent magnet synchronous motors.

UNIT I STEPPER MOTORS 9

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single & multi stack configurations – Lead angle - Torque equations – Modes of excitation – Static and Dynamic characteristics – Drive circuits – Closed loop control – Microprocessor based control of stepper motors – Applications - Case study: Computer printer.

UNIT II SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features of Axial and radial flux motors – Operating principles – Variable reluctance motors – Voltage and torque equations - Phasor diagram - Performance characteristics – Controllers – Applications.

UNIT III SWITCHED RELUCTANCE MOTORS (SRM) 9

Types - Constructional features - Principle of operation – Equivalent circuit - Torque production – Analytical method for obtaining machine characteristics – Design considerations - Power Converter configurations – Methods of Rotor position sensing – Sensor-less operation – Closed loop control schemes – Applications - Case study: Aero application – Simulation of a SRM drive.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

Permanent Magnet materials – Magnetic circuit analysis – BLDC motor: Principle of operation, Merits and Demerits - EMF and torque equations – Characteristics - Mechanical and Electronic commutator - Position sensors: Hall sensors, Optical sensors - Power Converter Circuits and their controllers – Sensor-less control - Applications - Case study: Fan application - Simulation of a BLDC motor drive.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) 9

Construction & Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Self control, Vector control schemes - Converter VA requirements – Comparison of BLDC and PMSM – Applications - Simulation of a PMSM drive.

TOTAL : 45 PERIODS

OUTCOMES:

- Design a stepper motor drive for an application.
- Learn the principle and characteristics of a synchronous reluctance motor drive.
- Configure a switched reluctance motor drive for an application.
- Understand the operation and control of a PMBLDC motor drive.
- Learn the operation and control of a permanent magnet synchronous motor drive.

TEXT BOOKS:

1. K.V.Ratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2. E.G. Janardanan, 'Special Electrical Machines', PHI learning Private Limited, Delhi, 2014.
3. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Oxford Press, 1995.
4. R.Krishnan, 'Permanent magnet synchronous and brushless dc motor drives', CRC press, 2010.
5. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.

REFERENCES:

1. P.P. Acarnley,' Stepping Motors – A Guide to Motor Theory and Practice', IET Control Engineering Series, 4th edition, 2002.
2. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.

EE18018 MICROELECTRONIC CIRCUITS L T P C
3 0 0 3

OBJECTIVES:

- To acquire knowledge on semiconductor physics and its evolutions in device characteristics.
- To implement any analog, digital or mixed signal circuits using semiconductor devices.

UNIT–I PN JUNCTION AND ITS APPLICATION 9

Energy band theory of crystal–Classification of semiconductors–charge carriers–carrier transport–Generation and recombination.

PN Junctions: Equilibrium Analysis–Ideal diode–Carrier Transport Under Applied Bias – Junction Capacitance– Diode Circuit Models. Applications of PN Junction –Rectifiers–LEDs– Detectors–Limiting and clamping circuits–Digital logic gates.

UNIT–II BIPOLAR JUNCTION TRANSISTOR 9

Device structure and Physical operation– Current –Voltage characteristics –Non ideal effects– The BJT as a amplifier and switch–Small signal operation and Models.

UNIT–III MOS FIELD EFFECT TRANSISTOR 9

Two terminal MOS structure–Energy band diagrams–Depletion layer thickness–work function differences–Flat–band voltage–Threshold voltage–Charge distribution–Capacitance–Voltage characteristics. MOSFET operation–Current–Voltage characteristics–Velocity saturation – Channel Length Modulation–Circuit Models.

UNIT–IV ANALOG CIRCUITS 9

IC Biasing- Current source, Current mirrors and Current steering circuits- Basic Gain Cell – The common gate and common base amplifiers- Cascode Amplifier – Current mirror circuits with improved performance.

UNIT–V DIGITAL CIRCUITS 9

Inverter Characteristics and Circuits– Gates (AND/NAND, OR/NOR) CMOS Inverters and Gates– Switching transients and gate delays. Simple CMOS implementation of logic circuits.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the transport behavior of the semiconductor devices.
- Analyze the characteristics of Bipolar junction transistor.
- Analyze the characteristics of MOS device.
- Design and analyze any analog circuit using BJT and MOS devices.
- Design and analyze any digital circuit using CMOS devices.

TEXT BOOKS:

1. Adel S.Sedra, Kenneth.C.Smith, “Microelectronic Circuits”, Oxford University Press, 7th Edition, 2016.
2. Donald.A.Neamen, “Semiconductor Physics and Devices”, Fourth edition, McGraw-Hill, 2012.

REFERENCES:

1. B.G. Streetman and S. Banerjee, "Solid State Electronic Devices", 6th edition, PHI Learning, 2009.
2. Richard Muller, Theodore.I.Kamins, Mansun Chan, "Device Electronics for Integrated Circuits", 3rd edition, John Wiley,2003.
3. M. S. Tyagi, "Introduction to Semiconductor Materials and Devices", John Wiley, 2004

EE18020 DIGITAL CONTROL SYSTEM L T P C
3 0 0 3

OBJECTIVES:

- To introduce the components of digital control system
- To understand time response and frequency response design methods in discrete systems using transfer function and state space forms.

UNIT I z PLANE ANALYSIS OF DISCRETE TIME SYSTEMS 9

Structure of Digital Control System – Data Conversion and Quantization – Z Transform – Properties and Theorems of the Z Transform – Inverse Z Transform – Z Transform Method for Solving Difference Equations – Impulse Sampling and Data Hold – Pulse Transfer Function – Block Diagram Reduction Methods.

UNIT II TIME RESPONSE DESIGN 9

Mapping between s-plane and z-plane – Time-Domain Analysis of Second Order Systems – Design based on the Time Response Method – Root Locus Method – Design Procedure of Compensators and Digital PID Controllers – Case study - Digital Temperature Control System, Digital Position Control System.

UNIT III STABILITY AND FREQUENCY RESPONSE DESIGN 9

Stability Analysis of closed loop systems in the Z-Plane – Jury Stability Test – Bilinear transformation – Stability by Pole Location – Transient and Steady State Response Analysis – Design based on the Frequency Response Method – Bode Plot – Nyquist Plot – Gain margin and phase margin.

UNIT IV STATE VARIABLE ANALYSIS 9

State variable models – Solving Discrete Time State Space Equations – Pulse Transfer Function Matrix – Discretization of Continuous Time State Space Equations – Solution of State Difference Equations – Controllability and Observability.

UNIT V STATE FEEDBACK CONTROLLERS AND OBSERVERS 9

Design of State Feedback Controller through Pole Placement – Necessary and Sufficient Conditions, Ackerman's Formula – State Feedback with Integral Control – Design of State Observers – Deadbeat Control by State Feedback and Deadbeat Observers – Case study Examples.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the modeling of digital control systems
- Determine the performance of a given pulse transfer function in time domain and frequency domain
- Analyze the effect of stability in state-space design of digital controllers.
- Construct state feedback controller with full order or reduced order observers for a given Linear Time Invariant sampled data system

TEXT BOOKS:

1. K. Ogata, "Discrete-Time Control systems", Pearson Education/PHI, 2nd Edition, 2005.
2. Benjamin C Kuo, "Digital Control Systems", Oxford University Press, 2nd Edition, 2010.

REFERENCE BOOKS:

1. M. Gopal, "Digital Control and State variable methods", Tata McGraw Hill Publishing Company, 4th Edition, 2012.
2. M.Sami Fadali, Antonio Visioli, "Digital Control Engineering Analysis and Design", Academic Press, 2013.
3. M. Gopal, "Digital Control Engineering", New Age International, 2006.
4. Franklin, Powell, Workman, "Digital Control of Dynamic Systems", Pearson Education Third edition, 2006.

CS18401 COMPUTER ARCHITECTURE L T P C
3 0 0 3

OBJECTIVES:

- To make students understand the basic structural operation of digital computer and the hardware-software interface.
- To familiarize the students with arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations.
- To expose the students to the concept of pipelining.
- To familiarize the students with hierarchical memory system including cache memories and virtual memory.
- To expose the students with different ways of communicating with I/O devices and standard I/O interfaces.

UNIT I OVERVIEW AND INSTRUCTIONS 9

Functional units – Basic operational concepts – Bus structures – Performance and metrics Eight ideas -Technology – Performance – Power wall – Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions – Logical operations – control operations – Addressing and addressing modes

UNIT II ARITHMETIC OPERATION 9

ALU - Addition and subtraction – Multiplication – Division – Floating Point operations – Subword parallelism

UNIT III CONTROL UNIT 9

Basic MIPS implementation – Building datapath – Control Implementation scheme – Pipelining – Pipelined data path and control – Handling Data hazards & Control hazards – Exceptions

UNIT IV PARALLELISM 9

Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware multithreading – Multi core processors

UNIT V MEMORY AND I/O SYSTEMS 9

Memory hierarchy - Memory technologies – Cache basics – Measuring and improving cache performance - Virtual memory, TLBs - Input/output system, programmed I/O, DMA and interrupts, I/O processors.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand Bus structure and Instruction set
- Design Arithmetic and Logic unit.
- Design of Control units
- Understand Parallel processing
- Evaluate performance of Memory

TEXT BOOKS:

1. David A. Patterson and John L. Hennessey, ―Computer organization and design, The Hardware/Software Interface‟, Morgan kauffman /Elsevier, Fifth edition, 2014

REFERENCES:

1. V. Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, ―Computer Organisation―, VI edition, McGraw-Hill Inc, 2012
2. William Stallings ―Computer Organization and Architecture‖, Seventh Edition, Pearson Education, 2006.
3. Vincent P. Heuring, Harry F. Jordan, ―Computer System Architecture‖, Second Edition, Pearson Education, 2005.
4. Govindarajalu, ―Computer Architecture and Organization, Design Principles and Applications", first edition, Tata McGraw Hill, New Delhi, 2005.
5. John P. Hayes, ―Computer Architecture and Organization‖, Third Edition, Tata McGraw Hill, 1998.
6. http://nptel.ac.in/

EE18022 ADVANCED POWER ELECTRONICS L T P C
3 0 0 3

OBJECTIVES:

- Analyze and design different power converter circuits.
- Study the types of Resonant Converters - zero voltage and zero current switching techniques.
- Disseminate knowledge about types of multilevel inverters and impedance source Inverters
- Acquire knowledge about power electronic converters in power system control applications

UNIT I SWITCHING VOLTAGE REGULATORS 9

Introduction; Linear power supply (voltage regulators); Switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode of operations, Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter, Sepic Converter; Design criteria for SMPS; Multi-output switch mode regulator.

UNIT II RESONANT CONVERTERS 9

Introduction, Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zero voltage switching dc-dc converters, zero current switching dc-dc converters, clamped voltage topologies.

UNIT III MULTI-LEVEL CONVERTERS AND MULTI-PULSE CONVERTERS 9

Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations; Features and relative comparison of these configurations applications, Introduction to carrier based PWM technique for multi-level converters- Z Source Inverter and its applications.

UNIT IV HVDC TRANSMISSION 9

Introduction, Operation of 12-pulse converter as receiving and sending terminals of HVDC system, Equipment required for HVDC System and their significance, Comparison of AC and DC transmission, Control of HVDC transmission.

UNIT V FACTS DEVICES 9

Definition of Flexible AC Transmission Systems (FACTS) and brief description, possible benefits from FACTS, STATCOM configuration and operating principle, Static characteristics of SVC and STATCOM Comparison of SVC and STATCOM, Principle of series compensation, Introduction to Static Synchronous Series Compensator, Advantages and limitations of SSSC, Introduction to UPFC and operating principle.

TOTAL: 45 PERIODS

OUTCOMES:

- Develop skills to build and troubleshoot Power electronic DC- DC converters.
- Acquire knowledge on Multilevel Inverters and Impedance source Inverters.
- Apply power converters in HVDC power transmission.
- Apply power converters in FACTS based power system control.

REFERENCES:

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd edition, 2007
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Pearson Education; 4th edition (2017)
3. L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009
4. Muhammad H. Rashid , "Power Electronics Handbook", Elsevier, 3rd ed., 2011.
5. Derek A. Paice "Power Electronic Converter Harmonics – Multipulse Methods for Clean Power", IEEE Press, 1996.
6. Bin Wu, "High Power Converters and AC Drives", John Willey & sons, Inc, Second Edition 2016.
7. P.C.Sen, "Modern Power Electronics ", S Chand & Company; 2nd Revised edition 2005
8. Vijay K. Sood, "HVDC and FACTS Controllers Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Boston, 2004.

EE18024 **NANOELECTRONICS** **L T P C**
3 0 0 3

OBJECTIVES:

- Provide a good understanding of the carrier transport in MOS devices, its characteristics and develop related models.

UNIT I INTRODUCTON TO NANOELECTRONICS **9**

Moore's Law –Node technology, Basic CMOS Process flow- MOS Scaling theory, Issues in scaling MOS transistors: Short channel effects, Description of a typical 65 nm CMOS technology. Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics

UNIT II ELECTRON TRANSPORT **9**

Electron transport in semiconductors and nanostructures- Time and length scales of the electrons in solids- Statistics of the electrons in solids and nanostructures- Density of states of electrons in nanostructures- Electron transport in nanostructures-Electrons in traditional low-dimensional structures- Electrons in quantum wells- Electrons in quantum wires- Electrons in quantum dots

UNIT III MOS CAPACITOR **9**

C-V characteristics; Effect of metal work function, oxide and interface trapped charges. Threshold voltage. Tunnelling current.

UNIT IV MOSFET **9**

Threshold based models of static I-V characteristics: Channel length modulation, field dependent mobility, short channel and narrow width effects; Subthreshold current. Quantum mechanical effects, Capacitances, concept of non-reciprocal capacitances.

UNIT V MOSFET MODELING **9**

Dynamic behavior under small and large signals. Surface potential and charge based models. Model parameters and their extraction. SOI MOSFETs, Double Gate MOSFETs and FinFETs.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand the fundamentals of nanoelectronics.
- Understand the transport phenomenon at the nanoscale.
- Understand the functionality of MOS capacitors.
- Analyze the Characteristics of MOSFET.
- Model and characterize various MOS devices.

TEXT BOOKS:

1. N. DasGupta and A. DasGupta, "Semiconductor Devices Modelling and Technology, PHI Learning Pvt.Ltd."
2. Lessons from Nanoelectronics A New Perspective on Transport, Supriyo Datta, World Scientific Publishing Co. Pte. Ltd., 2012

REFERENCES:

1. Streetman and Banerjee, “Solid State Electronic Devices”, Prentice-Hall.
2. Paolo Antognetti, Giuseppe Massobrio, Semiconductor Device Modeling with Spice.

EC18601	VLSI DESIGN	L	T	P	C
	(Common to EC and EE)	3	0	0	3

OBJECTIVES:

To study the

- Fabrication processes of MOS circuits, design rules for layouts and the limitations in scaling
- Realization of MOS circuits for various combinational logic blocks and analyze the performance tradeoffs with respect to the area, power and delay
- Various arithmetic building blocks and their timing constraints
- Various synchronous and asynchronous sequential designs and analyze the timing constraints
- Various architectural choices available for FPGA.

UNIT I MOS TRANSISTOR PRINCIPLE 9

NMOS, PMOS -Enhancement and depletion MOSFET; MOS transistor-Ideal I-V characteristics; Fabrication Process - MOSFET, CMOS- n-well, p-well, Twin tub, SOI; Scaling principles and fundamental limits; CMOS inverter characteristics; Stick diagram; Layout diagrams ; Design rules; Layer Representation

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Static CMOS Design: Examples of Combinational Logic Design; Complementary CMOS concept and properties; Ratioed Logic - DCVSL logic gate; Pass Transistor Logic - Concept, Complementary PTL and Differential PTL; CMOS transmission gate; Elmores constant; **Dynamic CMOS design:**Dynamic Logic - Basic Principles; Issues in Dynamic Design; Cascading Dynamic Gates

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Timing Metrics for Sequential Circuits; Static Latches and Registers; Bi-stability Principle; Multiplexer Based Latches; Master-Slave based Edge Triggered Register; Non-ideal clock signals; Dynamic Latches and Registers; Transmission-Gate Edge-triggered Registers; C2MOS Register; Dual-Edge Registers; True Single-Phase Clocked Register (TSPCR) Timing issues; Pipelines; Clock Strategies; Synchronous and Asynchronous design- Low power design principles

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS 9

Data path circuits; Architectures for Ripple Carry Adders; Carry Look Ahead Adders; Carry Select Adder; Carry Bypass Adder; High speed adders - Brunt Kung adder, Kogge Stone; Multipliers - Wallace Tree multiplier, Booth Multiplier; Barrel shifters; Speed and Area Trade-off for all above Arithmetic Building Blocks

UNIT V IMPLEMENTATION STRATEGIES 9

Full custom and Semi-custom design; Standard cell design and cell libraries; FPGA building block architecture - FPGA interconnect routing procedures; Design for Testability: Ad Hoc

Testing, Scan Design, BIST

TOTAL: 45 PERIODS

OUTCOMES:

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

- Sketch the CMOS logic circuit using Stick Diagrams and Layout Diagrams.
- Identify the MOS circuits for various combinational logic blocks and analyze performance parameters.
- Develop Sequential logic blocks and perform timing analysis.
- Detect suitable MOS logic style for designing arithmetic logic blocks.
- Compute FPGA and perform testing.

TEXT BOOKS:

1. Jan Rabaey, AnanthaChandrakasan, B.Nikolic, “Digital Integrated Circuits: A Design Perspective”, Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997

REFERENCES:

1. N.Weste, K.Eshraghian, “Principles of CMOS VLSI Design”, Second Edition, Addision Wesley 1993
2. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005
3. A.Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Third Edition, Prentice Hall of India, 2007.

EE 18026 HIGH VOLTAGE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To study the propagation, reflection and refraction of travelling waves.
- Generation & measurement of High voltages and High currents.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination.

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

Causes of over voltages and its effects on power system –Internal causes-switching surges and temporary over voltages – Reflection and Refraction of Travelling waves-External causes theories of charge formation, Lightning mechanism - Protection against overvoltage.

UNIT II DIELECTRIC BREAKDOWN 9

Gaseous breakdown – uniform field, Non uniform fields and Corona discharges – Vacuum breakdown – Conduction and breakdown in liquids– Breakdown mechanisms in solid and composite dielectrics- application of insulating materials.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of High DC, AC, impulse voltages and currents –- Triggering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers –Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators, transformers, surge arrester and Cables- Insulation Coordination.

TOTAL: 45 PERIODS

OUTCOME:

- Understand the over voltage phenomena in the Electrical power system and apply the protection schemes against over voltages.
- Analyze breakdown mechanism in solid, liquid and gaseous dielectric in uniform and non uniform fields
- Appraise the various methods of generation and measurements of high voltages and high currents
- Investigate the international and Indian standards of Electrical apparatus testing.

TEXT BOOKS:

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition,2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier, New Delhi, 2005.
3. Subir Ray, 'An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.

REFERENCES:

1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
2. C.L. Wadhwa, 'High Voltage Engineering', New Age International Publishers, Third Edition,2010.

EE18028 **MEMS TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- Impart knowledge on the properties of materials, microstructure, micromachining and fabrication.
- Design and model various MEMS based sensors and actuators.

UNIT I INTRODUCTION **9**

Introduction to Micro electro mechanical systems - Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – Packaging and Integration- MEMS Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor conductivity and resistivity – Stress and strain analysis – Flexural beam bending- Torsional deflection - Fabrication of a micro-heater.

UNIT II SENSORS AND ACTUATORS-I **9**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors

UNIT III SENSORS AND ACTUATORS-II **9**

Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.

UNIT IV SENSORS AND ACTUATORS-III **9**

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements– Applications to Inertia, Pressure, Tactile and Flow sensors – Case Study: Novasensor BP sensor.

UNIT V SENSORS AND ACTUATORS-IV **9**

Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia, Acoustic, Tactile and Flow sensors - Optical MEMS – Texas Digital Light Processor

TOTAL: 45 PERIODS

OUTCOMES:

- Acquire knowledge of materials, microstructure and fabrication techniques
- Design and analyze electrostatic MEMS devices
- Design and analyze thermal based MEMS devices
- Design and analyze Piezoresistive MEMS devices
- Design and analyze Piezoelectric MEMS devices

TEXT BOOK:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.

REFERENCES:

1. Marc Madou , "Fundamentals of microfabrication",CRC Press, 1997.
2. Boston , "Micromachined Transducers Source book",WCB McGraw Hill, 1998.
3. M.H.Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes", Elsevier, Newyork, 2000.
4. P. Rai Choudry" MEMS and MOEMS Technology and Applications", PHI, 2012.
5. Stephen D. Senturia, "Microsystem Design", Springer International Edition, 2011.

EE18030 **POWER SYSTEM MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- To identify the roles and responsibilities of different entities in the power market
- To educate the distributed system design based on forecasted data
- To analyze the load curves and the concept of economic load dispatch
- To understand the electrical safety procedures and methods
- To discuss the need for energy management and energy conservation

UNIT I DEREGULATION **9**

Introduction - Deregulation of Electric Utilities - Energy Generation under new environment - Competitive whole sale electricity market - Transmission expansion in new environment — Transmission Open Access - Pricing Electricity in Deregulated environment - Availability based Tariff Advances in online control of Power System - Application of Internet and GPS in power system control, Congestion management.

UNIT II LOAD CHARACTERISTICS AND LOAD FORECASTING **9**

Basic definitions - load definitions, load factor definitions, diversity principle in distribution systems, Load Forecast - factors affecting load forecasting methods, small areas load forecasting, spatial load forecasting methods, simulation, trending and mixed load forecasting methods.

UNIT III POWER SYSTEM PLANNING **9**

Basics of Power System Economics & Short-term Operation Planning of Power System, Load curves and load duration curves, Economic load dispatch - concept of marginal cost and Kuhn-Tucker's condition of optimum in power dispatch, participation factors.

UNIT IV ELECTRICAL SAFETY **9**

Hazards of electricity - Electrical Safety Equipment - Safety Procedures and methods - Grounding of Electrical Systems and Equipment - Regulatory and Legal Safety Requirements and Standards - Safety Audits - Rescue and first aid procedures.

UNIT V ENERGY MANAGEMENT **9**

Need for energy management, Energy Conservation Through Demand Side Management- Load Management- Reactive Power Control. Blackouts and cascading failures: Blackout mechanism, modeling of blackouts and cascading failures, prediction of blackouts, control of blackouts.

TOTAL: 45 PERIODS

OUTCOMES:

- Acquire knowledge on the deregulated environment and congestion management.
- Learn the fundamental concepts of load forecasting.
- Study the role of planning in power system.
- Understand the electrical system safety requirements.
- Analyze the blackouts and cascading failures.

TEXT BOOKS:

1. S. Sivanagaraju, G. Sreenivasan, “Power System Operation and Control”, Pearson Publisher.

REFERENCES:

1. Loi Lei Lai. 'Power System Restructuring and Deregulation: Trading Performance and Information Technology" John Wiley, 2001.
2. John Cadick, Mary Capelli - Schellpfeffer, Dennis. K, 'Electrical Safety Handbook", Me Graw Hill, 2005.
3. Craig B Smith, 'Energy management principles*, Pergamon Press.

EE18032 ADVANCED POWER SYSTEM PROTECTION L T P C
3 0 0 3

OBJECTIVES

- Illustrate concepts of transformer protection
- Describe about the various schemes of over current protection
- Analyze distance and carrier protection
- Familiarize the concepts of Busbar protection and Numerical protection

UNIT I OVER CURRENT PROTECTION 9

Zones of protection – Primary and Backup protection – operating principles and Relay Construction - Time-Current characteristics - Current setting – Time setting - Over current protective schemes - Reverse power or directional relay - Protection of parallel feeders - Protection of ring feeders - Earth fault and phase fault protection - Combined Earth fault and phase fault protection scheme - Phase fault protective scheme directional earth fault relay - Static over current relays; numerical example for a radial feeder

UNIT II EQUIPMENT PROTECTION 9

Types of transformers – Phasor diagram for a three – Phase transformer-Equivalent circuit of transformer – Types of faults in transformers- Over – current protection Percentage Differential Protection of Transformers - Inrush phenomenon-High resistance Ground Faults in Transformers - Inter-turn faults in transformers - Incipient faults in transformers - Phenomenon of over-fluxing in transformers - Transformer protection application chart .Generator protection: Electrical circuit of the generator –Various faults and abnormal operating conditions - stator faults - rotor faults –Abnormal operating conditions; numerical examples for typical transformer and generator protection schemes

UNIT III DISTANCE AND CARRIER PROTECTION OF TRANSMISSION LINES 9

Drawback of over – Current protection – Introduction to distance relay – Simple impedance relay – Reactance relay – mho relays comparison of distance relay – Distance protection of a three – Phase line-reasons for inaccuracy of distance relay reach - Three stepped distance protection - Trip contact configuration for the three - Stepped distance protection - Three-stepped protection of three-phase line against all ten shunt faults - Impedance seen from relay side - Three-stepped protection of double end fed lines-need for carrier – Aided protection – Various options for a carrier – Coupling and trapping the carrier into the desired line section - Unit type carrier aided directional comparison relaying – Carrier aided distance schemes for acceleration of zone II - numerical example for a typical distance protection scheme for a transmission line.

UNIT IV BUSBAR PROTECTION 9

Introduction – Differential protection of busbars - external and internal fault - Actual behaviors of a protective CT - Circuit model of a saturated CT - External fault with one CT saturation: need for high impedance – Minimum internal fault that can be detected by the high – Stability ratio of high impedance busbar differential scheme - Supervisory relay -protection of three – Phase busbars - Numerical examples on design of high impedance busbar differential scheme.

UNIT V NUMERICAL PROTECTION AND MODERN SCHEMES 9

Introduction–Block diagram of numerical relay - Sampling theorem- Correlation with a reference wave–Least error squared (LES) technique-Digital filtering-numerical over - Current protection–Numerical transformer differential protection-Numerical distance protection of transmission line

Overview of HVDC protection systems - Protection scheme for distributed generators (DGs) - Special Protection Schemes (SPS) - Power system protection testing - Common Format for Transient Data Exchange (COMTRADE) - Communication architecture for substation automation - Basics of synchro phasor based Wide Area Monitoring Systems (WAMS)

TOTAL : 45 PERIODS

OUTCOME:

- Understand the concepts of transformer protection.
- Analyze the various schemes of Over current protection.
- Analyze distance and carrier protection of transmission line.
- Acquire knowledge on Busbar protection schemes.
- Comprehend Numerical protection and aware of modern schemes.

TEXT BOOKS

1. Badri Ram and D.N. Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw- Hill Publishing Company, 2002.
2. T.S.M. Rao, “Digital Relay / Numerical relays”, Tata McGraw Hill, New Delhi, 1989

REFERENCES

1. P.Kundur, “Power System Stability and Control”, McGraw-Hill, 1993.
2. Stanley Horowitz, “Protective Relaying for Power System II”, IEEE press, New York, 2008
3. Y.G. Paithankar and S.R Bhide, “Fundamentals of Power System Protection”, Prentice-Hall of India, 2003

EE18034 CONTROL SYSTEM DESIGN FOR POWER ELECTRONICS LT P C
3 0 0 3

OBJECTIVES:

- To explore conceptual bridges between the fields of Control Systems and Power Electronics
- To Study Control theories and techniques relevant to the design of feedback controllers in Power Electronics

UNIT I MODELLING OF DC-TO-DC POWER CONVERTERS 9

Modelling of Buck Converter, Boost Converter, Buck-Boost Converter, Cuk Converter, Sepic Converter, Zeta Converter, Quadratic Buck Converter ,Double Buck-Boost Converter, Boost-Boost Converter General Mathematical Model for Power Electronics Devices

UNIT II SLIDING MODE CONTROLLER DESIGN 9

Variable Structure Systems. Single Switch Regulated Systems Sliding Surfaces, Accessibility of the Sliding Surface Sliding Mode Control Implementation of Boost Converter, Buck-Boost Converter, Cuk Converter, Sepic Converter, Zeta Converter, Quadratic Buck Converter, Double Buck-Boost Converter, Boost-Boost Converter

UNIT III APPROXIMATE LINEARIZATION CONTROLLER DESIGN 9

Linear Feedback Control, Pole Placement by Full State Feedback , Pole Placement Based on Observer Design ,Reduced Order Observers , Generalized Proportional Integral Controllers, Passivity Based Control , Sliding Mode Control Implementation of Buck Converter , Boost Converter ,Buck-Boost Converter

UNIT IV NONLINEAR CONTROLLER DESIGN 9

Feedback Linearization Isidori's Canonical Form ,Input-Output Feedback Linearization ,State Feedback Linearization, Passivity Based Control , Full Order Observers , Reduced Order Observers

UNIT V PREDICTIVE CONTROL OF POWER CONVERTERS 9

Basic Concepts, Theory, and Methods, Application of Predictive Control in Power Electronics, AC-DC-AC Converter System, Faults and Diagnosis Systems in Power Converters.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand an overview on modern linear control strategies for power electronics devices.
- Understand an overview on modern nonlinear control strategies for power electronics devices.
- Model modern power electronic converters for industrial applications.
- Design appropriate controllers for modern power electronics devices.

REFERENCES:

1. Hebertt Sira-Ramírez PhD, Ramón Silva-Ortigoza, “Control Design Techniques in Power Electronics Devices”, Springer 2012
2. Mahesh Patil, PankajRodey, “Control Systems for Power Electronics: A Practical Guide”, Springer India, 2015.
3. Blaabjerg José Rodríguez, “Advanced and Intelligent Control in Power Electronics and Drives” , Springer, 2014
4. Enrique Acha, Vassilios Agelidis, Olimpo Anaya, TJE Miller, “Power Electronic Control in Electrical Systems”, Newnes, 2002
5. Marija D. Aranya Chakrabortty, Marija , “Control and Optimization Methods for Electric Smart Grids”, Springer, 2012.

GE18054	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES **10**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management

UNIT II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOMES:

On completing this course, the students will be able to

- Summarize the importance of core values that shape the ethical behavior of a professional.
- Apply ethical theories in controversial issues while playing the role of engineering Professionals.
- Solve moral and ethical problems through exploration and assessment by established experiments and relate the code of ethics to social experimentation.
- Enumerate the importance of safety, responsibilities and rights of an engineer at work place.
- Explain the ethical attributes of engineers in various roles and in different domains of engineering in the global context

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2015.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2012.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2012
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2017
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2008.
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011.

WEB SOURCES:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

GE18051	INTELLECTUAL PROPERTY RIGHTS (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the process and need for protecting technology innovations through Intellectual Property Rights.

UNIT I TECHNOLOGICAL INNOVATIONS 10

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - problem solving and creativity through brain storming - different techniques - Selection criteria - screening ideas for new products - evaluation techniques. Protection of IP as a factor in R&D and few case studies.

UNIT II INTRODUCTION TO IPR & RELATED AGREEMENTS AND TREATIES 8

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications. History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments.

UNIT III BASICS OF PATENTS AND CONCEPT OF PRIOR ART 10

Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches, USPTO, EPO, PATENT Scope (WIPO), IPO, etc.)

UNIT IV PATENT FILING PROCEDURES 9

National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies

UNIT V PATENT RIGTS AND NEW DEVELOPMENTS IN IPR 8

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Interpret the process of problem solving through technological innovations.
- Infer the appropriate IPR elements for protecting intellectual property.
- Illustrate the concept of prior art search and performing it.
- Explain the procedure for filing patent.
- Enumerate the scope of patent rights for licensing and transfer of technology

TEXT BOOKS:

1. Ramappa, T. "Intellectual Property Rights Under WTO", S. Chand, 2008.
2. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.
3. Adair, J. "Effective Innovation", 1st Ed., Macmillan Publishing, 2003.

REFERENCES:

1. Robert P. Merges, Peter S. Menell and Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers, 2016.
2. Kankanala C., "Genetic Patent Law & Strategy", 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007.
3. Nystrom, H.,"Creativity and Innovation", 2nd Ed., John Wiley & Sons, 1996.

CS18052 FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE L T P C
3 0 0 3

OBJECTIVES

- To understand the various characteristics of Intelligent agents
- To learn about the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To know about the various applications of AI
- To introduce the concepts of Expert Systems

UNIT I INTRODUCTION 9

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents – Typical Intelligent Agents – Problem Solving Approach to Typical AI problems - Production system characteristics -Specialized production systems

UNIT II PROBLEM SOLVING METHODS 9

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Stochastic Games

UNIT III KNOWLEDGE REPRESENTATION 9

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Structured representation of knowledge.

UNIT IV APPLICATIONS 9

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving

UNIT V EXPERT SYSTEMS 9

Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XCON, Expert systems shells.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course: The students will be able to

- Understand the characteristics of Intelligent agents, define AI and learn about production systems.
- Learn to use appropriate search strategies for solving AI problems.
- Understand, represent knowledge, and use first-order logic in solving AI problems.
- Know about current applications of AI and compare some of them.
- Design an expert system from the concepts learned.

TEXT BOOKS:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill-2008.

REFERENCES:

1. M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press,2009.
3. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
4. 4. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.

EE18036 FPGA BASED SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To introduce reconfigurable and FPGA based system Design, FPGAs fabrics and introduce essential FPGA concepts.
- To impart knowledge on the design of digital electronic circuits with field programmable gate arrays (FPGAs).

UNIT I INTRODUCTION TO RECONFIGURABLE AND FPGA BASED SYSTEM DESIGN 9

Introduction to reconfigurable and FPGA based system Design-Goals and Techniques-Hierarchial Design- Design abstraction- Methodologies ; Basic and Advanced FPGA Fabrics – SRAm based FPGA- Permanently programmable FPGA- ChipI/O – Circuit Design of FPGA fabrics – Architecture of FPGA fabrics.

UNIT II COMBINATIONAL REALIZATION ON FPGA 9

Combinational realization on FPGA- Logic Design Process- Combinational Network Delay- Power and Energy Optimization- Arithmetic Logic- Logic Implementation for FPGAs- Physical Design for FPGAs.

UNIT III SEQUENTIAL LOGIC REALIZATION ON FPGA 9

Sequential logic realization on FPGA – Sequential Machine Design Process – Sequential Design styles – Rules for clocking – Performance Analysis – Power Optimization.

UNIT IV ARCHITECTURE 9

Architecture - Behavioral /high level Design and implementation methodologies: HDL, IP Core, System Generator; Processor and memory cores; Timing analysis; Clock distribution and management systems - DSP system Design and Implementation using FPGA.

UNIT V LARGE SCALE SYSTEM DESIGN 9

Large scale System Design- Busses and I/O communication system - Platform FPGA, Multi-FPGA Systems – Novel Architectures.

TOTAL: 45 PERIODS

OUTCOMES:

- Learn and understand FPGA fabrics: the basic programmable structures of FPGAs.
- Design, optimization and implementation of complex combinational digital circuits.
- Design, optimization and implementation of complex sequential digital circuits.
- Inspect and Analyze a wide range of design problems related to DSP based systems.
- Understand building of large-scale platform and multi-FPGA systems.

TEXT/REFERNCE BOOKS:

1. Wayne Wolf, ―FPGA-Based System Design‖, Prentice Hall Modern Semiconductor Design Series, 2004.
2. Ron Sass and Andrew G. Schmidt, Morgan Kaufmann (MK), ―Embedded System design with Platform FPGAs‖, Elsevier,2010.
3. Steve Kilts, ―Advanced FPGA design – Architecture, Implementation and Optimization‖, Wiley publications, 2007.

EE18038 ENGINEERING DESIGN AND PROTOTYPING L T P C
3 0 0 3

OBJECTIVES:

- Instruct the basics of engineering design process, analysis and synthesis of design with the incorporation of innovation and critical thinking.
- Impart knowledge to select, analyze and assess a engineering design choice.
- Enable the students to achieve an economic design.
- Build a prototype of a design for a domain/interdisciplinary domain.

UNIT I INTRODUCTION TO ENGINEERING DESIGN 9

Introduction to Engineering design - Engineering design Process - Requirements Analysis - Functional Analysis and Allocation - Design Synthesis - Verification - Systems Engineering Process Outputs – Innovation and Critical thinking.

UNIT II DESIGN,SYSTEMS, AND SOCIETY 9

Technology know-how, Design Choices - System engineering - Impact analyses - Evidence-based analyses – Assessment - Design process - Advocacy and professional engineering.

UNIT III ENGINEERING ECONOMICS OF DESIGN 9

Economic factors in Engineering, Business plan, Price fixation and output decisions, Alternative inputs, Production processes, Evaluating alternative investments, Equipment service life, Depreciation, New products

UNIT IV ENGINEERING PROTOTYPING 9

Generating technical specifications - material selection- fastener basics - motor selection - electronic switching - - technical data sheets and schematics - Advanced microcontroller implementation.

UNIT V CAPSTONE PROTOTYPE 9

Design and implement a prototype in an interdisciplinary domain.

TOTAL: 45 PERIODS

OUTCOME:

- Acquire knowledge on basics of engineering design.
- Select and analyze a design choice.
- Achieve an economic design by analyzing various factors.
- Identify the components to build a prototype.
- Build a prototype in an interdisciplinary domain.

TEXTBOOKS:

1. Engineering Design - A Project Based Introduction; Clive L. Dym, Patrick Little, Elizabet J. Orwin Wiley Publisher, 4th edition.
2. Engineering Design, Linda C. Schmidt, George Dieter, McGraw Hill Education; Fourth edition, 2017

OPEN ELECTIVES

(ODD SEMESTER)

OE18601 ELECTRICAL MACHINES AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- To study the working principles of DC machine as generator, determination of their no load / load characteristics and applications.
- To study the working principles of DC machines as Motor, estimate the various losses taking place in D.C. Motor and to study the different testing methods to arrive their performance and applications.
- To familiarize the constructional details, the principle of operation, performance & methods of testing of transformers, three phase transformer connections and applications.
- To impart knowledge on starting and speed control of poly -phase induction motors and applications.
- To understand the construction, principle of operation, performance characteristics, control and applications of stepper motors, switched reluctance motors, permanent magnet brushless-dc motors and applications

UNIT I DC GENERATORS 6

Construction & Components of DC Machines, Classification on methods of excitation, armature reaction, interpoles and compensating winding, commutation, load characteristics of DC generators, regulation, parallel operation.

UNIT II DC MOTORS 9

Principle of operation – Types of DC Motors – Back EMF and Torque equations, Torque equation, characteristic curves of shunt, series and compound motors, starting starter and grading of starting resistance, speed control – armature voltage control and field control methods. Ward Leonard method, choice of motors for different duties, losses and efficiency, testing- Swinburne's test, back to back test, retardation test and brake test.

UNIT III TRANSFORMER 12

Construction – Methods of Cooling – Principle of operation on no load and load -Emf equation., relation between voltage per turn and KVA output, phasor diagram based on approx. and exact equivalent circuit, per unit equivalent resistance reactance, open circuit and short circuit tests, back to back test, regulation, losses and efficiency, All day efficiency, cooling of transformer. Two winding and three winding transformers, auto transformer, phase transformer and connections, parallel operation.

UNIT IV POLYPHASE INDUCTION MOTOR 12

Operation of polyphase induction motors, effect of slots on performance of the motor, equivalent circuit and phasor diagram, locus diagrams, torque and power, speed – torque curve – effect of rotor resistance, deep bar and double cage rotors, performance calculation from circle diagram, methods of speed control, testing, losses and efficiency, application, induction generators and induction regulator.

UNIT V SPECIAL ELECTRICAL MACHINES 6

Construction, principle of operation, working and applications of Stepper Motors, Switched Reluctance Motor and Permanent Magnet Brushless DC Motor.

TOTAL: 45 PERIODS

OUTCOMES:

- Obtain the characteristics and the performance of DC generators, motors and applications
- Familiarize the computation of performance parameters of a transformer by suitable tests
- Determine the performance parameters of a poly phase induction motor by suitable tests and applications
- Understand the principle and characteristics of a Stepper motor, SRM, PMBLDC motor and their applications

TEXT BOOKS:

1. Nagrath I. J and Kothari D. P. "Electric Machines", Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2010.
2. M.N.Bandyopadhyay, "Electrical Machines Theory and Practice", PHI Learning PVT LTD., New Delhi, 2009.
3. Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, "Electric Machinery", Sixth edition, Tata McGraw Hill Books Company, 2003.
4. B. L. Theraja, and A. K. Theraja; S. Chand Publication
5. K.V.Ratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
6. E.G. Janardanan, 'Special Electrical Machines', PHI learning Private Limited, Delhi, 2014.

REFERENCES:

1. P. C. Sen, "Principles of Electrical Machines and Power Electronics", John Wiley& Sons, 1997.
2. Deshpande M. V, "Electrical Machines" , PHI Learning Pvt. Ltd., New Delhi, 2011.
3. P.S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2003.
4. S.Sarma&K.Pathak, "Electric Machines", Cengage Learning India (P) Ltd., Delhi, 2011. 5. Richard C Dorf, "Electrical Power Engineering hand book" , CRC Press, 1998.
5. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Oxford Press, 1995.
6. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989

OE18603 CONTROL SYSTEM ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To understand the use of transfer function models for analysis physical systems and introduce the control system components
- To provide adequate knowledge in the time response of systems and steady state error analysis
- To accord basic knowledge in obtaining the open loop and closed loop frequency responses of systems
- To introduce stability analysis and design of compensators
- To introduce state variable representation of physical systems and study the effect of state feedback

UNIT I SYSTEMS AND THEIR REPRESENTATION 9

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical– Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE 9

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction – Time response analysis.

UNIT III FREQUENCY RESPONSE AND STABILITY ANALYSIS 9

Frequency response – Bode plot – Polar plot – Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications – Stability – Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion.

UNIT IV STATE VARIABLE ANALYSIS 9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability – Concepts of digital control systems.

UNIT V COMPENSATOR DESIGN 9

Effects of P, PI, PID modes of feedback control – Lag, lead and lag-lead networks – Lag/Lead compensator design using bode plots

TOTAL 45 PERIODS

OUTCOMES:

- Derive transfer functions for electrical and mechanical systems.
- Draw the root locus for a transfer function.
- Sketch Bode and Polar plots for a transfer function.
- Verify the stability of a system by Routh-Hurwitz and Nyquist criteria.
- Model a physical system with state variables and solve.
- Design a compensator using Bode plots.

TEXT BOOKS:

1. M. Gopal, 'Control Systems, Principles and Design', 4th Edition, Tata McGraw Hill, New Delhi, 2012.
2. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.
3. Dhanesh. N. Manik, Control System, Cengage Learning, 2012.

REFERENCES:

1. Arthur, G.O.Mutambara, Design and Analysis of Control; Systems, CRC Press, 2009.
2. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Prentice Hall, 2012.
3. Benjamin C. Kuo, Automatic Control systems, 7th Edition, PHI, 2010.
4. K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.
5. S.N.Sivanandam, S.N.Deepa, Control System Engineering using Mat Lab, 2nd Edition, Vikas Publishing, 2012.
6. S.Palani, Anoop. K.Jairath, Automatic Control Systems including Mat Lab, Vijay Nicole/ Mcgraw Hill Education, 2013.

OE18605 MICRO AND SMART GRID L T P C
3 0 0 3

OBJECTIVE:

- Develop a conceptual introduction to micro grids and their control.
- Develop a conceptual introduction to smart grids and their control.

UNIT I BASICS OF A MICROGRID 9

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids.

UNIT II CONTROL AND OPERATION OF MICROGRID 9

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

UNIT III INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, Functions, opportunities, challenges and benefits, Difference between conventional & smart Grid, National and International Initiatives in Smart Grid.-Implementation of smart grid technologies in India.

UNIT IV SMART MEASURING DEVICES AND SMART METERING INFRASTRUCTURE 9

Phasor Measurement Unit (PMU), Limitations of RTU, GPS Time Synchronization, Location & Placement, Features - Wide Area Monitoring Systems (WAMS) - Sub-station Automation Systems (SAS) - Distribution Automation Systems (DAS).

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits,AMI protocols, standards and initiatives

UNIT V HIGH PERFORMANCE COMPUTING 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN),Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Types of cyber-attacks in smart grid, Prevention of cyber-attacks by means of cyber security in smart grids.

TOTAL: 45 PERIODS

OUTCOMES

- Differentiate conventional grids, micro grids and smart grids.
- Select suitable control scheme, communication and protection of micro grids.
- Understand Smart measuring devices
- Acquire Knowledge on advanced metering infrastructure and analyzing hardware implementation.
- Identify suitable computer network for smart grid applications

REFERENCES:

1. Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, ISBN: 978-0-470- 62761-7, Wiley
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, ISBN: 978-0-470-88939- 8, Wiley
3. S. Chowdhury, S.P. Chowdhury and P. Crossley, Microgrids and Active Distribution Networks, ISBN 978-1-84919-014-5, IET, 2009
4. Vehbi C. Gungor, Dilan Sahin, Taskin Kocak, Salih Ergut, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
5. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey", IEEE Transaction on Smart Grids.

OE18607 ELECTRIC VEHICLE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To introduce the architecture of electric vehicles.
- To impart the knowledge on the technologies used in electric vehicles and familiarize on the charging and battery management technologies in EV.

UNIT I INTRODUCTION TO ELECTRIC VEHICLE 9

Historical background of electric vehicle – Benefits of Electric Vehicles – Overview of the different types of Electric vehicles: classification based on propulsion systems, energy sources and energy carriers- classification of Hybrid electric vehicle - challenges in EVs.

UNIT-II ELECTRIC VEHICLE CONFIGURATIONS 9

Different configurations of Battery electric vehicle - Different Configurations of full hybrid vehicles - Configuration of Fuel cell electric vehicle - Converted EVs.

UNIT-III EV ENERGY STORAGE SYSTEM 9

Ragone plot -Energy storage technologies in electric and hybrid electric vehicles - battery, flywheel, fuel cell, ultra-capacitors- comparison of different energy storage technologies- Hybridization of different energy storage devices.

UNIT IV EV MOTR DRIVE TECHNOLOGY 9

Comparison of speed torque characteristics of IC engine and Electric motor – Requirements of EV motor compared to industrial motor – Types of Electric motors: DC motor, Induction motor, Switched reluctance motor, Brushless DC motor and Permanent Magnet Synchronous motor.

UNIT V EV BATTERY CHARGING AND BATTERY MANAGEMENT TECHNOLOGY 9

Charging schemes for EV: Normal charging, opportunity charging and fast charging – Need for Charging algorithms - Different charging algorithms – Wireless power transfer schemes – Vehicle to grid technology – Peak shaving and coordinated charging – Battery Management System.

TOTAL: 45 PERIODS

OUTCOMES:

- Comprehend the architecture of Electric Vehicles.
- Analyze different propulsion technology used for electric vehicle application.
- Analyze different energy storage technology used for electric vehicle application.
- Design the subsystems of an electric vehicle.
- Analyze energy management strategies and charging technologies in EVs

TEXT BOOK:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, Second edition, 2011.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, Third edition 2018.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, Second edition 2012.

REFERENCES:

1. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
2. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001.
3. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles and Applications With Practical Perspectives, Wiley Publication, 2011.
4. NPTEL lecture on “Electric vehicles - Part 1”

OE18609 **NANOTECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the evolution of Nanotechnology in various fields of engineering.
- To acquire knowledge on clean room environment and Safety Hazards.
- To acquire various preparation methods of nano systems and nanofabrication techniques.
- To study of different characterization techniques used for Nano systems.

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Nanoscale Science and Technology– Introduction – Historical Development–Dimensionality and size dependent phenomena–Surface to volume ratio–Implications for Physics, Chemistry, Biology and Engineering–Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of Nanomaterials – Classifications of nanomaterials based on dimensionality –Zero dimensional, one– dimensional and two dimensional nanostructures– multilayer thin films and super lattice. Carbon based nanomaterials – Properties, Synthesis and Applications of Carbon Nanotubes and Graphene.

UNIT II SEMICONDUCTOR PROCESSING AND MICROFABRICATION 9

Introduction to semiconductor processing – Necessity for a clean room– different types of clean rooms– Structure and requirements of a clean room– Safety issues, flammable and toxic hazards, biohazards – Microfabrication process flow diagram – Chip cleaning, coating of photoresists, patterning, etching, inspection – Process integration – Etching techniques– Wet and Dry Etching– Reactive Ion etching.

UNIT III GENERAL METHODS OF PREPARATION 9

Preparation of nanoscale materials: Spray Pyrolysis, Co–Precipitation, Sol–gel, Mechanical Milling, Self–assembly, Preparation of thin films: Electroplating, Sputtering, Evaporation, MOCVD, Molecular Beam Epitaxy, Atomic Layer Epitaxy and Pulsed layer deposition.

UNIT IV CHARACTERIZATION TECHNIQUES 9

X–ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high–resolution imaging, Surface Analysis Techniques – AFM, SPM, STM, SNOM, ESCA.

UNIT V APPLICATIONS 9

Nano InfoTech: Information storage–nano computer, molecular switch, super chip, nanocrystal, Nano biotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging– Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)–Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products – In Photostat, printing, solar cell, battery

TOTAL: 45 PERIODS

OUTCOMES:

- Understand unique properties of Nano material structure and apply them for different Engineering fields.
- Familiarize the safety protocol followed in clean room environment.
- Demonstrate different synthesis methods of nanomaterials.
- Develop knowledge on characterization of nano-particles and nano-devices.

TEXTBOOKS:

1. Chattopadhyay K.K and A.N Banerjee, Introduction to Nanoscience and nanotechnology,PHI, 2009.
2. T. Pradeep, Nano: The Essentials understanding Nanoscience and Nanotechnology, Tata–McGraw Hill Education, 2007.

REFERENCES:

1. Fahrner W.R., "Nanotechnology and Nanoelectronics", Springer (India) Private Ltd., 2011.
2. Mitin Vladimir V, Kochelap, Viatcheslav A, Stroscio Michael, "Introduction to Nanoelectronics: Science, Nanotechnology, Engineering and Applications", Cambridge University Press, 201.
3. Madou Marc J, "Fundamentals of Microfabrication", CRC Press, New York, 1997.
4. Delstein A.S, Cammarata .R, "Nanomaterials: Synthesis, Properties and Applications", Taylor & Francis Publishers, 1996.

OE18611 **IoT AND MACHINE LEARNING** **L T P C**
3 0 0 3

OBJECTIVES :

- To understand IoT architecture and various IoT sensors
- To educate the students on several fundamental concepts and methods for machine learning.
- To demonstrate typical applications of Embedded system enabled with IoT.

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II IoT ARCHITECTURE 9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus–Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security.

UNIT IV MACHINE LEARNING 9

Introduction to Supervised Learning - Classification; Regression; Linear Regression; Ridge Regression; LASSO; K-NN, Decision Tree, Naive Bayes, Logistic Regression, Perceptron, Support-Vector Machines, Introduction to Neural Networks, Unsupervised Learning - K-means Clustering, PCA

UNIT V IoT ENABLED EMBEDDED SYSTEM 9

Building IoT with RASPBERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms – Arduino.

TOTAL : 45 PERIODS

OUTCOMES

- Articulate the main concepts, key technologies, strength and limitations of IoT
- Understand different architectures of IoT.
- Analyze how the sensors are communicated in IoT .
- Understand the basic theory underlying machine learning.
- Apply IoT in a Embedded System application.

TEXT BOOKS

1. Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, 2011.
3. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014

REFERENCES

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
2. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.
3. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, 2011
4. Jiawei Han, MichelineKamber, Jian Pei, Data Mining: Concepts and Techniques, Elsevier, 2011.
5. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-onApproach)”, VPT, 1 st Edition, 2014

OPEN ELECTIVES
(EVEN SEMESTER)

OE18602 INDUSTRIAL AUTOMATION L T P C
3 0 0 3

OBJECTIVES:

- Recapitulate the working of sensors and signal conditioning process
- Study of components and circuits associated with pneumatics and hydraulics
- Learn the operation and programming of PLCs and human machine interfaces.
- Obtain an overview of distributed control systems and CNC machines
- Familiarize with the interconnection and data exchange between PLCs, field devices and supervisory units with different bus structures.

UNIT I SENSOR & MEASUREMENT SYSTEMS 9

Introduction to Industrial Automation – Architecture - Sensors and measurement systems for position, temperature, pressure, displacement, flow and level - Signal conditioning & Processing - Smart sensors – Basics of Industry 4.0 and IoT for plant automation.

UNIT II PNEUMATICS & HYDRAULICS 9

Pneumatics: Types of Pneumatic actuators, selection of actuators, control valves for direction, pressure and flow. Compressor – types. **Hydraulics**: Pumps and motors, servo and proportional valves. **Circuit design** - symbols, schematic, travel step diagram, Classical method.

UNIT III PLCs **9**

Introduction - Advantages, capabilities & architecture. Scan cycle, Types of I/O modules, Analog Scaling, PLC Wiring, Selection criteria for PLC. Types of Programming. Bit instructions, Arithmetic functions, timers, counters, data transfer.

UNIT IV HMI, DCS and CNC 9

Introduction to HMI and SCADA.**DCS**: Architecture, local control unit, programming language, communication facilities, operator interface, engineering interfaces. **CNC**: Features, drive systems for CNC machine tools, Control of machine tools

UNIT V NETWORKING 9

IEEE Standards - Networking of sensors, actuators and controllers - Introduction to Field bus communication and its Protocols - Field bus, CAN bus, PROFI bus, Ethernet, MOD bus, Ethernet, OSI/ISO, ICCPDTE, DCE and RTU

TOTAL:45 PERIODS

OUTCOMES:

- Choose and design a suitable measurement system
- Configure a pneumatic / hydraulic circuit as per requirements
- Design and program a PLC system for an application
- Control a PLC through human-machines interfaces
- Network PLCs with field devices and supervisory control systems
- Learn basic concepts of DCS, CNCs, and IoT

TEXT BOOKS:

1. S. Mukhopadhyay, S. Sen and A. K. Deb, “Industrial Instrumentation, Control and Automation”, Jaico Publishing House, 2013.
2. William C.Dunn, “Fundamentals of Industrial Instrumentation and Process control”, Mcgraw Hill, 2005.
3. Anthony Esposito, “Fluid power with applications”, Pearson New International Edition, 2014.
4. Frank D Petruzella “Programmable Logic Controllers ", McGraw Hill Inc, 2005
5. John W Webb & Ronald A Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
6. Michael P. Lukas, “Distributed Control systems”, “Van Nostrand Reinfold Company”1995.
7. Steve F Krar, “Computer Numerical Control Simplified“, Industrial Press, 2001.

REFERENCES:

1. W. Bolton, “Mechatronics”, Pearson Education, 2009
2. Kelvin T Erikson, “Programmable Logic Controllers ", Dogwood Valley Press, 2005
3. L.A.Bryan, E.A.Bryan, “Programmable controllers – Theory and Implementation”, IndustrialText company, Second edition, 1997.
4. Steve Mackay, “Practical Industrial data networks: Design, Installation and Troubleshooting”,Elsevier Newnes, 2004.
5. B.G.Liptak, “Instrument Engineers handbook”, 3rd edition, CRC press.

OE18604 **MEMS AND NANO DEVICES** **L T P C**
3 0 0 3

OBJECTIVES:

- Provide a good understanding of the nanodevices and its applications
- Provide a good understanding of the MEMS devices and its applications

UNIT I INTRODUCTION TO SEMICONDUCTOR MATERIALS 9

Fundamentals of crystal structure, defects, crystal planes and orientation. Silicon Planar Process, Crystal Growth, Thermal Oxidation, Introduction to lithography- Positive and negative photoresists, Dopant Addition and Diffusion, Dry and wet etching, Chemical Vapor Deposition, Interconnection- Thin film deposition, sputtering methods and types, and Packaging.

UNIT II NANO DEVICES 9

Classifications of nanostructures- nano particles- quantum dots, nanowires-ultra-thin films multilayered structures. Introduction – Scaling of physical systems, Tunnel junction, Metal—Insulator, Metal-Semiconductor, and Metal-Insulator-Metal Junctions, Spintronics, MOSFETs, FinFETs, construction of FinFET, properties of FinFETs, Resonant Tunneling Diode.

UNIT III CHARACTERIZATION TECHNIQUES 9

Electrical IV, CV characteristics- X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, STM, ESCA.

UNIT IV INTRODUCTION TO MEMS 9

Intrinsic characteristics of MEMS, miniaturization, Review of Electrical and Mechanical concepts in MEMS- Stress and strain analysis –MEMS based sensors and actuators. Electrostatic sensors and Actuators- Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors

UNIT V MEMS DEVICES 9

Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators

TOTAL: 45 PERIODS

OUTCOMES:

- Acquire knowledge on various process involved in making nanoscale devices
- Comprehend various nano devices and its applications.
- Understand various MEMS devices and its applications.

TEXT BOOKS:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.

REFERENCES:

1. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology by T.Pradeep; Tata Mc.Graw Hill.
2. Marc Madou, Fundamentals of microfabrication & Nanofabrication.

OE18606 RENEWABLE ENERGY SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

To impart knowledge on the following Topics

- Awareness about renewable Energy Sources and technologies.
- Adequate inputs on a variety of issues in harnessing renewable Energy.
- Recognize current and possible future role of renewable energy sources.

UNIT I RENEWABLE ENERGY (RE) SOURCES 7

Environmental consequences of fossil fuel use-Importance of renewable sources of energy-Sustainable Design and development-Types of RE sources-Limitations of RE sources-Present Indian and international energy scenario of conventional and RE sources.

UNIT II WIND ENERGY 8

Power in the Wind – Types of Wind Power Plants (WPPs)–Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.

UNIT III SOLAR PV AND THERMAL SYSTEMS 9

Solar Radiation-Solar Thermal Power Plant- Thermal Energy storage system with PCM- Solar Photovoltaic systems - Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells- PV Module I-V Characteristics-maximum power point tracking- Applications.

UNIT IV BIOMASS AND GEOTHERMAL ENERGY 9

Introduction- Bio mass resources – Energy from Bio mass-conversion processes- Biomass Cogeneration-Environmental Benefits-Geothermal Energy-Basics- Geothermal Electricity-Mini/micro hydro power- Classification of hydropower schemes.

UNIT V OTHER ENERGY SOURCES 12

Tidal Energy- Energy from the tides- Barrage and Non Barrage Tidal power systems- Wave Energy- Energy from waves, wave power devices- Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell- Principle of working- various types - construction and applications- Energy Storage System- Hybrid Energy Systems.

TOTAL: 45 PERIODS

OUTCOMES:

- Acquire knowledge on variety of issues in harnessing renewable Energy.
- Analyze the current and possible future role of renewable energy sources.
- Select renewable energy resources and technologies for applications.
- Identify the impact of energy sources on environment.

TEXT BOOKS:

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
3. Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning, USA, 2016.

REFERENCES:

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.
3. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4. Bradley A. Striebig,Adebayo A.Ogundipe and Maria Papadakis," Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.
5. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
6. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education, 2015.

OE18608 **INDIAN POWER GRID** **L T P C**

3 0 0 3

OBJECTIVE:

- Comprehend Indian grid codes.
- Understand Restructuring of power system and renewable energy potential in India.
- Illustrate the types, planning and operational issues related to Microgrids.
- Understand the need, policies and technologies of Smart Grid.

UNIT I INTRODUCTION TO GRID CODES **9**

General introduction, Role of various Organizations and their linkages, Planning Code for Inter State Transmission, Connection Code, Operating Code for Regional Grids and Scheduling and Despatch Code

UNIT II ELECTRICITY DEREGULATION **9**

Introduction - Motivation for Restructuring of Power System - Electricity Market Entities and Models - Milestones and Benefits of deregulation - Availability based tariff - Day Scheduling process - Definition and Technologies of Distributed Generation - Indian power sector past and present status - Growth of power sector in India - Players in the Indian power sector.

UNIT III RENEWABLE ENERGY **9**

Introduction to non-conventional energy resources - Overview of solar energy technologies - Solar Photovoltaic devices - Performance and durability of solar devices - Wind energy - technology and geographical aspects - Geothermal and Biomass - Energy storage - Batteries - Fuel cell - Characterization and durability.

UNIT IV MICRO GRID **9**

Microgrids vs Central Conventional power system - Structure of Microgrid - Types of Microgrid system - Operations of AC and DC Microgrids - Comparison - Power Electronic Converters in Microgrid application - DC Microgrid : Topologies - Application - Standards.

UNIT V SMART GRID **9**

Introduction - Architecture - Standards and policies - Control layer and elements - Components control elements - Technologies - Monitoring - Phasor measurement units - Phasor estimation - Dynamic Phasor estimation - Operation and control of AC and DC Smart Grid.

TOTAL: 45 PERIODS

OUTCOME:

- Interpret the Indian power grid codes.
- Understand the deregulated electricity market models functioning.
- Explain renewable energy based electrical power generation in India.
- Analyze microgrid planning and operational issues with Distributed Generators
- Describe modern power distribution system functions and communication networks for smart grid applications

TEXT BOOKS:

1. Kankar Bhattacharya Maath H.J. Bollen and Jaap E.Daalder, ―Operation of restructured power systems‖, Kluwer academic publishers, USA ,first edition, 2001.
2. Janaka Ekanayake and Kithsiri Liyanage and Jianzhong Wu and Akihiko Yokoyama -Smart Grid: Technology And Applications, John Wiley,2015.
3. Hassan Bevrani, Bruno François, Toshifumi Ise -Microgrid Dynamics and Control, John Wiley.
4. Rai G.D -Non Conventional Energy Sources, Khanna Publishers

REFERENCES:

1. Daniel Kirschen and Goran Strbac ,Fundamentals of power system economics, John Wiley sons, 2004.
2. P.Venkatesh, B.V.Manikandan, S.Charles Raja and A.Srinivasan , ― Electrical power systems analysis, Security and Deregulation‖, PHI 2012.
3. Jha I S. D.P.Kothari, - Smart Grid Fundamentals & Applications, New Age International publishers.

OE18610 **POWER CONVERTERS** **L T P C**
3 0 0 3

OBJECTIVES:

- To acquire knowledge on various power semiconductor devices.
- To learn various switching techniques used in power control applications.

UNIT I INTRODUCTION **9**

Status of development of power semiconductor devices -Operation, Characteristics and its applications -PN junction diode-SCR-Triac– MOSFET, IGBT

UNIT II CONTROLLED RECTIFIERS **9**

Single Phase diode rectifier-single phase half controlled and fully controlled rectifier with R, RL load-Three phase fully controlled rectifier.

UNIT III DC- DC CONVERTERS **9**

Principle of operation of chopper-step up, step down chopper-control strategies-Time Ratio and current ratio control- voltage regulators -buck-boost- fly back -Full bridge converterr

UNIT IV INVERTERS AND AC VOLTAGE CONTROLLERS **9**

Single and three phase bridge inverter with R, RL load -Single phase and Three phase ac voltage controllers with R, RL load

UNIT V APPLICATIONS **9**

Chargers and Adapters, Switch mode power supply, Battery charges-UPS-Electronic Light Dimmer-Domestic and Industrial applications.

TOTAL: 45 PERIODS

OUTCOMES:

- Acquire knowledge on the characteristics of various power electronic devices.
- Analyze operation of single phase and three phase controlled rectifiers.
- Comprehend the salient aspects of DC-DC converters.
- Comprehend the salient aspects of inverters and AC voltage controllers.
- Appreciate the various domestic and industrial applications of power electronic technology.

TEXT BOOK:

1. M.H. Rashid,"Power Electronics: Circuits, Devices & Applications", Pearson India, 4th Edition,2018.
2. P.S. Bhimbra, " Power Electronics", Khanna Publishers.

REFERENCES:

1. MD Singh and K B Khanchandani,"Power Electronics"Tata McGraw Hill, 2006
2. M.S. Jamil Asghar, “Power Electronics” Prentice Hall of India Ltd., 2004
3. Chakrabarti &Rai, “Fundamentals of Power Electronics &Drives”, Dhanpat Rai & Sons.
4. V.R. Moorthy, “ Power Electronics : Devices, Circuits and Industrial Applications” Oxford University Press,2007
5. S.N. Singh, “A Text Book of Power Electronics” Dhanpat Rai& Sons

OE18612 NANOTECHNOLOGY AND PROTOTYPING LABORATORY **L T P C 2 0 2 2**

OBJECTIVES:

- Train the students on semiconductor Nanotechnology and microfabrication
- Demonstrate various synthesis methods of nanostructures
- Characterize any form of nanostructures
- Hands-on training on nanostructure synthesis
- Hands-on training on characterization of nanostructures

UNIT I INTRODUCTION TO NANOTECHNOLOGY 6+6

Introduction to semiconductor processing – Necessity for a clean room– different types of clean rooms– Structure and requirements of a clean room– Safety issues, flammable and toxic hazards, biohazards – Microfabrication process flow diagram – Chip cleaning, coating of photoresists, patterning, etching, inspection – Process integration – Etching techniques– Wet and Dry Etching– Reactive Ion etching.

UNIT II GENERAL METHODS OF PREPARATION 6+6

Preparation of nanoscale materials: Spray Pyrolysis, Co–Precipitation, Sol–gel, Mechanical Milling, Self–assembly, Preparation of thin films: Electroplating, Sputtering, Evaporation, MOCVD, Molecular Beam Epitaxy, Atomic Layer Epitaxy and Pulsed layer deposition.

UNIT III CHARACTERIZATION TECHNIQUES 6+6

X–ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high–resolution imaging, Surface Analysis Techniques – AFM, SPM, STM, SNOM, ESCA.

UNIT IV CAPSTONE PROJECT HANDS-ON TRAINING 6+6

Hands-on experience on various sophisticated tools such as, RF/DC Sputtering, Thermal evaporation, Photolithography, DLS and Electrical characterization.

UNIT V CAPSTONE PROJECT EXECUTION 6+6

Fabrication of Nano scale device and prototyping.

TOTAL: 45 PERIODS

OUTCOMES:

- Understand various semiconductor process technology and microfabrication methods
- Synthesis nanostructures using variety of semiconductor technology for a given application.
- Characterize any specific nanostructure structurally, electrically and by imaging.
- Trained in cleanroom protocol, utilize vacuum and physical deposition technology.
- Design and prototype any Nano device.

TEXT BOOKS:

1. Madou Marc J, "Fundamentals of Microfabrication", CRC Press, New York, 1997.
2. Fahrner W.R., "Nanotechnology and Nanoelectronics", Springer (India) Private Ltd., 2011.

REFERENCES:

1. T. Pradeep, Nano: The Essentials understanding Nanoscience and Nanotechnology, Tata–McGraw Education, 2007.

MANDATORY COURSE

MC18001	INDIAN CONSTITUTION AND SOCIETY	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To know about Indian constitution and fundamental rights.
- To know about central and state government functionalities in India.
- To know about Judicial system and Election commission of India.

UNIT I INTRODUCTION 11

Historical Background – Philosophical foundations of the Indian Constitution – Preamble – Schedules – Amendments.

UNIT II FUNDAMENTAL RIGHTS AND FUNDAMENTAL DUTIES OF THE CITIZEN 8

Union and Territories – Citizenship - Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Directive Principles of state policy.

UNIT III STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 8

Union Government – Structures of the Union Government and Functions – Powers of President, Vice President, Prime Minister – Cabinet ministers – Parliament.

UNIT IV STRUCTURE AND FUNCTION OF STATE GOVERNMENT 8

State Government – Structure and Functions – Powers of Governor, Chief Minister, Cabinet ministers – State Legislature

UNIT V STRUCTURE OF JUDICIAL SYSTEM AND MAJOR FUNCTIONARIES 10

Supreme Court of India - Judicial System in States – High Courts and other Subordinate Courts – Judicial Review – Case studies. Election Commission of India and its functions

TOTAL: (L: 45): 45 PERIODS

OUTCOMES:

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

CO	CO Statement	Weightage
CO-1	Enhance human values, create awareness about law enactment and importance of Constitution	10%
CO-2	To Understand the Fundamental Rights and Fundamental Duties of the Indian Citizen to instill morality, social values, honesty, dignity of life and their social Responsibilities.	30%
CO-3	To Understand the powers and functions of Central Government.	20%
CO-4	To Understand the powers and functions of State Government	20%
CO-5	To Understand the powers and functions of Judicial systems and Election commission of India.	20%

TEXTBOOKS:

1. Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
2. R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
3. Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
4. K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCES:

1. Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.
3. R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

VD18601 HANDS ON TRAINING ON EMBEDDED C L T P C
2 0 0 2

OBJECTIVES:

- To program Arduino using 'C' starting from scratch
- To create your own Arduino projects
- To build Arduino circuit with many hardware components in it
- To create an online simulation of the course project
- To Serial communicate between Arduino and Computer

UNIT I INTRODUCTION 6

What is arduino - install and setup arduino ide - customize your arduino ide for better readability- connect your arduino board and find it on the arduino ide- simulation: create a tinkercad account and get started.

UNIT II PROGRAMMING IN ARDUINO USING 'C' 6

Variables-data types-functions-scope-conditions-loops-arrays - libraries- make a led blink-change the led blink rate, and print a message when it turns on/off-debug your projects with the serial monitor- how to restart your arduino program (different ways).

UNIT III ANALOG AND DIGITAL PINS IN ARDUINO 6

Digital pins work as output pins - set a digital value - power on a led - digital pins work with analog values (pwm) - set an analog value - change the brightness of a led - make a led fade in/out - potentiometer : analog pins - add a potentiometer to your circuit- read an analog value from the potentiometer-set the led brightness with the potentiometer.

UNIT IV SERIAL COMMUNICATION, DELAT AND INTERRUPTS IN ARDUINO 6

Send and receive data - send data with serial - receive data with serial - change serial baud rate for faster communication-get the time delay in millis() and micros() - compute the duration of an action- set up an interrupt in your program - software debounce inside an interrupt- count how many times you press on the push button with interrupts.

UNIT V INTERFACING WITH ARDUINO 6

Get the distance from an obstacle using ultrasonic sensor using pulsein() function - use the ultrasonic sensor with interrupts- print text on the lcd screen and tune it with the potentiometer-make your projects more interactive by adding the IR receiver to your circuit- use a switch structure to handle IR commands -choose which led to power on with the remote controller.

TOTAL: 30 PERIODS

OUTCOMES:

- Programming Arduino using 'C' for various embedded projects.
- Simulate various embedded projects using tinkercad tool.
- Acquire knowledge to use Arduino IDE and various libraries.

TEXT BOOKS:

1. Simon Monk 'Programming Arduino: Getting Started with Sketches', McGraw Hill , 2nd edition , 2016.

REFERENCES:

1. James Arthur 'Arduino: The complete guide to Arduino for beginners, including projects, tips, tricks, and programming!' , Ingram Publishing , 2020.

VD18602 NANO DEVICE MANUFACTURING L T P C
2 0 0 2

OBJECTIVES:

- Train the students on semiconductor process technology and microfabrication
- Demonstrate various synthesis methods of nanostructures
- Characterize the nanostructures
- Hands-on training on nanostructure synthesis
- Hands-on training on characterization of nanostructures

UNIT I SEMICONDUCTOR PROCESSING AND MICROFABRICATION 6

Introduction to semiconductor processing – Necessity for a clean room– different types of clean rooms– Structure and requirements of a clean room– Safety issues, flammable and toxic hazards, biohazards – Microfabrication process flow diagram – RCA cleaning, coating of photoresists, patterning, etching, inspection – Process integration – Etching techniques– Wet and Dry Etching– Reactive Ion etching.

UNIT II GENERAL METHODS OF PREPARATION 6

Preparation of nanoscale materials: Spray Pyrolysis, Co–Precipitation, Sol–gel, Mechanical Milling, Preparation of thin films: Electroplating, Sputtering, Evaporation, MOCVD, Molecular Beam Epitaxy, Atomic Layer Epitaxy and Pulsed layer deposition.

UNIT III CHARACTERIZATION TECHNIQUES 6

X–ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high–resolution imaging, Surface Analysis Techniques – AFM, STM, ESCA.

UNIT IV VACCUM TECHNOLOGY 6

Vacuum technology, Hands-on training/Demonstration on DC and RF Sputtering, Thermal Evaporation

UNIT V DEVICE FABRICATION 6

Hands-on training/Demonstration on Photolithography, Spin coating, UV-visible spectroscopy, Electrical probe station

TOTAL: 30 PERIODS

OUTCOMES:

- Understand various semiconductor process technology and microfabrication methods
- Synthesis nanostructures using variety of semiconductor technology for a given application.
- Characterize any specific nanostructure structurally, electrically and by imaging.
- Technically trained in the cleanroom protocol, vacuum technology, and physical deposition.
- Microfabricate any nano device and electrically characterize it.

TEXT BOOK:

T. Pradeep, Nano: The Essentials understanding Nanoscience and Nanotechnology, Tata–McGraw Hill Education, 2007.

REFERENCE:

Madou Marc J, “Fundamentals of Microfabrication”, CRC Press, New York, 1997.

VD18603 MODELING AND SIMULATION OF ELECTRICAL SYSTEM **L T P C 2 0 0 2**

OBJECTIVES:

- Develop mathematical models for electrical and electronics components and simulate for performance evaluation.
- Analyze the simulation results of developed electrical circuits and systems.

UNIT I SIMULATION OF SEMICONDUCTOR DEVICES 6

Fundamentals of MATLAB coding for Electrical Stream - Fundamentals of SIMULINK for Electrical Stream - Operating Characteristics and Simulation of diode, zener diode, BJT, FET/MOSFET - Hands-on in Simulation of Semiconductor Devices and its applications - Simulation of Single phase half wave and full wave rectifiers

UNIT II ANALOG CIRCUITS AND DIGITAL CIRCUITS 6

Applications of Operational Amplifier - inverting & non-inverting amplifier and Adder - comparator, Integrator and Differentiator - Hands-on in simulation of Applications of Operational Amplifier - Steady State and Transient Analysis of DC and AC Circuits - Hands-on in simulation of Steady State and Transient Analysis of DC/AC Circuits

UNIT III SENSORS, INSTRUMENTATION AND CONTROL SYSTEMS 6

Simulation of Transducers and its Applications - Simulation of ADC/DAC - Hands-on in instrumentation and its applications - Time Domain Analysis of First Order and Second Order Systems - Frequency Domain Analysis using Root Locus, Bode Plot, Polar Plot and Nyquist Plot - Hand-on in simulation of basic control systems

UNIT IV ELECTRICAL MACHINES 6

Performance Evaluation and Simulation of DC Generators and DC Motors - Hand-on in simulation of performance of DC machines - Performance Evaluation and Simulation of AC motors, alternators and transformers - Hand-on in simulation of performance of AC machines.

UNIT V POWER SYSTEMS 6

Transmission Line Parameters Evaluation - Modeling and performance analysis of transmission lines - Hands-on in performance evaluation of transmission lines – Power flow analysis using Gauss-Seidal method – Fault analysis using Thevinin's method – Hands-on in simulation of power flow and fault analysis.

TOTAL: 30 PERIODS

OUTCOMES:

- Expertise in the available simulation software packages
- Develop models for electrical and electronics components
- Develop models for electrical circuits and systems
- Simulate for performance evaluation of modeled components
- Analyze the simulation results of implemented circuits and systems

TEXT BOOKS:

1. Millman J, Christos C Halkias, SatyabatraJit, "Electronic devices and circuits", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2008.
2. RamakantA.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003 / PHI. 2000
3. John M.Yarbrough, 'Digital Logic, Application & Design', Thomson, 2002.
4. S. Mukhopadhyay, S. Sen and A. K. Deb, "Industrial Instrumentation, Control and Automation", Jaico Publishing House, 2013
5. M. Gopal, "Modern control system Theory", New Age International, 2005.
6. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

REFERENCES:

1. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
2. Robert F.Coughlin, Fredrick F. Driscoll, 'Operational amplifier and linear integrated circuits",Prentice Hall of India 2003.
3. Salivahanan, Arivazhagan, 'Digital Circuits & Design', Vikas Publishing
4. William C. Dunn, "Fundamentals of Industrial Instrumentation and Process control", McGraw Hill, 2005.
5. Graham C. Goodwin, Stefan F. Graebe and Mario E. Salgado "Control system Design", PHI, 2003
6. A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, 'Electric Machinery', Tata McGraw Hill publishing Company Ltd, 2003.
7. M G Say, 'Performance and Design of Alternating current machines', CBS publishers and distributors, 2005.
8. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, ' Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.

VD18604 ELECTRIC VEHICLE DESIGN L T P C
2 0 0 2

OBJECTIVES:

- To introduce the architecture and design of electric vehicle components..
- To impart the knowledge on the design of drive train, motors, controllers, battery and battery management systems.

UNIT I TORQUE CALCULATION 6

Calculating the Rolling Resistance - grade resistance – Acceleration Force - Total Tractive Effort - Torque Required on the Drive Wheel - Comparison of speed torque characteristics of IC engine and Electric motor – Requirements of EV motor.

UNIT II ARCHITECTURE DESIGN 6

Types of Electric Vehicle and components - Electrical protection and system requirement - Battery Electric vehicle (BEV) - Hybrid electric vehicle (HEV) - Plug-in hybrid vehicle (PHEV) -Fuel cell electric vehicle (FCEV)- Electrification Level of EV.

UNIT III BATTERY DESIGN 6

Battery selection criteria - Cell Types (Lead Acid/Li/NiMH) - Battery charging and discharging calculation - Cell Selection and sizing - Battery lay outing design - Battery Pack Configuration - Battery Pack Construction - Voltage and Temperature Monitoring – Cell balancing – Protection & control - Battery Management System.

UNIT IV MOTOR SIZING 6

Selection and sizing of Motor – Speed and Torque calculation of motor - Motor Controllers - Component sizing – Function of control unit - Development Process - Data Management - GUI/HMI -Performance comparison of DC motor, Induction motor, Switched reluctance motor, Brushless DC motor and Permanent Magnet Synchronous motor – Design case study on 2 wheeler, 3 wheeler and 4 wheeler.

UNIT V CHARGING & CONTROL DESIGN 6

Charging schemes – Charging algorithms - Vehicle to grid technology – Energy Management System - Rule based control and optimization based control - Software-based high level supervisory control.

Electric Vehicles charging station: Type - Selection and Sizing - Components - Single line diagram – EV Technology and Market Scenario – EV Policies and Regulations in India

TOTAL: 30 PERIODS

OUTCOMES:

- Determine the Electric Vehicles sizing.
- Select & design the architecture of Electric Vehicle.
- Design the battery and battery management system used for electric vehicle application
- Design & control of motors for electric vehicles
- Design of Energy Management system and Charging infrastructure.

TEXT BOOKS:

4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, Second edition, 2011.
5. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, Third edition 2018.
6. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, Second edition 2012.

REFERENCES:

5. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
6. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001.
7. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles and Applications With Practical Perspectives, Wiley Publication, 2011.
8. NPTEL lecture on “Electric vehicles - Part 1”

VD18605 HARDWARE IMPLEMENTATION OF POWER SUPPLY CIRCUIT **L T P C 2 0 0 2**

OBJECTIVES:

- Understand the various types of power supply circuits.
- To impart knowledge on understanding the specification, design and implementation of fixed voltage DC power supply circuit for an application.
- To impart knowledge on understanding the specification, design and implementation of variable voltage DC power supply circuit for an application.
- Design, validation and implementation of SMPS circuits.
- Learn the various types of AC power supply and their applications.

UNIT I CLASSIFICATION OF POWER SUPPLY CIRCUIT **6**

Power supply – Need for power supply – Basic classification of power supplies: unregulated, regulated, and switching- Three subsets of regulated power supplies: linear, switched, and battery-based - Block diagram of power supply unit- Types of DC power supplies and AC power supplies.

UNIT II FIXED VOLTAGE DC POWER SUPPLY **6**

Block diagram of a fixed voltage DC power supply - Design of individual stages of a fixed voltage DC power Supply - Construct and test a fixed voltage regulator -. Identify the different types of fixed positive and negative regulator ICs.

UNIT III VARIABLE VOLTAGE DC POWER SUPPLY **6**

Block diagram of DC power supply with variable voltage and current-Design of DC power supply with variable voltage using voltage regulator ICs - Prototype –Applications.

UNIT IV SMPS **6**

Different types of SMPS circuits- DC-DC Converter - Forward converter- Flyback converter – Self-oscillating flyback converter – Design - Simulation and prototype - Advantages of SMPS.

UNIT V AC POWER SUPPLY **6**

Introduction – A quantitative study of AC power supplies - Isolation transformer, Variable AC supply, Frequency changer, Inverter, Generator and UPS - Applications

TOTAL: 30 PERIODS

OUTCOMES:

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

- Examine and identify the power supply circuit for a given application.
- Design, validate and implement a fixed voltage DC power supply circuit.
- Design, validate and implement adjustable DC power supply circuit.
- Design, validate and implement SMPS circuit for an application.
- Analyze and apply appropriate AC power supply circuit for a given application.

TEXT BOOKS:

1. Dr. P.S.Bimbhra “Power Electronics” Khanna Publishers, Sixth Edition, 2018.
2. D.RoyChoudhary, SheilB.Jani, “Linear Integrated Circuits”, II edition, New Age, 2003.
3. RamakantA.Gayakward, “Op-amps and Linear Integrated Circuits”, IV edition, Pearson Education, 2003 / PHI. 2000.
4. David A Bell, “Electronic Devices and Circuits”, Oxford university press, 2008.
5. M.H. Rashid, “Power Electronics Circuits, Devices and Applications”, Pearson Education, PHI Fourth Edition, New Delhi, 2017.

REFERENCES:

1. Raymond A. Mack, "Demystifying Switching Power Supplies", Newnes; Illustrated edition (5 May 2005)
2. Sanjaya Maniktala, "Switching Power Supplies A - Z", Newnes; 2nd edition (10 May 2012)
3. Abraham Pressman, Keith Billings, Taylor Morey, "Switching Power Supply Design", McGraw Hill; 3rd edition (April 16, 2009)
4. Texas Instruments Incorporation, “Transistor Circuit Design”, Mcgraw Hill Book Company.

VD18606 DESIGN THINKING AND INNOVATION L T P C
2 0 2 3

OBJECTIVES:

- Introduce the process of design thinking as a tool for innovation.
- Explain the concept of design thinking for Product development and providing services.
- Develop business strategies through innovations.
- Inculcate teamwork and leadership skills.

UNIT I INTRODUCTION TO DESIGN THINKING 6

Understanding Design thinking- Ethics and Moral framework- Innovation Design and innovation management- Team based design - Theory and practice in Design thinking - MVP or Prototyping - Tools for Design Thinking - Real-Time design - digital space – Empathy for design - Idea generation - Visualization - Journey mapping -Mindset for innovation - Leadership Styles

UNIT II PRODUCT DESIGN 6

Design thinking in Engineering Design - Design thinking in Social sector - Introduction to Synthesis - Design Research Strategies - Introduction to Ideation and Prototyping Strategies - User Testing - – Case study

UNIT III SERVICE DESIGN 6

Service design innovation - design thinking methods - Customer-centric – Holistic – Interdisciplinary - iterative process – Communication - Delivery Gap - Organisational Design & Culture Data – Case study

UNIT IV STRATEGIC INNOVATIONS 6

Growth – Story telling representation – Strategic Foresight - Change – Sense Making – Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design.

UNIT V CASE STUDIES AND DESIGN 6

Design Thinking Workshop through Empathize, Design, Ideate, Prototype and Test. Problem statement and solution identification through Group discussion and presentation by students.

TOTAL: 30 PERIODS

OUTCOMES:

- Realize various design process procedure.
- Design a product prototype, through design thinking and innovation.
- Design a service system, through a typical process flow.
- Demonstrate business strategy for product and service design.
- Demonstrate team work, leadership and soft skills through self awareness.

TEXTBOOKS:

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
2. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011

REFERENCE:

1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.

VD18607 ROBOTICS AND CONTROL L T P C
2 0 0 2

OBJECTIVES:

- To get familiar with Atmel Studio 6 IDE
- To get familiar with interfacing of Atmega 2560 microcontroller with different I/O devices.
- To program the Firebird V Robot using 'C' to perform different tasks

UNIT I INTRODUCTION TO FIRE BIRD V ROBOT 6

Fire Bird V Atmega 2560 Robot - block diagram - technical specifications - software requirements : Atmel studio 6 IDE - Debug a 'c' program. Write a 'c' program to find whether a number is odd or even.

UNIT II ATMEGA 2560 I/O PORTS 6

Write a 'c' program to interface an output device (bar graph LED) to the microcontroller Atmega 2560.Write a 'c' program to interface a switch to turn on bar graph LEDs.

UNIT III INTERFACING ATMEGA 2560 WITH LCD 6

Write a 'c' program to interface a 16x2 LCD with Atmega 2560 microcontroller in Firebird V Robot to display alphanumeric characters - Write a 'c' program to display two numbers in the 1st and 2nd row of the LCD.

UNIT IV ATMEGA 2560 TIMERS 6

Write a 'c' program to generate delay using timer in Atmega 2560 and turn on the buzzer - Write a 'c' program to indicate the value of counter on LCD.

UNIT V INTERFACING ATMEGA 2560 WITH DC MOTORS 6

Write a 'c' program to control dc motors interfaced with Atmega 2560 microcontroller . Write a 'c' program to decelerate the robot using PWM and indicate this on the bar graph LEDs .Write a 'c' program to convert the analog values of the front sharp sensor into digital values.

TOTAL: 30 PERIODS

OUTCOMES:

- Acquire knowledge to use Atmel Studio 6 IDE and various libraries.
- Programming the Firebird V robot in ‘C’ to interface it with different I/O devices and perform various tasks.

TEXT BOOKS:

1. Muhammad Ali Mazidi, Sarmad Naimi , Sepehr Naimi , "The AVR Microcontroller and Embedded Systems Using Assembly and C", Pearson Education, 2009.

REFERENCES:

1. Steven F Barret, Daniel J Pack , "Atmel AVR Microcontroller Primer Programming and Interfacing", The Morgan & Claypool Publishers series, 2008.
2. Timothy S. Margush , "Some Assembly Required Assembly Language Programming with the AVR Microcontroller", CRC Press, 2012.

VC 18004 DESIGN THINKING AND PROTOTYPING LABORATORY **L T P C 0 0 4 2**

OBJECTIVE:

To apply design thinking principles in arriving at innovative engineering solutions for problems relevant to society.

SYLLABUS

The course will use a combination of lectures and hands-on project work. The project will give an opportunity to come up with an innovative engineering solution to problems or challenges particular to our society.

1. Concepts of design thinking and human centered design thinking.
2. Identifying societal problems using indirect and qualitative research.
3. Forming teams and assignments of major societal problems and arriving at sound concept hypotheses, and solution using brainstorming sessions. Societal problems such as water management, energy sources, basic amenities (health, education, food, clean water, sanitation, connectivity etc), organic farming, livelihood etc. will be assigned as projects.
4. Developing a prototype that allows for meaningful feedback in a real-world environment.
5. Presenting the developed prototype in front of a technically qualified audience.

Evaluation will be done as per following details.

Project Work	Internal (65 Marks)			End Semester Examination (35 Marks)			
	Review I	Review II	Review III	Project Report (15)	Viva - Voce (20)		
				External	Internal	External	Supervisor
Phase	15	25	25	15	5	10	5

TOTAL: 45 PERIODS

OUTCOMES:

- Apply design thinking principles in arriving innovative design.
- Solve unique societal problems.
- Make prototypes of a model / concept technically.
- Work as a team member or lead interdisciplinary engineering teams.
- Demonstrate the product prototype to technically qualified audience.

VC18005 BASICS OF ENTREPRENEURSHIP DEVELOPMENT L T P C
1 0 2 2

OBJECTIVES :

- To provide Knowledge on Self-discovery and Problem identification.
- To provide Skill set on Identifying customer segment and Practice on Business Model.
- To understand the Market, Sales and support.

UNIT I Self-Discovery & Problem Identification 6

Orientation of Entrepreneurship – Case Study – activity – Effectuation – Principles of Effectuation – Identifying Entrepreneur skill.

Problem Identification – Design thinking – look for solution – activity – Brain storming.

UNIT II Customer & Business Model 6

Identifying customer segment, understanding the market – Product selection –activity – value proposition canvas.

Identify the Problem, Solution and Risk identification – Activity – Business model.

UNIT III Validation and Resources 6

Build a Minimum Viable Product (MVP) – validation and launching of MVP –activity – MVP Interview.

Cost – Revenue – Pricing – Profitability – Sources of finance – activity – Bootstrap Finance – Leadership – Identifying Co-founders and Hiring a Team – activity –Pitching about a venture

UNIT IV Market and sales 6

Positioning and branding – network and channels – sales planning – activity – selling skill.

UNIT V Support 6

Project Management – Project tracking – Basics of Business regulations – Activity – capstone project.

TOTAL : 30 PERIODS

OUTCOMES

CO1: Acquire knowledge and Practice on Self Discovery and Problem identification.
CO2: Understand the concept of Identifying the Customer and Business model.
CO3: Acquire knowledge on various Resource and Practice on validation.
CO4: Acquire knowledge on marketing and sales.
CO5: Practice on Project management.

TEXT BOOKS:

1. S.S.Khanka, "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, " Entreprenuership – Theory, Process and Practice", 9th edition, Cengage Learning 2014.

REFERENCES :

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Entrepreneurship Theory at Cross Roads: paradigms and Praxis", 2nd Edition Dream Tech, 2005.

Web Resource:

https://learnwise.wfglobal.org/#/IN/en/courses

VC18006 ADVANCE IN ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
1	0	2	2

OBJECTIVES :

- To provide Knowledge on Business model, Business plan and new business model/prototype.
- To provide Skill set on increasing revenue and funding.
- To understand the Team building, Measurement of progress and legal matters.

UNIT I Business Model & Product service **6**

Introduction to the concept of pivoting –Business Model-Types of Business Model-Business Model Evaluation-Refining Business Model-Analyzing Business Model-Adding New customer to Business model. Problem in new product development-New business model/Prototype

UNIT II Business Planning **6**

Business Plan-Sales plan- People plan- Finance plan-understanding finance planning-Forecasting template. Creating procurement plan-Negotiation role play-Activity.

UNIT III Increasing Revenue and Funding **6**

Understanding of primary revenue source-Customer life cycle-Exploring secondary revenue source-Funding option. Exploring funding option-Pitch deck.

UNIT IV Building a team and Brandings **6**

Introduction to building a team-pitching to attract team-Setting a team for success-standardize key process-Branding-Definition of values-Positioning statement-Identification of right channel-Digital marketing. Brand name and logo activity.

UNIT V Measurement of Progress and legal Matters **6**

Metrics for customer retention and satisfaction-Metrics dash board-legal and compliance requirement-Identify mentor and advisors. Project.

TOTAL : 30 PERIODS

OUTCOMES

CO1: Acquire knowledge and Practice on Business model and Business planning.

CO2: Understand the concept of increasing the revenue and funding.

CO3: Acquire knowledge on building a team and branding.

CO4: Acquire knowledge on Measurement of progress and legal matters.

CO5: Practice on Project management.

TEXT BOOKS:

1. S.S.Khanka, "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
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Web Resource:

https://lms.learnwise.wfglobal.org/IN/en/home