DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM & SYLLABI

Regulations 2016

(Applicable to candidates admitted in the Academic Year 2016-2017 onwards)

K.S.R. College of Engineering (Autonomous)

(Approved by AICTE, Accredited by NAAC with A grade & Affiliated to Anna University)

K.S.R. Kalvi Nagar, Tiruchengode – 637 215

Namakkal (Dt), Tamilnadu, India

Email : info@ksrce.ac.in Website : www.ksrce.ac.in

	K.S.R. COLLEGE OF ENGINEERING (Autonomous) (Approved by AICTE, Affiliated to Anna University & Accredited by NAAC with "A" Grade) K.S.R. Kalvi Nagar, Tiruchengode – 637 215	CURRICULUM UG R – 2016
Department	Electrical and Electronics Engineering	
Programme	B.E. – Electrical and Electronics Engineering	

SEMESTER – I

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16EN151	Technical English – I (Common to all Branches)	HS	3	0	0	3	30	70	100
2	16MA152	Engineering Mathematics – I (Common to all Branches)	BS	3	1	0	4	30	70	100
3	16PH153	Engineering Physics (Common to all Branches)	BS	3	0	0	3	30	70	100
4	16CY154	Engineering Chemistry (Common to all Branches)	BS	3	0	0	3	30	70	100
5	16GE141	Basics of Civil and Mechanical Engineering (Common to CS, EC, EE & IT)	ES	3	0	0	3	30	70	100
6	16CS146	Fundamentals of Computer and CProgramming (Common to AU,CE, EC, EE &ME)	ES	3	0	0	3	30	70	100
PRACTICAL										
7	-	Physics and Chemistry Laboratory* (Common to all Branches)	BS	0	0	3	-	-	-	-
8	16GE027	Engineering Practices Laboratory (Common to AU, CE, EE & ME)	ES	0	0	3	2	50	50	100
9	16CS127	Computer Practices Laboratory (Common to AU, CE, EC, EE & ME)	ES	0	0	3	2	50	50	100
		Total		**18**	**1**	**9**	**23**	**800**		

*** End semester Laboratory Examination only in the II Semester**

SEMESTER – II

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16EN251	Technical English – II (Common to All Branches)	HS	3	0	0	3	30	70	100
2	16MA242	Engineering Mathematics – II (Common to AU, CE, EC, EE, ME & IT)	BS	3	1	0	4	30	70	100
3	16PH243	Materials Physics (Common to EC & EE)	BS	3	0	0	3	30	70	100
4	16CY254	Environmental Science and Engineering (Common to All Branches)	HS	3	0	0	3	30	70	100
5	16EE215	Electric Circuit Analysis	PC	3	1	0	4	30	70	100
6	16EE216	Power Plant Engineering	ES	3	0	0	3	30	70	100
PRACTICAL										
7	16GE228	Physics and Chemistry Laboratory (Common to All Branches)	BS	0	0	3	2	50	50	100
8	16EE221	Electric Circuit Analysis Laboratory	PC	0	0	3	2	50	50	100
9	16AU027	Engineering Graphics Laboratory (Common to CS, EC, EE & IT)	ES	0	0	3	2	50	50	100
10	16HR251	Career Development Skills – I (Common to all Branches)	EEC	-	2	-	-	50	50	100
		Total		**18**	**2**	**11**	**26**	**1000**		

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SEMESTER – III

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16MA333	Differential Equations and Numerical Methods	BS	3	1	0	4	30	70	100
2	16EE312	Electro Magnetic Theory	PC	3	1	0	4	30	70	100
3	16EE313	Measurements and Instrumentation	PC	3	0	0	3	30	70	100
4	16EE314	Electron Devices and Circuits	ES	3	0	0	3	30	70	100
5	16EE315	Network Analysis and Synthesis	PC	3	0	0	3	30	70	100
6	16CS346	Object Oriented Programming with C++ (Common to CS and EE)	EEC	3	0	0	3	30	70	100
PRACTICAL										
7	16EE321	Measurements and Instrumentation Laboratory	PC	0	0	3	2	50	50	100
8	16EE322	Electron Devices and Circuits Laboratory	ES	0	0	3	2	50	50	100
9	16CS327	Object Oriented Programming with C++ Laboratory (Common to CS and EE)	EEC	0	0	3	2	50	50	100
10	16HR352	Career Development Skills – II (Common to all Branches)	EEC	-	2	-	-	50	50	100
			Total	**18**	**4**	**9**	**26**	**1000**		

SEMESTER – IV

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16EE411	Electrical Machines – I	PC	3	0	0	3	30	70	100
2	16EE412	Transmission and Distribution	PC	3	0	0	3	30	70	100
3	16EE413	Analog Integrated Circuits	ES	3	0	0	3	30	70	100
4	16EE414	Digital Electronics	ES	3	1	0	4	30	70	100
5	16EE415	Signals and Systems	PC	3	1	0	4	30	70	100
6	16CS436	Data Structures and Algorithms	EEC	3	0	0	3	30	70	100
PRACTICAL										
7	16EE421	Electrical Machines – I Laboratory	PC	0	0	3	2	50	50	100
8	16EE422	Analog and Digital Integrated Circuits Laboratory	ES	0	0	3	2	50	50	100
9	16CS426	Data Structures and Algorithms Laboratory	EEC	0	0	3	2	50	50	100
10	16HR453	Career Development Skills – III	EEC	-	2	-	-	50	50	100
			Total	**18**	**4**	**9**	**26**	**1000**		

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SEMESTER – V

Sl.No.	Course Code	Course Name	Category	Hours/ Week		Credit		Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16EE511	Electrical Machines-II	PC	3	0	0	3	30	70	100
2	16EE512	Control Systems	PC	3	1	0	4	30	70	100
3	16EE513	Digital Signal Processing	PC	3	1	0	4	30	70	100
4	16EE514	Microprocessors and Microcontroller	PC	3	0	0	3	30	70	100
5	16EC541	Computer Networks (Common to EC & EE)	PC	3	0	0	3	30	70	100
6	16EC531	Basics of VLSI Design	PC	3	0	0	3	30	70	100
PRACTICAL										
7	16EE521	Electrical Machines – II Laboratory	PC	0	0	3	2	50	50	100
8	16EE522	Control Systems Laboratory	PC	0	0	3	2	50	50	100
9	16EE523	Microprocessors and Microcontroller Laboratory	PC	0	0	3	2	50	50	100
10	16HR554	Career Development Skills – IV	EEC	-	2	-	-	50	50	100
			Total	**18**	**4**	**9**	**26**	**1000**		

SEMESTER – VI

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16EE611	Electrical Machine Design	PC	3	1	0	4	30	70	100
2	16EE612	Power System Analysis	PC	3	1	0	4	30	70	100
3	16EE613	Power System Protection, Switchgear and Utilization	PC	3	0	0	3	30	70	100
4	16EE614	Power Electronics and Drives	PC	3	0	0	3	30	70	100
5	-	Professional Elective – I	PE	3	0	0	3	30	70	100
6	-	Open Elective – I	OE	3	0	0	3	30	70	100
PRACTICAL										
7	16EE621	Power System Simulation Laboratory	PC	0	0	3	2	50	50	100
8	16EE622	Power Electronics and Drives Laboratory	PC	0	0	3	2	50	50	100
9	16EE623	System Design Laboratory	PC	0	0	3	2	50	50	100
10	16HR655	Career Development Skills – V	EEC	0	2	0	0	50	50	100
			Total	**18**	**4**	**9**	**26**	**1000**		

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SEMESTER – VII

Sl.No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16HS751	Professional Ethics (Common to all Branches)	HS	3	0	0	3	30	70	100
2	16EE712	Embedded Systems	PC	3	0	0	3	30	70	100
3	16EE713	Industrial Automation and Control	PC	3	0	0	3	30	70	100
4	16EE714	Energy Management and Audit	PC	3	0	0	3	30	70	100
5	-	Professional Elective – II	PE	3	0	0	3	30	70	100
6	-	Open Elective – II	OE	3	0	0	3	30	70	100
PRACTICAL										
7	16EE721	Embedded Systems Laboratory	PC	0	0	3	2	50	50	100
8	16EE722	Technical Writing and Presentation	EEC	0	0	3	1	50	50	100
			Total	**18**	**0**	**6**	**21**	**800**		

SEMESTER – VIII

Sl. No.	Course Code	Course Name	Category	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16HS001	Principles of Management (Common to CE, EC & EE)	HS	3	0	0	3	30	70	100
2	-	Professional Elective – III	PE	3	0	0	3	30	70	100
3	-	Professional Elective – IV	PE	3	0	0	3	30	70	100
PRACTICAL										
4	16EE821	Project Work	EEC	0	0	12	6	50	50	100
			Total	**9**	**0**	**12**	**15**	**400**		

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Professional Elective – I (Semester - VI)

Sl.No.	Course Code	Course Name	Specialization	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16EE661	Industrial Electronics	S1	3	0	0	3	30	70	100
2	16EE662	Flexible AC Transmission Systems	S1	3	0	0	3	30	70	100
3	16EE663	Power System Transients	S2	3	0	0	3	30	70	100
4	16EE664	Special Electrical Machines	S2	3	0	0	3	30	70	100
5	16EE665	Advanced Control Systems	S3	3	0	0	3	30	70	100
6	16EE666	Microcontroller Based System Design	S3	3	0	0	3	30	70	100
7	16EE667	Programmable Logic Control	S4	3	0	0	3	30	70	100
8	16EC681	Communication Engineering	S4	3	0	0	3	30	70	100
9	16EC683	Tele Communication Switching and Networks	S5	3	0	0	3	30	70	100
10	16CS686	Internet and Web Technology	S6	3	0	0	3	30	70	100

Professional Elective – II (Semester - VII)

Sl.No.	Course Code	Course Name	Specialization	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16EE761	Soft Computing Techniques	S1	3	0	0	3	30	70	100
2	16EE762	Power Electronics for Renewable Energy Sources	S1	3	0	0	3	30	70	100
3	16EE763	High Voltage Direct Current Transmission	S2	3	0	0	3	30	70	100
4	16EE764	Power System Operation & Control	S2	3	0	0	3	30	70	100
5	16EE765	Electric and Hybrid Vehicles	S3	3	0	0	3	30	70	100
6	16EE766	Bio Medical Instrumentation	S3	3	0	0	3	30	70	100
7	16EE767	Fundamentals of Nanoscience	S4	3	0	0	3	30	70	100
8	16CS005	Computer Architecture (Common to CS, EE, & EC)	S6	3	0	0	3	30	70	100
9	16CS788	Mobile Application Development	S6	3	0	0	3	30	70	100
10	16HS003	Disaster Preparedness and Management (Common to CS, EE, & IT)	S7	3	0	0	3	30	70	100

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Professional Elective – III & IV (Semester - VIII)

Sl.No.	Course Code	Course Name	Specialization	Hours/ Week			Credit	Maximum Marks		
				L	T	P	C	CA	ES	Total
THEORY										
1	16EE861	Simulation of Power Electronic systems	S1	3	0	0	3	30	70	100
2	16EE862	Power Quality	S2	3	0	0	3	30	70	100
3	16EE863	Smart Grid Technology	S2	3	0	0	3	30	70	100
4	16EE864	High Voltage Engineering	S2	3	0	0	3	30	70	100
5	16EE865	Computer Aided Design of Electrical Apparatus	S3	3	0	0	3	30	70	100
6	16EE866	Digital Image Processing	S4	3	0	0	3	30	70	100
7	16EE867	Micro Electro Mechanical Systems	S5	3	0	0	3	30	70	100
8	16EE868	Robotics and Industrial Automation	S5	3	0	0	3	30	70	100
9	16CS003	Operating Systems (Common to CS, EE, & EC)	S6	3	0	0	3	30	70	100
10	16HS002	Total Quality Management (Common to AU, CE, CS, EE, ME & IT)	S7	3	0	0	3	30	70	100

S1 – Power Electronics S2 – Power Systems S3 – Electrical Engineering

S4 – Electronics Engineering S5 – Embedded Systems S6 – Computer Programming

S7 – Management Studies

List of Proposed One Credit Courses:

Sl.No.	Course Name	Number of hours	Offered by Internal / External
1.	Control of Motors using Special Drives	15 Hours	Internal / External
2.	Control Panel Wiring	15 Hours	Internal / External
3.	LV switchgears	15 Hours	Internal / External
4.	Industrial Automation using PLC	15 Hours	Internal / External
5.	Electrical Safety Standards And Practices	15 Hours	Internal / External
6.	Automotive Electrical Systems	15 Hours	Internal / External
7.	Arduino	15 Hours	Internal / External
8.	Low Power Microcontrollers and Applications	15 Hours	Internal / External
9.	PCB Design	15 Hours	Internal / External
10.	PLC- SCADA	15 Hours	Internal / External
11.	Solar PV Systems: Design, Simulation and Monitoring And Control	15 Hours	Internal / External
12.	Power Electronics in More-Electric Aircraft	15 Hours	Internal / External

COURSE COMPONENT SUMMARY

Sl.No	Subject Area	Credits per semester								Credits Total	Percentage Credits
		I	II	III	IV	V	VI	VII	VIII		
1	HS	3	6					3	3	15	**7.94 %**
2	BS	10	9	4						23	**12.17 %**
3	ES	10	5	5	9					29	**15.34 %**
4	PC		6	12	12	26	20	11		87	**46.03 %**
5	PE						3	3	6	12	**6.35 %**
6	OE						3	3		6	**3.17 %**
7	EEC			5	5			1	6	17	**8.99 %**
Total		23	26	26	26	26	26	21	15	189	**100%**

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SEMESTER - I

		L	T	P	C
16EN151	**TECHNICAL ENGLISH – I**				
	(Common to All Branches)	3	0	0	3

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objectives:

- *To develop basic conversation skills.*
- *To build vocabulary skills with the right choice of words.*
- *To improve students' understanding of grammar in context progressively.*

UNIT - I GRAMMAR AND VOCABULARY [9]

Synonyms & Antonyms – Tenses (Simple Present, Present Continuous, Present Perfect, Simple Past, and Simple Future) - Use of Modal Auxiliaries – Infinitive and Gerund – Preposition of Time, Place and Movement – Concord (Subject & Verb Agreement) - British & American Terminology – Phrasal Verbs (Put, Give, Look, Take, Get, Call) – Pick the Grammatically correct sentences – Impersonal passive – Technical Abbreviations and Acronyms

UNIT - II LISTENING [9]

Active Listening - Listening for the main idea - Predicting - Drawing inferences - Listening for specific details - Listening to News – Listening to Dialogues – Listening to Telephonic Conversation.

UNIT - III PHONETICS AND SPOKEN ENGLISH [9]

Consonant Sounds – Pronunciation guidelines related to Vowels and Consonant – Drills using Minimal pairs – Welcome Speech – Vote of Thanks – MoC – Anchoring – Role play in academic context.

UNIT - IV READING [9]

Intensive Reading – Predicting Content – Interpretation – Skimming and Scanning - Vocabulary Building - Inference – Context Based Meaning – Note making

UNIT - V WRITING SKILLS [9]

Need based Correspondence (request for joining hostel, bonafide certificate, In plant training & Industrial Visit) – Writing Instructions - Letter of Invitation (inviting , accepting and declining) – Paragraph writing with given hints - Letter to the Editor of a Newspaper.

Total = 45 Periods

Course Outcomes: On completion of this course, the student will be able to

CO1: Understand and apply Grammar in context for professional communication.
CO2: Understand the gist and specific information.
CO3: Speak, express and interact in the society and place of study.
CO4: Critically interpret by reading a text and comprehend a given text.
CO5: Correspond and communicate for jobs.

Text Book :

1. Dr.P.Rathna, English Work Book – I, VRB Publishers Pvt. Ltd., Chennai,2015

Reference Books :

1. Meenakshi Raman. Technical Communication, Oxford University Press, New Delhi, 2004.
2. Seely, The Oxford Guide to Writing and Speaking, Oxford University Press, New Delhi, 2004.
3. M Ashra Rizvi, Effective Technical Communication, Tata McGRAW HILL, New Delhi, 2005.
4. P.Kiranmani Dutt, A course in Communication Skills,Cambridge University Press, New Delhi, 2008.

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SEMESTER - I

		L	T	P	C
16MA152	**ENGINEERING MATHEMATICS – I**				
	(Common to All Branches)	3	1	0	4

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objectives:

- *To study the concepts of Matrices and its Applications.*
- *To study the concepts and its applications of Ordinary Differential Equations.*
- *To improve ability in solving geometrical applications of differential calculus problems.*
- *To acquire knowledge in the concepts of functions of several variables.*
- *To study the concept of three dimensional analytical geometry.*

UNIT - I MATRICES [12]

Introduction – types of Matrices- Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley-Hamilton theorem (statement only) and its applications – Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT - II ORDINARY DIFFERENTIAL EQUATIONS [12]

Linear differential equations of second and higher order with constant coefficients – Differential equations with variable coefficients – Cauchy's and Legendre's linear equations – Method of variation of parameter - simultaneous first order linear differential equations with constant coefficients.

UNIT - III DIFFERENTIAL CALCULUS [12]

Curvature in Cartesian co-ordinates – radius of curvature – Centre of curvature and Circle of curvature – Involutes and Evolutes – Envelopes (except evolutes as the envelope of normals) – Properties of envelopes and evolutes.

UNIT - IV FUNCTIONS OF SEVERAL VARIABLES [12]

Partial derivatives – Euler's theorem for homogenous functions – Jacobians – Taylor's series expansion - Maxima and Minima for functions of two variables – Method of Lagrangian multipliers.

UNIT - V THREE DIMENSIONAL ANALYTICAL GEOMETRY [12]

Equation of straight line – Angle between two lines - Coplanar lines and Shortest distance between skew lines (symmetrical form only) – Equation of a sphere – Plane section of a sphere – Orthogonal spheres.

Total (L: 45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Interpret the basics of Matrix applications in the field of engineering.
CO2: Acquire knowledge in solving ordinary differential equations.
CO3: Understand and apply the concepts of differential calculus problems.
CO4: Improve Skills in Developing and solving the functions of several variables.
CO5: Understanding the concepts of three dimensional analytical geometry.

Text Book :

1. Ravish R Singh and Mukul Bhatt, Engineering Mathematics – I, McGraw Hill Publications, 3rd Edition, New Delhi 2013.

Reference Books :

1. Grewal B.S, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company, 43rd Edition, New Delhi, 2013.
2. Bali N. P and Manish Goyal, Text book on Engineering Mathematics, Laxmi Publications (p) Ltd., 6th Edition, 2015.
3. H.K. Dass, Advance Engineering Mathematics, S. Chand and company, 11th Edition, 2015.

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SEMESTER - I

16PH153	**ENGINEERING PHYSICS (Common to All Branches)**	L	T	P	C
		3	0	0	3

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objectives:

- *To Understand the fundamentals of physics that have a direct application in the field of engineering.*
- *To Compute and analyze various problems related to engineering physics.*
- *To Understand the basic concepts behind the Acoustics, Ultrasonics, Lasers, Optical fibers, solar cells & Photo devices, and Quantum mechanics*.

UNIT - I ACOUSTICS AND ULTRASONICS [9]

Acoustics – Introduction – Classification of sound – Characteristics of musical sound – Loudness – Weber – Fechner law – Decibel – Absorption coefficient – Reverberation – Reverberation time – Sabine's formula: growth and decay (derivation) – Factors affecting acoustics of buildings and their remedies. Ultrasonics – Production – piezoelectric method – Properties – Velocity measurement: acoustical grating – Engineering applications – SONAR.

UNIT - II LASERS AND APPLICATIONS [9]

Introduction – Principle of Spontaneous emission and stimulated emission – Population inversion, pumping – Einstein's A and B coefficients (derivation). Types of lasers – Nd-YAG, CO_2 and Semiconductor lasers (homo-junction and hetero-junction) – Qualitative Industrial Applications: Lasers in welding, heat treatment and cutting – Medical applications – Holography (construction and reconstruction).

UNIT - III FIBER OPTICS AND APPLICATIONS [9]

Principle and propagation of light in optical fibers – Numerical aperture and Acceptance angle (derivation) – Types of optical fibers (material, refractive index and mode) – Double crucible technique of fiber drawing – Splicing – Losses in optical fiber: attenuation, dispersion and bending – Fiber optical communication system (Block diagram) – Fiber optic sensors: temperature and displacement sensors – Medical Application: Endoscope.

UNIT - IV SOLAR CELLS AND PHOTO DEVICES [9]

Solar cells – classification – working- V-I characteristics – experiment - Materials for solar cell – Applications – Photoconductive devices – PIN and Avalanche photodiode – construction, working and characteristics – Light Emitting Diode – construction, working and characteristics – Applications: Voltage indicator and seven segment display.

UNIT – V QUANTUM PHYSICS [9]

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect – Theory and experimental verification – Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box .

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Describe the impact of engineering solutions in the constructional and designing environment.
CO2: Categorize the types of laser and utilize it for specific application based on their desirable requisite.
CO3: Comprehend the fundamental ideas of optical fibers and to fabricate it for the potential applications.
CO4: Exploit the concepts of photo devices for fabricating solar cells.
CO5: Enumerate the preambles of quantum physics and to implement its concepts to tackle the cumbersome engineering problem

Text Books :

1 Dr.G.Senthil Kumar, Engineering Physics – I, VRB Publishers Pvt Ltd, 2009
2 V. Rajendran, Engineering Physics, Tata McGraw Hill, 2011.

References:

1 Brij Lal and Subramaniam, A Text Book of Sound, S. Chand and Co Ltd, New Delhi, 2005.
2 Dr. P. Mani, Engineering Physics – I, Dhanam Publications, Chennai, 2012.
3 S. Selladurai, Engineering Physics-I, PHI Learning Pvt, Ltd., New Delhi, 2010.
4 Dr.S.Muthukumaran, G.Balaji and S.Masilamani, Engineering Physics- I, Sri Krishna HI—Tech Pvt. Ltd. 2010.
5 www.fadooengineers.com

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SEMESTER – I

16CY154	**ENGINEERING CHEMISTRY (Common To All Branches)**	L	T	P	C
		3	0	0	3

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objectives:

- *To make the students conversant with basic concepts and applications of engineering polymers.*
- *To understand the principles and functioning of batteries, fuel cell and solar cell.*
- *To impart knowledge about the manufacture and uses of advanced engineering materials.*
- *To gain sound knowledge on the water treatment methods and its industrial applications.*
- *To acquaint the students with the basic concepts of corrosion mechanism and its control.*

UNIT - I ENGINEERING POLYMERS [9]

Polymer – definition – degree of polymerization – functionality. Polymerisation – addition, condensation and co-polymerization – free radical mechanism of addition polymerization; Plastics – classification – thermosetting and thermoplastics. Properties of polymers – glass transition temperature and tacticity. Preparation, properties and uses of engineering polymers [PVC, nylon-6, 6, PET and SBR]; Fabrication of polymers – compression and Injection moulding; Composites – FRP only.

UNIT - II ENERGY STORAGE DEVICES [9]

Batteries – primary batteries – alkaline batteries, secondary batteries – lead – acid, nickel – cadmium and lithium batteries. Fuel cells – H_2-O_2 fuel cell, solar cells – principle, applications and advantages; Nano batteries and its applications. Nuclear energy – fission and fusion reactions; Nuclear reactor – components and power generation – breeder reactor.

UNIT - III ADVANCED ENGINEERING MATERIALS [9]

Abrasives – moh's scale of hardness – types – natural [Diamond] – synthetic [SiC]; Refractories – characteristics – classifications [Acidic, basic and neutral refractories] – properties – refractoriness – RUL – porosity – thermal spalling; Lubricants – definition – function – characteristics- properties – viscosity index, flash and fire points, cloud and pour points, oiliness. Solid lubricants – graphite and MoS_2. Nano materials – CNT – synthesis [CVD, laser evaporation, pyrolysis] – applications – medicine, electronics, biomaterials and environment.

UNIT - IV WATER AND ITS PURIFICATION TECHNIQUES [9]

Hardness – types, equivalence of $CaCO_3$ [problems] ,units – estimation of hardness by EDTA method; Boiler feed water – requirements, disadvantages of using hard water in boilers – scale and sludge – priming and foaming – caustic embrittlement – boiler corrosion. Softening methods – internal conditioning – calgon, carbonate, phosphate – external conditioning – zeolite process and Ion exchange process; Desalination – reverse osmosis. Characteristics of potable water – domestic water treatment – break point chlorination.

UNIT - V CHEMISTRY OF CORROSION AND ITS CONTROL [9]

Electrochemical cells – types – single electrode potential and its determination; Electrochemical series – applications – corrosion – chemical corrosion – Pilling – Bedworth rule, electrochemical corrosion – mechanism, galvanic corrosion and differential aeration corrosion [Pitting corrosion, water line corrosion]; Factors influencing corrosion; Corrosion control – cathodic protection methods – sacrificial anode and impressed current methods – corrosion inhibitors.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Know the preparation and fabrication of various types of polymers and composite materials.
CO2: Understand the usage of nuclear power plants and batteries for the production of electricity.
CO3: Gain knowledge in the manufacture and uses of advanced engineering materials.
CO4: Be familiarized with the water quality parameters and understand the various water treatment methods.
CO5: Perceive knowledge on the concept of corrosion and it's control.

Text Books :

1 P.C. Jain and Monica Jain, Engineering Chemistry, Dhanpat Rai Pub. Co., 16th Edition, 2013.
2 Dr. A.Ravikrishnan, Engineering Chemistry, Srikrishna Hi-tech Publishing Company Pvt. Ltd. 14th Edition, 2014.

Reference Books :

1. B. Sivasankar, Engineering Chemistry, Tata McGraw-Hill Pub. Co. Ltd., 14th Edition, 2011.
2. S.S.Dara, A Text book of Engineering Chemistry, S.Chand & Co.Ltd., 10th Edition, 2005.
3. Dr. S. Vairam, Dr. P. Kalyani, Dr. Subaramesh, Engineering Chemistry, Wiley India Pvt.Ltd., 2nd Edition, 2013.

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SEMESTER - I

16GE141 **BASICS OF CIVIL AND MECHANICAL ENGINEERING** L T P C

(Common to CS, EC, EE & IT) 3 0 0 3

Prerequisite: *No Prerequisites needed for enrolling into the course.*

Objectives:

- To develop awareness on materials, structures, components and methods in Civil Engineering.
- To acquire knowledge on Power Plants, IC Engines, Refrigeration and Air Conditioning systems

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A - CIVIL ENGINEERING

UNIT - I SURVEYING AND CIVIL ENGINEERING MATERIALS [9]

Surveying: objects - types - 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 COMPONENTS AND STRUCTURES [9]

Foundations: types, bearing capacity - requirement of good foundations - superstructure - types of bridges and dams - brick masonry - stone masonry - beams - columns - lintels - roofing - flooring - plastering - mechanics - internal and external forces - stress - strain - elasticity.

B - MECHANICAL ENGINEERING

UNIT - III POWER PLANT ENGINEERING [9]

Introduction, classification of Power Plants - working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants - merits and demerits - Pumps and Turbines - working principle of Reciprocating pumps (single acting and double acting) - Centrifugal pump.

UNIT - IV IC 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.

UNIT - V REFRIGERATION AND AIR CONDITIONING SYSTEM [9]

Terminology of Refrigeration and Air Conditioning. principle of vapour compression and absorption system -layout of typical domestic refrigerator -Window and Split type room Air Conditioner.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: To calculate the areas, volumes and relative positions of the object and to gain knowledge about the various materials used in construction.

CO2: Familiar with construction practices and the components of the structures.

CO3: Learn the working principle of various types of power plants, pumps and turbines.

CO4: Gain the knowledge about the various classifications and terminologies of engines. Such as two stroke and four stroke petrol and diesel engines.

CO5: Acquire the knowledge about the refrigeration process and also the working principle of various types of Air conditioners.

Text Books :

1 Ramesh Babu," Basic civil and Mechanical Engineering, VRB" Publishers, 2011.

2 Shanmugam G and Palanichamy M S, Basic Civil and Mechanical Engineering, TMH Publishing Co., New Delhi, 1996.

References :

1 Seetharaman.S., "Basic Civil Engineering", Anuradha Agencies, 2005.

2 Ramamrutham. S., "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd., 1999.

3 Venugopal. K and Prahu Raja V., Basic Mechanical Engineering, Anuradha Publishers, Kumbakonam, 2000.

4 Shantha Kumar S.R.J., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.

5 http://nptel.ac.in.

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SEMESTER - I

		L	T	P	C
16CS146	**FUNDAMENTALS OF COMPUTER AND C PROGRAMMING (Common to AU , CE ,EC, EE & ME)**	3	0	0	3

Prerequisite: *No prerequisites are needed for enrolling into the course*

Objectives:

- *To Learn the organization of a digital computer.*
- *To think logically and write pseudo code or draw flowchart of a problem*
- *To write simple programs using C language.*

UNIT - I BASICS OF COMPUTERS [9]

Generation and Classification of Computers – Basic Computer Organization – Number System and its Conversions – Problem Solving: Algorithm – Pseudo code – Flow Chart.

UNIT - II C PROGRAMMING BASICS [9]

Fundamentals – Structure of a 'C' program – Compilation and Linking processes – Constants, Variables – Data Types – Operators – Expressions – 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 – String Arrays – Simple programs: Sorting – Searching – Matrix operations.

UNIT - IV FUNCTIONS AND POINTERS [9]

Function: Declaration – Definition – Categories – Pass by value – Pass by reference – Recursion – Pointers: Definition – Initialization – Pointers arithmetic – Pointers to Pointers – Pointers and arrays – Example Problems.

UNIT - V STRUCTURE AND UNION [9]

Structure: Declaration – Definition – Structures within structures – Union – Programs using structure and Union – Storage classes – Pre-processor directives – Files.

Total = 45 Periods

Course Outcomes: On completion of this course, the student will be able to

CO1: Identify Basics of Computer.
CO2: Write C Programs for solving simple scientific and statistical problems.
CO3: Implement C programs for arrays and strings.
CO4: Write C Programs using Functions and Pointers.
CO5: Implement Simple C applications using Structures and Unions.

Text Book :

1 Ashok N.Kamathane, Computer Programming, Pearson Education, 2014.

References :

1 Pradip Dey, Manas Ghosh, Fundamentals of Computing and Programming in C, First Edition, Oxford University Press, 2013.
2 Anita Goel and Ajay Mittal, Computer Fundamentals and Programming in C, Dorling Kindersley India Pvt. Ltd., Pearson Education in South Asia, 2011.
3 Yashavant P. Kanetkar, Let Us C, BPB Publications, 2011.
4 Dromey R.G., How to Solve it by Computer, Pearson Education, Fourth Reprint, 2007.
5 Kernighan,B.W and Ritchie,D.M, The C Programming language, Second Edition, Pearson Education, 2006.
6 http://nptel.ac.in/courses/106105085/4

K.S.R. COLLEGE OF ENGINEERING (Autonomous)
SEMESTER - I

R 2016

PHYSICS AND CHEMISTRY LABORATORY
(Common to all Branches)

L	T	P	C
0	0	3	-

Prerequisite: *Knowledge in Engineering Physics , Chemistry and Materials science*

Objectives:

- To gain the practical knowledge and hands on experiences of understanding the physics concepts applied in optics, sound and thermal physics.
- To gain practical knowledge by applying theoretical principles and performing the following experiments.

List of Experiments in Physics Laboratory

1. Determination of wavelength of laser using grating and the size of the particles.
2. Determination of thickness of the given material by Air – wedge method.
3. Determination of velocity of Ultrasonic waves and compressibility using Ultrasonic interferometer.
4. Spectrometer grating - Determination of wavelength of mercury spectrum.
5. Determination of thermal conductivity of a bad conductor by Lee's disc method.

List of Experiments in Chemistry Laboratory

1. Estimation of hardness in water by EDTA method.
2. Estimation of chloride in water sample by Argentometry.
3. Estimation of dissolved oxygen (DO) in water by winkler's method.
4. Estimation of copper in brass by EDTA method.
5. Determination of molecular weight and degree of polymerization using viscometry.
6. Determination of rate of corrosion of mild steel by weight loss method.

Total : 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Comprehend the different physical parameters of optics and perceive the production of ultrasonic waves through inverse piezoelectric effect and to determine the velocity of sound waves in the given liquid.

CO2: Understand the principle of thermal conductivity thereby to calculate the thermal conductivity of various bad conductors like cardboard, mica, etc.

CO3: Know the applicability of water in various fields.

CO4: Know the composition of brass quantitatively and the molecular weight of the polymer.

CO5: Understand the nature of corrosion process.

Text Book :

1. Physics Lab manual, Department of Physics, K.S.R. College of Engineering.
2. Chemistry Lab Manual, Department of Chemistry, K.S.R. College of Engineering.

Reference Book :

1. Dr.G.Senthilkumar, Physics Lab manual, VRB Publications Pvt. Ltd.,(2006).
2. Advanced Practical Physical Chemistry by J.B. Yadav, GOEL Publishing House.
3. Advanced Practical Inorganic Chemistry by Gurdeep Raj, GOEL Publishing House.

Note:

- **A minimum of five experiments shall be offered in chemistry laboratory.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**

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SEMESTER - I

16GE027	**ENGINEERING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
	(Common to AU, CE, EE & ME)	0	0	3	2

Prerequisite: *No Prerequisites needed for enrolling into the course.*

GROUP A (CIVIL & MECHANICAL)

Objective:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical Engineering.

List of Experiments

1. Study of fitting, carpentry, smithy, sheet metal, foundry, welding, plumbing and machine tools.
2. Make a V joint from the given work pieces using Fitting operation.
3. Make Lap joint / Butt joint / T joint from the given wooden pieces using carpentry tools.
4. Make a Tray/funnel/Cone Model with the given sheet metal.
5. Prepare a mould using solid / split patterns in Foundry.
6. Make a butt joint / lap joint / Tee joints using arc / gas welding equipment.
7. Make a basic / mixed pipe connection for the given layout using plumbing tools.
8. Perform simple Facing and Turning operation using Centre Lathe.
9. Make holes as per the given dimensions using drilling machine.
10. Demonstration on upsetting, swaging and bending operations using smithy tools.

List of Equipment

1.	Fitting tools and its accessories	-	15 Sets
2.	Carpentry tools and its accessories	-	15 Sets
3.	Smithy tools and Open hearth furnace setup	-	2 Sets
4.	Sheet metal and its accessories	-	15 Sets
5.	Foundry tools and its accessories	-	5 Sets
6.	Arc Welding equipments and its accessories	-	5 Sets
7.	Oxy Acetylene welding setup and its accessories	-	1 Set
8.	Plumbing tools and its accessories	-	15 Sets
9.	Centre Lathe with its accessories	-	2 Nos.
10.	Pillar type drilling machine	-	1 No.

Course outcomes: On completion of this course, the students will be able to:

CO1: To acquire knowledge on plumbing works for water supply and basic pipe connections.
CO2: To learn about the carpentry work practices for planning, sawing and cutting.
CO3: Understand about welding operations like butt joints, lap joints and T – joints.
CO4: Gain the knowledge on basic machining operations in conventional machines.
CO5: Grasp the knowledge on metal forming operations.
CO6: Demonstrate on smithy operations.

(contd…)

GROUP B (ELECTRICAL & ELECTRONICS)

Prerequisite: *No Prerequisite needed for enrolling into the course*

Objectives:

- *To study different types of wiring used in house.*
- *To find the parameter of electrical quantity using different measuring devices.*
- *To study Peak-Peak, RMS value, time period, frequency of AC Signal Parameters using CRO.*
- *To learn different logic gates and its truth tables.*
- *To solder different electronic components.*
- *To build a Half Wave, Full Wave Rectifier using diodes*

List of Experiments:

ELECTRICAL ENGINEERING

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 and power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.

ELECTRONICS ENGINEERING

1. Study of Electronic components and equipments – Resistor colour coding.
2. Measurement of AC signal parameters (Peak-Peak, RMS value, time period, frequency) using CRO.
3. Study of logic gates AND, OR, EX-OR, NOT, Half and Full Adder.
4. Soldering practice – Components Devices and Circuits- Using general purpose PCB.
5. Construction of Half Wave and Full Wave Rectifier.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Construct different types of wiring used in house.
CO2: Estimate the parameter of electrical quantity using different measuring devices.
CO3: Discover peak-peak, RMS value, time period, frequency of AC Signal Parameters using CRO.
CO4: Infer different logic gates applications using truth tables.
CO5: Organize different electronic components.
CO6: Construct a Half Wave, Full Wave Rectifier using diodes.

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SEMESTER - I

		L	T	P	C
16CS127	**COMPUTER PRACTICES LABORATORY (Common to AU, EC, EE ,CE, & ME)**	0	0	3	2

Prerequisite: *No prerequisites are needed for enrolling into the course.*

Objective:

- *To gain the knowledge of PC hardware, Office software and simple applications using C programming.*

List of Experiments:

1. ***Study Experiment***
   a) Study of parts of the PC.
   b) Study of Internet Connection.
2. ***Word processing***
   a) Document creation, Text manipulation with Scientific notations.
   b) Table creation, Table formatting and Conversion.
   c) Mail merge and Letter preparation.
   d) Drawing - flow Chart.
3. ***Spread Sheet***
   a) Chart - Line, XY, Bar and Pie.
   b) Formulas and functions.
   c) Inclusion of object and protecting the sheet.
4. ***PowerPoint Presentation***
   Create simple power point presentation with animations.
5. ***MS Access***
   Generate a student report using MS Access.
6. ***Simple C Programming ****
   a) Conditional and looping Statements.
   b) Arrays and strings.
   c) Structures and Unions.
   d) Functions and pointers.

* For programming exercises Flow chart and pseudo code/algorithm are essential.

Total : 45 Periods

Course Outcomes: On completion of this course, the student will be able to:

CO1: Be familiar with creating a table, flow chart, mail merge and apply text manipulation in a word document.
CO2: Design a spreadsheet for creating the charts and apply formulas and functions.
CO3: Create power point presentation with animations and generate a report in MS access.
CO4: Apply good programming design methods for program development.
CO5: Design and implement C programs for simple applications.

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SEMESTER - II

		L	T	P	C
16EN251	**TECHNICAL ENGLISH – II (Common to All Branches)**	**3**	**0**	**0**	**3**

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objective:

- *To improve Listening, Speaking, Reading and Writing skills.*

UNIT - I LANGUAGE FOCUS [9]

Technical Vocabulary – Changing words from one form to another - Articles – Compound Nouns – Numerical Adjectives – Prefixes & Suffixes – Framing Questions – 'Wh' Question – Yes / No Question –Discourse markers - Cause and Effect Expression -Expression of Purpose – Editing text for Spelling and Punctuation.

UNIT - II SPEAKING [9]

Greetings and Introductions – Making Requests – Seeking Information – Inviting People – Likes & Dislikes- Instructions – Describing – Telephone Etiquette.

UNIT - III READING [9]

Critical reading, Making inference, Context based meaning - Transcoding (Interpretation of Charts).

UNIT - IV PROFESSIONAL WRITING [9]

Job Application and Resume - Report Writing - E-mail Writing - Business Correspondence – Calling for Quotations, Seeking Clarification, placing order and Complaint

UNIT - V LISTENING [9]

Listening to fill up forms and gapped texts – Extensive Listening – Listening and Note taking - Listening for main ideas.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Comprehend and apply the enriched vocabulary, by knowing the basic grammatical structure, in academic and professional contexts.
CO2: Recognize and use Standard English in diverse situations.
CO3: Critically interpret by reading a text and comprehend a given text.
CO4: Write clearly in professional contest.
CO5: Enhance the listening skill for academic purposes.

Text Book :

1. Dr.P.Rathna, English Work Book – II, VRB Publishers Pvt. Ltd., Chennai, 2016.

Reference Books :

1. Dr.S.Sumant, Technical English I, Tata McGraw Hill, Chennai, 2012.
2. Dept. of Humanities and social sciences, Anna University, Chennai, English for Engineers and Technologists, Orient Longman, 2008.
3. Hory Sankar Mukerjee, Business Communication, Oxford University Press, New Delhi, 2013.
4. Department of English, English for Technologists and Engineers, Orient Black Swan, Chennai 2012.

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SEMESTER - II

		L	T	P	C
16MA242	**ENGINEERING MATHEMATICS – II (Common to AU, CE, EC, EE, ME & IT)**	3	1	0	4

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objectives:

- *To study the concepts of Laplace transforms.*
- *To acquire knowledge in finding in inverse Laplace transform techniques.*
- *To study the double and triple integrations and its applications.*
- *To know the basics of vector calculus along with classical theorems involving them.*
- *To understand the concepts of analytic functions, conformal mapping and bilinear transformations.*

UNIT - I LAPLACE TRANSFORMATION [12]

Laplace transforms – Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse functions – Initial and final value theorems Transform of periodic functions.

UNIT - II INVERSE LAPLACE TRANSFORMATION [12]

Inverse Laplace transforms – Convolution theorem (excluding proof) – Solution of linear ordinary differential equations of second order with constant coefficients.

UNIT - III MULTIPLE INTEGRALS [12]

Double integration – Cartesian coordinates – Change of order of integration – Triple integration in Cartesian co-ordinates – Area as double integral – Volume as triple integral.

UNIT - IV 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 – Simple problems involving cubes and rectangular parallelopipeds.

UNIT - V ANALYTIC FUNCTIONS [12]

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proof) – Harmonic functions – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w= z+c, cz, 1/z and bilinear transformations.

Total (L: 45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Understand the fundamentals of Laplace transform and its applications.
CO2: Interpret the concepts of Inverse Laplace transforms and solving linear ODE.
CO3: Evaluate the area of the surface and volume using double and triple integrations.
CO4: Acquire the basics of vector calculus *and its applications.*
CO5: Understand and apply the concepts of analytic functions, conformal mapping and bilinear transformations.

Text Book :

1. Ravish R Singh and Mukul Bhatt, Engineering Mathematics II, McGraw Hill Publications, New Delhi,1st Edition, 2014,

Reference Books :

1. Grewal B.S, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company, New Delhi, 9th Edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India, 7th Edition, 2015.
3. Bali N. P and Manish Goyal,Text book of Engineering Mathematics, Laxmi Pub.(p) Ltd.,6th Edition, 2011.

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SEMESTER – II

		L	T	P	C
16PH243	**MATERIALS PHYSICS (Common to EC & EE)**	3	0	0	3

Prerequisite: *Knowledge in Engineering Physics*

Objectives:

- *To Explore the concepts of conducting materials through classical and quantum approach.*
- *To Describe the theory of intrinsic semiconducting materials and Extrinsic semiconducting materials.*
- *To Understand the fundamental concepts behind the magnetic, dielectric and modern engineering materials.*

UNIT – I CONDUCTING MATERIALS [9]

Conductors – Classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann –Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi function – Density of energy states – Carrier concentration in metals.

UNIT – II INTRINSIC SEMICONDUCTING MATERIALS [9]

Band theory of solids- Crystalline structure- Imperfection in semiconducting crystals – Effective mass of an electron – Properties – Types of semiconductors, elemental and compound semiconductors – Intrinsic semiconductors – carrier concentration – Fermi energy level- variation of Fermi level with temperature – Law of mass action in semiconductors - Electrical conductivity – Band gap determination.

UNIT – III EXTRINSIC SEMICONDUCTING MATERIALS [9]

Extrinsic semiconductor – P- type and N – type semiconductor – Carrier concentration, Fermi energy level, Variation of Fermi level with temperature, Electrical conductivity– Drift & diffusion current – Continuity equation - Hall effect – determination of Hall voltage – Experimental determination of Hall co-efficient - Applications .

UNIT – IV MAGNETIC AND DIELECTRIC MATERIALS [9]

Origin of magnetic moment – Bohr magneton – Dia, Para, Ferro and Anti ferromagnetism and its properties - Domain theory– Hysteresis – Soft and Hard magnetic materials – Applications (Qualitative). Dielectrics – Dielectric constant – Polarization in dielectrics – Electronic, Ionic, Orientational and Space charge polarizations (Derivation for polarizability) – Internal or local field- Clausius – Mosotti equation – Dielectric loss - Applications .

UNIT – V MODERN ENGINEERING MATERIALS [9]

Metallic glasses: Preparation, properties and applications - Shape memory alloys (SMA): characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA-Nanomaterials: synthesis – solgels – pulsed laser deposition - properties of nanoparticles and applications - Bioglasses.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Comprehend the basics of conducting materials and to determine the states of the electron in its associated energy level.

CO2: Perceive the preambles, several characteristics of intrinsic semiconductors.

CO3: Perceive the preambles, characteristics of extrinsic semiconductors and to conceive the Hall effect along with its applications.

CO4: Categorize the magnetic materials for various applications based on their properties and employing the advanced concepts of dielectrics in electronic appliances.

CO5: Apply the techniques for manufacturing of modern engineering materials.

Text Books :

1. Dr.G. Senthil Kumar," Engineering Physics" – II, VRB Publishers Pvt. Ltd., 2011.
2. Dr. P. Mani, "Engineering Physics – II', Dhanam Publications, 2012.

References :

1. G. Senthilkumar and N. Iyandurai, Engineering Physics, VRB Publications Ltd, Chennai, 2008.
2. Dr. P. Mani, Engineering Physics – II, Dhanam Publications, 2015.
3. V. Rajendran," Engineering Physics,' Tata McGraw Hill, 2011.
4. M.N. Avadhanulu and P.G.Kshirsagar, A Text Book of Engineering Physics, S. Chand & Co, New Delhi, 2005.
5. www.fadooengineers.com.

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SEMESTER - II

		L	T	P	C
16CY254	**ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to All Branches)**	3	0	0	3

Prerequisite *: No prerequisite are needed for enrolling into the courses*

Objectives:

- *To impart knowledge on the principle of environmental science and engineering.*
- *To understand the usages of natural resources, ecosystem and biodiversity.*
- *To create awareness on pollution, value education, population growth and social issues.*

UNIT - I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES [9]

Environment – definition, scope and importance, need for public awareness; Forest resources – use, over exploitation, deforestation, mining, dams and their effects on forests and tribal people; Water resources – use, over utilization of surface and ground water, floods, drought, conflicts over water; Mineral resources – use, exploitation, environmental effects of extracting and using mineral resources ; Food resources - world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity; Role of an individual in conservation of natural resources.

UNIT - II ECOSYSTEMS AND BIODIVERSITY [9]

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers, forest ecosystem and aquatic ecosystems (Estuary and marine ecosystem); Food chain, food web, energy flow in the ecosystem, ecological pyramids – ecological succession ; Biodiversity – introduction, definition – types (Genetic – species – ecosystem diversity); Values of biodiversity; Hot-spots of biodiversity; Threats to biodiversity; Endangered and endemic Species of India; Conservation of biodiversity – I*n-situ* and E*x-situ* conservation of biodiversity.

UNIT - III ENVIRONMENTAL POLLUTION [9]

Pollution – introduction and different types of pollution; Causes, effets and control measures of air pollution, water pollution – BOD and COD (Definition and significance), DO and its détermination by Winkler's method- waste water treatment methods ; Primary, secondary and tertiary treaments. Thermal pollution – noise pollution – nuclear pollution (Nuclear wastes, nuclear accident and nuclear holocaust); Solid waste management – causes, effects and control measures of urban and industrial waste; Hazardous waste –medical and e-wastes.

UNIT - IV SOCIAL ISSUES AND ENVIRONMENT [9]

Urban problems related to energy; Water conservation – rain water harvesting and watershed management; Resettlement and rehabilitation; Environmental ethics – Issues and possible solutions; Climate change – global warming and its effects on flora and fauna, acid rain, ozone layer depletion; Wasteland reclamation ; Environment protection act – air (Prevention and control of pollution) act, water (Prevention and control of pollution) Act, wildlife protection act and forest conservation act; Issues involved in enforcement of environmental legislation. Disaster Management- earth quake, cyclone, tsunami, disaster preparedness- response and recovery from disaster.

UNIT - V HUMAN POPULATION AND ENVIRONMENT [9]

Sustainable development – from unsustainable to sustainable development – 12 Principles of green chemistry – environmental impact assessment (EIA) ; Human population – population growth and variation among nations; Population explosion; Family welfare programme and family planning; Environment and human health; Human rights; Value education – HIV / AIDS ; Women and child welfare; Role of information technology in environment and human health.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: *Play an important role in conservation of resources for future generation.*
CO2: *Paraphrase the importance of ecosystem and biodiversity*
CO3: *Analyze the impact of pollution and hazardous waste in a global and societal context*
CO4: Understand contemporary issues that result in environmental degradation that would attempt to provide solutions to overcome the problems
CO5: Consider issues of environment and human population in their professional undertakings

Text Books :

1 Anubha Kaushik and C. P. Kaushik, Environmental Science and Engineering, New Age International Publishers, 14th Edition, 2014.
2 *Dr. T. Arun Luiz, Environmental Science and Engineering, S.Chand & Co.Pvt.Ltd.,1st Edition, 2016.*

Reference Books :

1 G. Tyler Miller, Jr, Environmental Science,Thomson-South western, 11th Edition, 2007.
2 Raman Sivakumar, Introduction to Environmental Science and Engineering, Tata McGraw Hill Education Pvt., Ltd., 4th Edition 2012.
3 Dara S. S., A Text Book of Environmental Chemistry and Pollution Control, S. Chand & Co., 10th Edition, 2005

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SEMESTER - II

		L	T	P	C
16EE215	**ELECTRIC CIRCUIT ANALYSIS**	3	1	0	4

Prerequisite: *Engineering Mathematics (algebraic equation, integral and differential calculus)*

Objectives:

- *To familiarize with basic concepts related to network reduction techniques and network theorems*
- *To gain knowledge about the solution of single phase and three phase circuits*
- *To impart knowledge on series resonance circuits, magnetic and coupled circuits*

UNIT - I DC CIRCUITS [12]

Basic Definitions – Circuit Terminologies - Ohm's Law & its Limitations – Kirchhoff's Laws – Resistors in Series and Parallel circuits – Voltage and Current division Techniques- Mesh Current and Node Voltage Methods.

UNIT - II REDUCTION TECHNIQUES AND NETWORK THEOREMS [12]

Source Transformation – Star Delta Conversion – Thevenin's Theorem - Norton Theorem – Superposition Theorem – Maximum Power Transfer Theorem – Reciprocity Theorem (DC Circuits only).

UNIT - III AC FUNDAMENTALS [12]

Characteristics of Sinusoids – Average and RMS Value –Form Factor – Peak Factor- Phase Difference - Phasor Representation - Concept of Impedance and Admittance - Purely Resistive Circuit - Purely Inductive Circuit - Purely Capacitive Circuit – Series RL, RC and RLC Circuit : Phasor diagram - Voltage Triangle, Impedance Triangle, Power Factor, Power Triangle.

UNIT - IV THREE PHASE CIRCUITS AND RESONANCE [12]

Three Phase Circuits**:** Advantages of Three Phase System - Star and Delta Connected Balanced and Unbalanced Loads – Two Wattmeter Method of Power Measurements. Series Resonance Circuit : Phasor Diagram – Properties – Variation of X_L, X_C, R and Z with Frequency - Q Factor - Half-Power Frequencies - Selectivity – Bandwidth.

UNIT - V MAGNETIC CIRCUITS AND COUPLED CIRCUITS [12]

Magnetic Circuits : Terminology– Composite and Parallel Magnetic Circuits - Leakage Flux and Fringing – Permanent Magnet and Electromagnet - Faraday's Laws- Lenz Law – Statically and Dynamically Induced EMF - Coupled Circuits: Self and Mutual Inductance – Coefficient of Coupling – Dot Convention.

Total (L:45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Solve the direct current DC electric circuits using basic concepts and fundamental laws.
CO2: Apply various network reduction techniques, including network theorems for simplifying the electric circuits
CO3: Illustrate about AC fundamentals
CO4: Describe three phase circuits, resonance circuits.
CO5: Describe the various types of magnetic circuits, coupling circuits.

Text Books :

1 Sudhakar, A. and Shyam Mohan S.P., Circuits and Network Analysis and Synthesis, Tata McGraw Hill Publishing Company Limited, New Delhi, Fourth Edition, 2010
2 Mahadevan K. and Chitra C., Electrical Circuit Analysis, PHI Learning Pvt. Ltd, First Edition, 2015.

Reference Books :

1 Charles K.Alexander, Matthew N.O.Sadiku, Fundamentals of Electric Circuits, McGraw Hill, Fifth Edition, 2013
2 William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill publishers, New Delhi, Seventh Edition, 2010.
3 Chakrabarti A, Circuit Theory (Analysis and Synthesis), Dhanpat Rai & Co, New Delhi, Sixth Edition, 2004
4 Nagrath I.Jand Kothari D. P., Electric Machines, Tata McGraw Hill Publishing Company Ltd, Fourth Edition, 2012.

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SEMESTER - II

		L	T	P	C
16EE216	**POWER PLANT ENGINEERING**	3	0	0	3

Prerequisite: *Knowledge on Basics of Civil and Mechanical Engineering*

Objective:

- *To acquaint the students with* basic concepts and layouts of various conventional and non-conventional power plants.

UNIT - I THERMAL AND NUCLEAR POWER PLANTS [9]

Indian Energy Scenario - various components of steam power plant - layout - coal handling and ash handling systems - Electrostatic Precipitator - Forced draft and induced draft fans - Nuclear reactor types : pressurized water reactor, boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor - layout.

UNIT - II HYDEL POWER PLANTS [9]

Hydel power plant classifications - essential elements, selection of water turbines, selection of site for a hydel power plant - layout – dams – pumped storage power plants - micro hydel developments.

UNIT - III GAS AND DIESEL POWER PLANTS [9]

Fuels - gas turbine material, open and closed cycle gas turbine, work output and thermal efficiency, methods to improve performance - combined cycle - types of diesel engine power plant - components and layout.

UNIT - IV SOLAR AND WIND ENERGY [9]

Solar radiation – availability, measurement and estimation – solar thermal conversion devices and storage – solar cells and photovoltaic conversion systems - Basic principles of wind energy conversion – components of wind energy conversion systems – types.

UNIT - V CHEMICAL, OCEAN AND GEOTHERMAL ENERGY [9]

Fuel cell – working principle and design of fuel cell – ocean thermal electric conversion and its types - tidal power plants - geothermal resources - introduction to biomass energy. **(Principles and working only)**

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recall the layout, working principle of steam and nuclear power plant.
CO2: Describe the working principle and operation of typical hydel power plants.
CO3: Explain the operation of gas and diesel power plants.
CO4: Recall the basic concepts and layouts of solar and wind energy.
CO5: Discuss the concepts of chemical, ocean, geothermal and biomass energy sources.

Text Books :

1 P.K. Nag, Power Plant Engineering, Tata McGraw Hill, Third Edition, 2010.
2 G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, Fourth Edition, 2000.

Reference Books :

1 Raja, A.K., Amit Prakash Srivastava, Manish Dwivedi, Power Plant Engineering, New Age International, First Edition, 2012.
2 Philip Kiameh, Power Generation Handbook, Tata McGraw Hill, Third Edition, 2013.
3 Dr. P.C. Sharma, A Textbook of Power Plant Engineering, S.K. Kataria and Sons, Edition: Revised 2013, Reprint 2015.
4 B.H. Khan, Non Conventional Energy Resources, Tata McGraw Hill, Second Edition, 2009.

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SEMESTER - II

		L	T	P	C
16GE228	**PHYSICS AND CHEMISTRY LABORATORY (Common to All Branches)**	0	0	3	2

Prerequisite: *Knowledge in Engineering Physics, Chemistry and Materials science.*

Objectives:

- To gain the practical knowledge and hands on experiences of understanding the physics concepts applied in materials science, properties of matter and solar cell.
- To gain knowledge in utilizing electrochemical methods by using analytical equipment and quantitative procedures.

List of Experiments in Physics Laboratory

1. Determination of Young's modulus of the material of a uniform bar by non – uniform bending method.
2. Determination of Band gap energy of a semiconductor.
3. Determination of Viscosity of a given liquid by Poiseuille's method.
4. Torsional pendulum - Determination of rigidity modulus of a given wire.
5. V-I Characteristics of solar cell.

List of Experiments in Chemistry Laboratory

1. Conductometric Titration – Strong Acid V_s Strong Base.
2. Conductometric Titration – Mixture of Weak and Strong Acids.
3. Conductometric Titration – Precipitation, $BaCl_2$ V_s Na_2SO_4.
4. Estimation of Ferrous ion by Potentiometry – Fe^{2+} V_s $K_2Cr_2O_7$.
5. Estimation of Hydrochloric Acid by pH metry.
6. Estimation of Iron by Spectrophotometry.

Total : 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Confer the experimental counterparts of materials properties such as modulus, solar cell, and energy gap.

CO2: Imbibe the concept of capillary action in fluid dynamics and to compare the coefficient of viscosity of the given liquid.

CO3: Gain practical knowledge in determining the strength of a solution in a given solution by conductometric titration methods.

CO4: Get conceptual knowledge in estimating the concentration of Iron in solution by electrochemical methods.

CO5: Determine the role of pH in quantitative analysis of a solution.

Text Books :

1. Physics Lab manual, Department of Physics, K.S.R. College of Engineering.
2. Chemistry Lab Manual, Department of Chemistry, K.S.R. College of Engineering.

Reference Books :

1. Dr.G.Senthilkumar, Physics Lab manual, VRB Publications Pvt. Ltd., 2006.
2. Advanced Practical Physical Chemistry by J.B. Yadav, GOEL Publishing House.
3. Advanced Practical Inorganic Chemistry by Gurdeep Raj, GOEL Publishing House.

Note:

- **A minimum of five experiments shall be offered in chemistry laboratory.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**

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SEMESTER - II

		L	T	P	C
16EE221	**ELECTRIC CIRCUIT ANALYSIS LABORATORY**	0	0	3	2

Prerequisite: *No Prerequisite needed for enrolling into the course*

Objective:

- To impart hands on experience to understand various network theorems, concept of resonance and transient response in electric circuits.

List of Experiments:

1. Simulation and Real time verification of Kirchhoff's Voltage and Current Laws.
2. Simulation and Real time Verification of Thevenin's and Norton's Theorems
3. Simulation and Real time Verification of Superposition Theorem.
4. Simulation and Real time Verification of Maximum Power Transfer Theorem.
5. Simulation and Real time verification of Reciprocity Theorem.
6. Simulation and Real time determination of frequency response of RL & RC circuit.
7. Design and Simulation of Series and Parallel Resonant Circuits.
8. Simulation of Series RL and RC Transients.
9. Experimental determination of time constant of series RL, RC circuits.
10. Experimental determination of power in a three phase circuits by Two-Wattmeter Method.

Use personal computers to solve and analyze the real time solution of electrical circuits with simulated results.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Accomplish fundamental experiments relating electrical circuits using electric instruments such as multimeters, power supplies, signal generators, and oscilloscopes.

CO2: Validate in actual practice of essential circuit theorems such as Thevenin, Norton's, Superposition, Maximum Power Transfer and Reciprocity with its usefulness.

CO3: Envisage and compute the transient and sinusoidal steady-state responses of simple RL, RC and RLC circuits.

CO4: Determine the solution of three phase circuits with balanced loads using Two-Wattmeter Method.

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SEMESTER - II

		L	T	P	C
16AU027	**ENGINEERING GRAPHICS LABORATORY (Common to CS,EC, EE & IT)**	0	0	3	2

Prerequisite: *No prerequisites are needed for enrolling into the course*

Objective:

- *To develop skill for using software to create 2D and 3D models.*

List of Experiments:

1. Study of basic tools, commands and coordinate system (absolute, relative, polar, etc.) used in 2D software.
2. Draw the conic curves and special curves by using AutoCAD.
3. Draw the front view, top view, side view of objects from the given pictorial view.
4. Draw the projections of straight lines.
5. Draw the projections of polygonal surface.
6. Draw the projections of simple solid objects.
7. Draw the sectional view and the true shape of the given section.
8. Draw the development of surfaces like prism, pyramids, cylinders and cone.
9. Draw the isometric projections of simple solids, truncated prism and pyramids.
10. Draw the isometric projections of cylinder and cone.

LIST OF EQUIPMENT (For a batch of 30 Students)

SL. No.	Name of the Equipment	Qty.
1.	Pentium IV computer or better hardware, with suitable graphics facility	30 Nos.
2.	Licensed software for drafting and modeling	15 Nos.
3.	Laser Printer or Plotter to print / plot drawings	2 Nos.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: *Construct various plane curves.*
CO2: *Do orthographic projection of lines and plane surfaces.*
CO3: *Draw projections of solids and development of surfaces.*
CO4: Prepare isometric sections of simple solids.
CO5: Develop the section of solids and surfaces.

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SEMESTER - II

		L	T	P	C
16HR251	**CAREER DEVELOPMENT SKILLS I (Common to all Branches)**	-	2	-	-

Prerequisite: *No prerequisites are needed for enrolling into the course*

Objective:

- To help individuals cope with continued changes in the world of work
- To help individuals understand their unique abilities, interests, and aptitudes.

UNIT - I SPOKEN ENGLISH [6]

Basic Rules of Grammar – Parts of Speech – Tenses – Verbs-Sentence construction – Vocabulary – idioms & Phrases – Synonyms –Antonyms – Dialogues and Conversation –Exercise(Speaking)

UNIT - II ESSENTIAL COMMUNICATION [6]

Verbal communication – Effective Communication – Active Listening – Paraphrasing – Feedback, Non Verbal Communication – Body language of Self and Others, Importance of feelings in communication – Dealing with feelings in communication Practice – Exercise

UNIT - III WRITTEN COMMUNICATION – PART 1 [6]

Usage of noun, pronoun, adjective (Comparative Forms), Verb, Adjectives, Adverb, Tenses, Articles and Preposition - Change of Voice - Change of Speech - One Word Substitution - Using the same word as different parts of Speech - Odd Man Out - Spelling & Punctuation (Editing)

UNIT - IV WRITTEN COMMUNICATION – PART 2 [6]

Analogies - Sentence Formation - Sentence Completion - Sentence Correction - idioms & Phrases -Jumbled Sentences, Letter Drafting (Formal Letters) - Reading Comprehension(Level 1) – Contextual Usage - Foreign Language Words used in English – Exercise

UNIT - V ORAL COMMUNICATION – PART 1 [6]

Self Introduction - Situational Dialogues / Role Play (Telephonic Skills) - Oral Presentations- Prepared -'Just A Minute' Sessions (JAM) - Presentation Skills - Exercise

Course Outcomes: ***On Completion of this course, the student will be able to***

CO1: Have competent knowledge on grammar with an understanding of its basic rules
CO2: *Communicate effectively and enhance interpersonal skills with renewed self-confidence*
CO3: *Construct sentence in English and make correction.*
CO4: *Perform oral communication in any formal situation*
CO5: *Develop their LSRW skills.*

Total = 30 Periods

Reference Books :

1 Anne Laws, Writing Skills, Orient Black Swan., Hyderabad, 2011.
2 Raj N Bakshmi, English Grammar Practice, Orient Black Swan., Hyderabad, 2009.
3 Sarah Freeman, Written Communication in English, Orient Black Swan., Hyderabad, 2015.
4 Thakur K B Sinha, Enrich Your English, Vijay Nicole., Chennai, 2005

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SEMESTER - III

16MA333	**DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Prerequisite: *No prerequisites are needed for enrolling into the course*

Objectives:

- *To acquire knowledge in solving partial differential equations.*
- *To understand and solving the polynomial and transcendental equations.*
- *To study the Interpolation concepts and solving first order differential equations.*
- *To study the concepts of numerical differentiation and integration.*
- *To solve ordinary differential equations and boundary value problems by numerical techniques.*

UNIT - I PARTIAL DIFFERENTIAL EQUATIONS [12]

Formation of partial differential equations-Lagrange's linear equation-- Homogeneous Linear Partial Differential Equations of second and higher order with constant coefficients.

UNIT - II SOLUTION OF EQUATIONS [12]

Solutions to polynomials and transcendental equations – Newton's method– Solutions to simultaneous linear equations – Gauss Elimination – Gauss-Seidel method.

Solving first order Ordinary Differential Equations by Taylor series method **-** Euler method and Modified Euler Method for first order equation – fourth order Runge-Kutta for solving first order equations.

UNIT - III INTERPOLATION AND APPROXIMATION [12]

Newton's forward and backward difference interpolation techniques (equal intervals) – Lagrange's interpolation and Divided difference method for solving unequal intervals- Cubic Splines.

UNIT - IV NUMERICAL DIFFERENTIATION AND INTEGRATION [12]

Numerical differentiation using Newton's forward and backward interpolation methods only – Numerical integration by trapezoidal and Simpson's 1/3rd and 3/8th rules – Double integrals using trapezoidal and Simpson's rules.

UNIT - V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS [12]

Finite difference solution of second order ordinary differential equation - Finite difference solution of one dimensional heat equation by explicit method – One dimensional wave equation and two dimensional Laplace and Poisson equations.

Total (L: 45 T: 15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Understand and apply the concepts of partial differential equations.

CO2: Solve polynomial, transcendental equations, simultaneous linear equations numerically and to solve ordinary differential equations numerically.

CO3: Apply the Interpolation techniques.

CO4: Develop their skills in numerical differentiation and integration.

CO5: Understand and apply the concepts of numerical solutions to boundary value problems.

Text Books :

1. Dr. B.S.Grewal, Numerical Methods in Engineering and Science, Khanna Publishers, New Delhi, 9th Edition, 2014.
2. Veerarajan.T, Engineering Mathematics, Tata McGraw Hill Publications, New Delhi, 3rd Edition, 2015.

Reference Books :

1. Sukhendu Dey and Shishir Gupta,Numerical Methods, Tata Mc Graw Hill Publishing Company, 1st Edition, 2015.
2. Dr. M.K. Venkataraman,Numerical Methods in Science and Engineering,National Publishing Co.,12th Edition, 2012.
3. Ramana .B.V, Higher Engineering Mathematics, Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2nd Edition, 2013.

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SEMESTER - III

16EE312	**ELECTRO MAGNETIC THEORY**	L	T	P	C
		3	1	0	4

Prerequisite: *Engineering Mathematics*

Objectives:

- *To impart knowledge on the concepts of Vector algebra in the electromagnetic field context.*
- *To discuss about the concepts of electrostatics, magnetostatics and time varying fields.*
- *To get familiar with Maxwell's equations.*
- *To study the concepts of electromagnetic waves and Poynting vector.*

UNIT - I INTRODUCTION [12]

Sources and effects of electromagnetic fields – Scalar and Vector fields – Different Co-ordinate Systems: Rectangular, Cylindrical and Spherical – Relationship between Coordinate systems - Vector Calculus – Gradient, Divergence and Curl – Divergence theorem - Stoke's theorem.

UNIT - II ELECTROSTATICS [12]

Coulomb's Law - Electric field intensity (E) - Field due to point and continuous charges – Electric field due to finite line charge, circular disc and infinite sheet of charge, two concentric shells and coaxial cylinders - Electric flux density (D) - Gauss's law and its applications - Electrical potential -Electric field in dielectric and equipotential plots - Electric Dipole, Electric field in multiple dielectrics -Boundary conditions between dielectric media, Poisson's and Laplace's equations – Capacitance -energy density.

UNIT - III MAGNETOSTATICS [12]

Lorentz Law of force, magnetic field intensity (H) - Biot-Savart's Law - Ampere's Law - Magnetic field intensity due to straight conductors, infinite sheet of current, at the centre of the toroid, along the axis of the circular loop and solenoid - Magnetic flux density (B) – Magnetic materials - Magnetization - Magnetic field in multiple media - Boundary conditions – Magnetic Scalar and vector potential - Magnetic force - Torque - Inductance - Energy density.

UNIT - IV ELECTRODYNAMIC FIELDS [12]

Faraday's laws, Induced EMF - Transformer and Motional EMF, Maxwell's Equations (differential and integral forms) – Conduction and Displacement Current – Continuity Equation of Current – Ohm's law in point form - Relation between field theory and circuit theory.

UNIT - V ELECTROMAGNETIC WAVES [12]

Generation - Electro Magnetic Wave equations - Wave parameters; velocity, intrinsic impedance, propagation constant – uniform plane wave and its properties - Waves in free space, lossy and lossless dielectrics, conductors - skin depth, Poynting vector and Poynting Theorem.

Total (L:45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Apply the spatial variations of physical quantities by using various co ordinate systems and to determine divergence, curl.
CO2: CO2: Apply basic laws of electrostatics to various applications and to determine force, electric field intensity.
CO3: CO3: Evaluate magnetic vector quantities, inductance and energy densities of various cables.
CO4: CO4: Analyze the electromagnetic fields from the basics of Maxwell's equations.
CO5: CO5: Analyze the electromagnetic wave propagation in different media using Poynting vector and theorem.

Text Books :

1 Mathew N. O. Sadiku, Elements of Electromagnetics, Oxford University Press, Fifth Edition, 2010.
2 William.H.Hayt, Engineering Electromagnetics,Tata McGraw Hill, Seventh Edition,2008.

Reference Books :

1 K.A.Gangadhar, Field Theory, Khanna Publishers, New Delhi, Fifth Edition, 2003.
2 S.P. Ghosh and Lipika Datta, Electromagnetic Field Theory, Tata McGraw Hill Educational Private Limited New Delhi, First Edition, 2012.
3 Joseph.A.Edminister, Thoery and problems of Electromagnetics, Schaum Series, Tata McGraw Hill, Second Edition, 1993.
4 David J.Griffiths, Introduction to Electrodymanics, Pearson Education, Fourth Edition, 2014.

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SEMESTER - III

16EE313	**MEASUREMENTS AND INSTRUMENTATION**	L	T	P	C
		3	0	0	3

Prerequisite : *Electric circuit Analysis*

Objectives:

- *To introduce the general instrument system, error, calibration, principles governing the operation of the instrument and the working of electrical and electronics instruments.*
- *To elaborately discuss about the resistance, inductance, capacitance and frequency measurements using bridges.*
- *To get familiarized with various transducers, modern data acquisition system.*
- *To elaborately discuss about the working of storage & display devices.*

UNIT - I INTRODUCTION [9]

Measurement – Instruments - Functional elements of an instrument – Static characteristics – Dynamic characteristics – Errors, Uncertainity in errors –Statistical evaluation of measurement data – Measurement Standards – Calibration methods.

UNIT - II ELECTRICAL AND ELECTRONICS INSTRUMENTS [9]

Principle and Operation of analog meters: Voltmeter, Ammeter and Multimeter – Energy meters: Single phase energy meter, Three phase energy meter - Wattmeters: Induction, electro-dynamometer type – Magnetic characteristics – Determination of BH curve – Measurement of iron loss - Instrument transformers.

UNIT - III BRIDGE MEASUREMENTS [9]

Potentiometers: A.C, D.C potentiometers – Measurement of Resistance: Kelvin Double Bridge, Wheatstone bridge, Megohm bridge – Measurement of inductance: Maxwell's bridge, Anderson bridge – Measurement of Capacitance: Schering Bridge, Desauty's bridge – Determination of frequency using Wein bridge.

UNIT - IV TRANSDUCERS AND DATA ACQUISITION SYSTEMS [9]

Classification of transducers: Resistive transducers, Inductive transducers, Capacitive Transducers, Piezoelectric transducer, Optical and digital transducers – Elements of data acquisition system - A/D, D/A converters – Smart sensor.

UNIT - V STORAGE AND DISPLAY DEVICES [9]

Recorders: Strip chart, X-Y recorders - Digital Plotters – CRO – Digital Storage Oscilloscope - LED - LCD – Dot matrix display – Data loggers.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the functional elements of instruments, their errors, characteristics, various standards and calibration.
CO2: Describe the various electrical and electronics instruments.
CO3: Evaluate unknown R, L, C and frequency using bridges and potentiometers.
CO4: Discuss the various types of transducers, ADC, DAC, sensors and their applications.
CO5: *Explain the working concepts of storage and display devices.*

Text Books :

1 E.O.Doebelin, Measurement Systems Application and Design, Tata Mc.Graw Hill, Fifth Edition, 2015.
2 A.K.Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Co, Nineteenth Edition, 2011.

Reference Books :

1 H.S.Kalsi, Electronic Instrumentation, Tata McGraw Hill, Third Edition, 2012.
2 A.J.Bowens, Digital Instrumentation, Tata McGraw Hill , Third Editon, 1986.
3 J.B.Gupta, A Course in Electronic and Electrical Measurements, S.K.Kataria and Sons, Delhi, Fourteenth Edition, 2014
4 D.V.S.Moorthy, Transducers and Instrumentation, Prentice Hall of India Pvt Ltd, Second Edition, 2007
5 H.S.Kalsi, Electronic Instrumentation, Tata McGraw Hill, Third Edition, 2012.

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SEMESTER - III

		L	T	P	C
16EE314	**ELECTRON DEVICES AND CIRCUITS**	3	0	0	3

Prerequisite: *Engineering Physics*

Objective:

- *To acquaint the students with construction, theory and characteristics of the semiconductor devices like p-n junction diode, Bipolar transistor, Field effect transistor, LED, LCD and other photo electronic devices*.

UNIT - I PN DIODE AND ITS APPLICATIONS [9]

PN junction diode: VI characteristics – Dynamic Resistance – Temperature effects on diode characteristics – Drift and diffusion currents – Switching characteristics – Rectifiers: Half Wave Rectifier, Full Wave Rectifier , Bridge Rectifier – Types of filters: Inductive filter, Capacitive filter, LC filter, π section filter – Zener diode: VI characteristics, Regulators (series and shunt) – Characteristics and application of Photo diode, LED, LCD.

UNIT - II BJT AND ITS APPLICATIONS [9]

Transistor Construction - Detailed study of current in transistor - CB, CC and CE Configurations – Input and Output Characteristics – Switching characteristics – hybrid parameters: voltage gain, current gain, input impedance and output impedance. Comparison of transistor configurations –Transistor as an amplifier–Characteristics and applications of Photo transistor – Opto couplers.

UNIT - III FET AND ITS APPLICATIONS [9]

JFET - Basic operation – MOSFET : Enhancement and Depletion mode - operation and characteristics - Application of FET as Voltage Variable Resistor – CMOS , BICMOS, SOI CMOS :Operation and Characteristics.

UNIT - IV AMPLIFIERS AND OSCILLATORS [9]

Differential amplifiers: Common Mode and Difference Mode – Common Mode Rejection Ratio – Feedback amplifiers : Barkhausen criterion – Gain with feedback – General characteristics of negative feedback amplifiers – Voltage /current, series / shunt feedback – Input and output resistances – Power Amplifiers – Oscillators: LC, RC, Crystal.

UNIT - V PULSE CIRCUITS [9]

RC wave shaping circuits : Differentiator and Integrator – Diode clampers and clippers – Multivibrators : Astable and Monostable – Schmitt trigger – Uni Junction Transistor (UJT): Construction ,Characteristics and relaxation oscillators.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the construction and working principle of different types of diodes and their applications.
CO2: Discuss the various configurations of BJT and their applications.
CO3: Describe the working principle of JFET, MOSFET and CMOS along with their applications.
CO4: Discuss the working of various types of amplifiers and oscillator circuits.
CO5: Explain the operation of different types of wave shaping circuits and pulse circuits.

Text Books :

1 S. Salivahanan, N. Suresh Kumar, Electronic Devices and Circuits, Tata McGraw Hill, Second Edition, 2011
2 David. A. Bell, Electronic Devices and Circuits, PHI Learning Private Ltd, India, Fourth edition, 2008.

Reference Books :

1 R.S.Sedha, AText Book of Applied Electronics, S.Chand and Company Ltd, Third Revised Edition, 2006.
2 Theodre F.Boghert, Electronic Devices & Circuits, Pearson Education, Sixth Edition, 2003.
3 Theodore F. Bogart Jr., J.S. Beasley and G. Rico, Electronic Devices and Circuits, Pearson Edition, Sixth Edition, 2004.
4 B.P.Singh & Rekha Sing, Electronic Devices and Integrated Circuits, Pearson Education, First Edition, 2006.
5 Robert T. Paynter, Introductory Electronic Devices and Circuits, PHI Learning Private Ltd, India, Seventh Edition, 2006.

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SEMESTER -III

		L	T	P	C
16EE315	**NETWORK ANALYSIS AND SYNTHESIS**	3	0	0	3

Prerequisite: Mathematics(algebraic equation, integral and differential calculus), Electric Circuit Analysis

Objectives:

- *To analyze the RL, RC, LC and RLC series circuits for different loading conditions with different inputs*
- *To get knowledge about complex frequency and pole zero concepts*
- *To gain knowledge about one port and two port networks and filters*
- *To synthesis the RL and RC circuits*

UNIT - I TIME RESPONSE OF CIRCUITS [9]

Time response of RL, RC, LC and RLC series circuits for zero input, step and sinusoidal inputs using Laplace Transform method.

UNIT - II APPLICATION OF COMPLEX FREQUENCY AND POLE– ZERO CONCEPTS [9]

Concept of complex frequency, Complex Impedance and Admittance- Poles and Zeros of network function, significance of pole and zero, Time domain response from pole - zero configuration, frequency response from pole- zero configuration.

UNIT - III ONE PORT AND TWO PORT NETWORKS [9]

Driving Point Impedance and Admittance of One Port Networks - Open Circuit Impedance and Short Circuit Admittance of Two Port Networks- Transfer Impedance and Admittance - Voltage and Current Ratio Transfer Functions- ABCD Parameters- Image Impedance, Equivalent Networks.

UNIT - IV FILTERS [9]

Characteristics of Ideal Filters - Low Pass, High Pass and Band pass Filters - Attenuation and Phase Shift- Constant K and M - Derived Filters.

UNIT - V ELEMENTS OF NETWORK SYNTHESIS [9]

Reliability of One Port Networks- Hurwitz Polynomials- PR function- Necessary and sufficient conditions of PR function- Properties of Driving Point Impedance- Synthesis of RL and RC Driving Point Impedance and solve problems.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Analyze the transient response of RL, RC, LC and RLC series circuits
CO2: Infer the knowledge about complex frequency and pole zero concept.
CO3: Explain the concepts of one port and two port networks
CO4: Design different types of filters
CO5: Synthesize RL and RC networks

Text Books :

1 Ravish R. Singh, Network Analysis and Synthesis, Tata McGraw Hill, 2013.
2 ShyamMohan S.P., Sudhakar A, “Circuits and Network Analysis & Synthesis”, Tata McGraw Hill, 2007.

Reference Books :

1 Arumugam .M and Premkumar .N, Electric Circuit Theory, Khanna & Publishers, 1989.
2 Soni M.L and Gupta J.C,Electrical Circuit Analysis, Dhanpat Rai and Sons, Delhi, 1990
3 Chakrabarti A, Circuit Theory (Analysis and Synthesis), Dhanpat Rai & Co, New Delhi, Sixth Edition, 2004
4 Mahadevan K. and Chitra C., Electrical Circuit Analysis, PHI Learning Pvt. Ltd, First Edition, 2015.

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SEMESTER - III

		L	T	P	C
16CS346	**OBJECT ORIENTED PROGRAMMING WITH C++ (Common to CS & EE)**	3	0	0	3

Prerequisite: *Basic knowledge of C Programming*

Objectives:

- *To understand the concepts of Object Oriented Programming*
- *To gain thorough knowledge in programming with C++.*

UNIT - I BASICS OF OOPS [9]

Object oriented programming concepts –Object oriented Vs Procedure oriented – Benefits – Applications – Introduction to C++ – Data types-operators – Classes –Objects – Default arguments – Static member functions – Static data members– Const member functions – Pointers to member functions – Local classes.

UNIT - II CONSTRUCTORS AND INHERITANCE [9]

Constructors – Default constructor – Parameterized constructors – Constructor with dynamic allocation – Copy constructor – Destructors – Inheritance – Derived class – Types of Inheritance – Single inheritance – Multilevel inheritance – Multiple inheritance – Hierarchical and Hybrid inheritance – Virtual base classes – Abstract class .

UNIT - III POLYMORPHISM AND TYPE CONVERSIONS [9]

Polymorphism – Compile time polymorphism: Function overloading – Operator overloading – Unary operator overloading – Binary operator overloading – Rules for operator overloading – Run time polymorphism: Virtual functions – Pure virtual function - Type conversions.

UNIT - IV CONSOLE I/O OPERATIONS AND FILE HANDLING [9]

C++ streams –Stream classes – Unformatted I/O operations –Formatted console operations – Managing output with Manipulators –Files: Opening and closing a file – Detecting end-of-file –– File pointers and Manipulations – Sequential I/O operations – Updating a File – Error handling in File operations.

UNIT - V TEMPLATES, EXCEPTION HANDLING AND STL [9]

Class Templates–Function Templates–Exception Handling–Throwing mechanism–Catching mechanism–Rethrowing Exception – Specifying Exceptions–Introduction to STL– Components of STL– Containers – Algorithms–Iterators.

Total =45 Periods

Course Outcomes: On completion of this course, the student will be able to

CO1: Determine the needs of object oriented programming.
CO2: Demonstrate the concepts of class and objects.
CO3: Demonstrate the concepts of operator overloading and inheritance.
CO4: Demonstrate the concepts of polymorphism and file streams.
CO5: Design of Templates, Exception Handling and STL.

Text Books :

1 Robert Lafore, Object Oriented Programming in-C++, Galgotia Publication, Fourth Edition, 2014 UNIT – I,II,III,IV)

2 E.Balagurusamy, Object Oriented Programming with C++, The McHill Sixth Edition,2013(UNIT V)

References:

1 B. Trivedi, “Programming with ANSI C++”, Oxford University Press, 2007

2 Deitel&Deitel, C++ How to Program, Prentice Hall, Ninth Edition 2014

3 K.R. Venugopal, Rajkumar and T.Ravishankar, Mastering C++, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006.

4 http://nptel.ac.in/courses/106103115/36.

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SEMESTER - III

		L	T	P	C
16EE321	**MEASUREMENTS AND INSTRUMENTATION LABORATORY**	0	0	3	2

Prerequisite: *Knowledge on Basic Electrical and Electronics Engineering*

Objective:

- *To train the students with the electrical and electronic instruments and to provide hands-on-experience on transducers using MATLAB and LabVIEW software.*

List of Experiments:

1. Calibration of Three - phase energy meter.
2. Measurement of Resistance using Wheatstone bridge and Kelvin's bridge
3. Measurement of Inductance using Maxwell's bridge and Anderson bridge.
4. Measurement of Capacitance using Schering's bridge and Desauty's bridge.
5. Measurement of frequency, peak-peak voltage , mean voltage and time period using Digital Storage Oscilloscope.
6. Measurement of displacement using LVDT.
7. Measurement of temperature using thermistor.
8. Analog to Digital Conversion.
9. Digital to Analog Conversion.
10. Simulation of Wheatstone bridge using MATLAB.
11. Temperature Measurement System using LabVIEW.
12. Pressure Measurement System using LabVIEW.

Total : 45 Periods

Course Outcomes: ***On Completion of this course, the student will be able to***

CO1: Estimate the energy for the given three- phase energy meter.
CO2: Determine the unknown resistance, inductance and capacitance using bridges.
CO3: Examine the operation of digital storage oscilloscope for different input signals.
CO4: Determine the unknown displacement and temperature using LVDT and thermistor.
CO5: Perform analog to digital to analog conversion and digital conversion for given inputs.
CO6: *Apply MATLAB for Wheatstone bridge simulation and LabVIEW software for temperature, pressure measurement.*

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SEMESTER - III

		L	T	P	C
16EE322	**ELECTRON DEVICES AND CIRCUITS LABORATORY**	0	0	3	2

Prerequisite: *Engineering Physics*

Objective:

- *To study the characteristics of various semiconductor devices and to analyze and design oscillators, pulse circuits employing semiconductor diodes, BJT, UJT devices.*

List of Experiments:

1. Simulation and real time verification of V-I Characteristics of Semiconductor diode and Zener diode
2. Simulation and real time verification of Single phase half wave and full wave rectifiers with inductive and capacitive filters
3. Characteristics of Transistor under common emitter configuration
4. Characteristics of Transistor under common collector configuration
5. Characteristics of Transistor under common base configuration
6. Characteristics of Photo diode and Phototransistor
7. Simulation and real time verification of V-I Characteristics of FET
8. Hartley and RC Phase shift Oscillator
9. Simulation and real time verification of Diode Clippers and Diode Clampers
10. Astable and Monostable multivibrators using BJT
11. Schmitt Trigger using BJT
12. Simulation and real time verification of V-I Characteristics of UJT and UJT Oscillator

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Analyze and simulate the characteristics of semiconductor diode
CO2: Understand the characteristics of different configurations of transistors
CO3: Examine the characteristics of photo diode and photo transistor.
CO4: Acquire the basic knowledge in different characteristics of Junction field effect transistor and simulate respectively.
CO5: Gain knowledge about the different types of clipper and clamper circuits
CO6: Determine the different ON and OFF periods for the various types of multivibrator circuits.

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SEMESTER - III

		L	T	P	C
16CS327	**OBJECT ORIENTED PROGRAMMING WITH C++ LABORATORY (Common to CS & EE)**	0	0	3	2

Prerequisite : *Basic Knowledge in C Programming*

Objective:

- *To provide solutions for the real world problems using object oriented concepts*

List of Experiments:

1. Write a C++ program for adding two numbers using class and object.
2. Write a C++ program for counting function calls using static members.
3. Write a C++ program for finding volume of cylinder using default arguments.
4. Write a C++ program for calculate the area of circle, rectangle and triangle using function overloading.
5. Write a C++ program for adding two complex numbers using friend function and operator overloading.
6. Write a C++ program for calculating factorial of a given number using copy constructor.
7. Write a C++ program for string manipulation using dynamic constructor.
8. Write a C++ program to read and display of student details using multiple and multilevel inheritance.
9. Write a C++ program to read and display of book details using virtual function (run-time polymorphism).
10. Write a C++ program for handling divide by zero exception using exception handling.
11. Write a C++ program to swap the numbers using the concept of function template.
12. Write a C++ program for adding two numbers using class template.

Total : 45 Periods

Course Outcomes: On completion of this course, the student will be able to

CO1: Develop simple programs using class and objects concepts.
CO2: Demonstrate the concepts of constructors, destructors and inheritance.
CO3: Demonstrate the concepts of operator overloading and function overloading
CO4: Develop programs the concepts of polymorphism
CO5: Develop code segments using templates and exception handling.

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SEMESTER - III

		L	T	P	C
16HR352	**CAREER DEVELOPMENT SKILLS II (Common to all branches)**	-	2	-	-

Prerequisite: *No prerequisites are needed for enrolling into the course.*

Objectives:

- *To enhance employability skills and to develop career competency.*
- *To help individuals develop a realistic understanding of themselves in regard to decision making and career alternatives.*

UNIT - I VERBAL REASONING – PART 1 [6]

Analogies - Alphabet Test - Theme Detection - Family Tree - Blood Relations (Identifying relationships among group of people) - Coding & Decoding - Situation Reaction Test – Statement & Conclusions.

UNIT - II SPEED MATHS AND QUANTITATIVE APTITUDE [6]

Think Without Ink(TWI) Approach - Speed Math's: Squaring of Numbers - Multiplication of Numbers - Finding Square Roots - Finding Cube Roots - Solving Simultaneous Equations Faster – Number System: HCF, LCM - Decimals - Percentages - Averages - Powers and Roots - Sudoku (level 1) - Series Completion (Numbers, Alphabets, Pictures) - Odd Man Out – Puzzles.

UNIT - III QUANTITATIVE APTITUDE – PART 1 [6]

Problem on Ages - Percentages - Profit and Loss - Simple & Compound Interest - Averages - Ratio, Proportion.

UNIT - IV QUANTITATIVE APTITUDE – PART 2 [6]

Speed, Time & Work and Distance - Pipes and Cisterns - Mixtures and Allegations - Races - Problem on Trains - Boats and Streams Practices: Puzzles, Sudoku, Series Completion, Problem on Numbers.

UNIT - V WRITTEN COMMUNICATION & READING COMPREHENSION [6]

What is Writing - Sentence - Phrase - Kinds of Sentences - Parts of Sentence - Parts of Speech - Articles - Types of Sentences - Academic Essay Writing - Precise Writing - Report Abstracts - Letter Writing - Memo - Cover Letter - Resume writing.

READING SKILLS : Importance of Reading - Definition of Reading - Levels of Reading - Requirements of Reading - Types of Reading - Techniques of Reading - Academic Reading Tips – Exercise.

Total = 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Speak and write appropriately by understanding and applying the basic grammatical rules.
CO2: Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
CO3: Enhance their communication skills and instructiveness.
CO4: Enhance interpersonal relationship building skills with self-confidence
CO5: Critically evalvate various real life situation by resorting to analysis of key issues and factors.

Reference Books:

1 Aggarwal, R.S.A Modern Approach to Verbal and Non-verbal Reasoning, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.

2 Abhijit Guha, Quantitative Aptitude, TMH, 3rd Edition.

3 Objective Instant Arithmetic by M.B. Lal & Goswami Upkar Publications.

4 Word Power Made Easy by Norman Lewis W.R. GOYAL Publications

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SEMESTER - IV

		L	T	P	C
16EE411	**ELECTRICAL MACHINES - I**	3	0	0	3

Prerequisite: *Electro Magnetic Theory*

Objectives:

- *To study the working principles of electrical machines using the concepts of electromechanical energy conversion.*
- *To study the constructional details of DC Machines, working principle and their performance.*
- *To familiarize with the constructional details of different types of transformers, working principle and their performance.*
- *To study the performance of D.C. machines and transformers the different testing methods.*

UNIT - I BASIC CONCEPTS IN ROTATING MACHINES [9]

Generated EMF in AC and DC machines - MMF of distributed AC windings – Rotating magnetic fields – Torque in round rotor machine – Magnetic leakage in rotating machines.

UNIT - II DC GENERATORS [9]

Constructional details – Principle of operation - EMF equation – Simple problems - Methods of excitation – Types of DC generators - Losses and efficiency – Simple problems – Armature reaction - Commutation - Characteristics of DC generators - Applications of DC Generators.

UNIT - III DC MOTORS [9]

Principle of operation - Back EMF – Simple problems – Types of DC motor – Torque equation, Losses and efficiency – Simple problems – Characteristics DC motors – Speed control of DC series and shunt motor - Necessity of a starter - Types of starters – Applications of DC motors.

UNIT - IV TRANSFORMERS [9]

Constructional details: Shell type and Core Type – principle of operation – EMF equation – Simple problems – Transformation ratio – Equivalent circuit – losses, Efficiency and Regulation – Rating of transformer – Auto transformer – Three phase transformer connections.

UNIT - V TESTING OF DC MACHINES AND TRANSFORMERS [9]

Testing of DC machines: Brake test, Swinburne's test, Retardation test, Hopkinson's test and Field's test for series motor - Testing of transformers: load test, open circuit and short circuit tests.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Discuss the basic concepts in rotating machines.
CO2: Explain the construction and operating performance of DC generator.
CO3: Describe the operating principle, performance, starting and speed control of DC motor.
CO4: Demonstrate the construction, working principle and performance of transformers.
CO5: Employ various testing methods to analysis the performance of DC machines and transformers.

Text Books :

1 Nagrath I. J and Kothari D. P., Electric Machines, Tata McGraw Hill Publishing Company Ltd, Fourth edition, Fifth Reprint 2012.
2 B.L.Theraja and A.K.Theraja, A Text Book of Electrical Technology, S.Chand Publishing, First multicolor edition 2005, Reprint 2015.

Reference Books :

1 A.E. Fitzgerald, Charles Kingsely Jr, Stephen D.Umans, Electric Machinery, McGraw Hill Books Company, Seventh edition, 2013.
2 K. Murugesh Kumar, Electric Machines, Vikas publishing house Pvt Ltd, First edition, 2003.
3 P.S. Bhimbhra, Electrical Machinery, Khanna Publishers, Seventh edition, 2013.
4 Samarajit Ghosh, Electrical Machines, Pearson Education, Second edition, 2012.

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SEMESTER - IV

		L	T	P	C
16EE412	**TRANSMISSION AND DISTRIBUTION**	3	0	0	3

Prerequisite: *Electro Magnetic Theory*

Objectives:

- *To develop expression for computation of line parameters and develop equivalent circuits for the same.*
- *To analyze the voltage distribution in insulator strings and cables and methods to improve the same.*
- *To analyze the mechanical design of lines, substations and grounding systems.*

UNIT - I INTRODUCTION [9]

Structure of electric power system: Generation, Transmission and Distribution - Types of AC and DC distributors: 2-wire and 3-wire, Radial and Ring main distribution; Distributed and Concentrated loads - HVDC and EHV AC systems

UNIT - II TRANSMISSION LINE PARAMETERS [9]

Parameters of Single and Three phase transmission lines with Single circuits: Resistance, Inductance and Capacitance of solid, stranded and bundled conductors: Symmetrical and Unsymmetrical spacing and Transposition - application of Self and Mutual GMD- Skin and Proximity effects.

UNIT - III MODELLING AND PERFORMANCE OF TRANSMISSION LINES [9]

Classification of lines: Short line, Medium line and Long line; Equivalent circuits, Attenuation constant, Phase constant, Surge impedance- Transmission efficiency and Voltage regulation - Real and Reactive power flow in lines - Ferranti effect and Corona loss.

UNIT - IV INSULATORS AND CABLES [9]

Insulators: Types, Voltage distribution in insulator string and grading, improvement of string efficiency. Underground cables: Introduction-Types of cables, Capacitance of Single-core cable, Grading of cables, Capacitance of 3- core belted cable, Constructional features of LT and HT cables.

UNIT - V MECHANICAL DESIGN OF LINES AND SUBSTATION SCHEMES [9]

Mechanical design of transmission line – sags and tension calculations for different weather conditions. Types of substations; Bus-bar arrangements; Substation bus schemes: Single bus scheme, Double bus with double breaker, Double bus with single breaker, Main and Transfer bus, Ring bus, Breaker and-a-half with two main buses, Double bus-bar with bypass isolators.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Describe about power system components.
CO2: Categorize the transmission line parameters for the different conductor arrangements.
CO3: Estimate the performance of various transmission lines and determine the line constants.
CO4: Illustrate the construction of different types of line insulator and cables.
CO5: Design a transmission line for different weather condition and able to identify different types of substation

Text Books :

1 C.L.Wadhwa, Electrical Power Systems, New Age International Pvt. Ltd, Third Edition, 2010.
2 S.N.Singh, Electric Power Generation Transmission and Distribution, Prentice Hall of India Pvt. Ltd, Second Edition, 2011.

Reference Books :

1 B.R.Gupta,Power System Analysis and Design, S.Chand Publishing, Third Edition, 2008.
2 D.P.Kothari,I.J.Nagarath,Power System Engineering, Tata McGraw-Hill Publishing Company Ltd, Second Edition, 2007.
3 Hadi Saadat, Power System Analysis, Tata McGraw Hill Publishing Company, Third Edition, 2010.
4 K.R.Padiyar, HVDC Power Transmission Systems, New Age International Pvt. Ltd, First Edition, 2007.

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SEMESTER - IV

		L	T	P	C
16EE413	**ANALOG INTEGRATED CIRCUITS**	3	0	0	3

Prerequisite : *Electron Devices and Circuits*

Objectives:

- *To Impart knowledge on the IC fabrication procedure*
- *To study the characteristics and applications of Op-amp*
- *To study working of special ICs like Timers, PLL circuits*
- *To introduce a few special functions integrated circuit*

UNIT – I IC FABRICATION [9]

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, monolithic transistors and FETs.

UNIT – II CHARACTERISTICS OF OPAMP [9]

Ideal OP-AMP characteristics. DC characteristics, AC characteristics, offset voltage and current, frequency response of OP-AMP, voltage series feedback and shunt feedback amplifiers, Differential amplifier,

UNIT – III APPLPICATIONS OF OPAMP [9]

Basic applications of op-amp – summer, differentiator and integrator, Instrumentation amplifier, first and second order active filters, V/I & I/V converters, Comparators, Multivibrators, sine wave generator, triangular wave generator, peak detector, S/H circuit, D/A converter, R-2R ladder and Weighted resistor types, A/D converter – flash type and successive approximation.

UNIT – IV TIMER AND PLL ICs [9]

Astable and Monostable multivibrators using 555 Timer, applications-missing pulse detector, pulse width modulation and FSK generator, 566-voltage controlled oscillator circuit, 565-phase lock loop circuit functioning and applications – frequency multiplication/division, frequency translation and AM detection.

UNIT – V SPECIAL FUNCTION ICs [9]

IC Voltage regulators- 78xx/79xx, LM317, 723 Regulators, switching regulator, LM 380 power amplifier, ICL 8038 function generator IC, isolation amplifiers, Opto-coupler, fiber optics ICs.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Classify the IC's and illustrate the IC fabrication process.
CO2: Analyze the DC and AC characteristics of OP-Amp.
CO3: Discuss the various Applications of Op-Amp.
CO4: Describe the working principle of IC 555 timer and PLL with their applications.
CO5: Explain the operation and types of regulator IC, Power amplifier IC, Function Generator IC , etc.

Text Books :

1 Ramakant A.Gayakward, Op-amps and Linear Integrated Circuit, Pearson Education, Sixth Edition, 2009.
2 D.Roy Choudhary and Shell B.Jani, Linear Integrated Circuits, New Age International, Fourth Edition, 2012.

Reference Books :

1 Jacob Millman and Christos C.Halkias, Integrated Electronics – Analog and Digital circuits system, Tata McGraw Hill, Second Edition, 2011.
2 Robert F.Coughlin and Fredrick F.Driscoll, Op-amp and Linear Integrated Circuits, Pearson Education, Sixth Edition, PHI. 2002.
3 David A. Bell, Op-amp & Linear ICs, Oxford University Press India, Third Edition , 2011.
4 Gray and Mayer, Analysis and design of Analog Integrated Circuits, Wiley International, Fifth Edition, 2009.

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SEMESTER - IV

		L	T	P	C
16EE414	**DIGITAL ELECTRONICS**	3	1	0	4

Prerequisite: *Electron Devices and Circuits*

Objectives:

- *To study various number systems and to simplify the mathematical expressions using Boolean functions*
- *To study the combinational circuits and design of various synchronous and asynchronous circuits*
- *To expose the students to various memory devices.*

UNIT - I BOOLEAN ALGEBRA [12]

Number Systems – Conversions - Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions – Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don't care conditions – Quine -McCluskey method of minimization

UNIT - II DIGITAL INTEGRATED CIRCUITS [12]

Logic Gates - Implementations of Logic Functions using gates - Design procedure : Half and Full Adder, subtractor Parallel binary adder – Multiplexer and Demultiplexer – encoder and decoder – parity generator and checker –code converters

UNIT - IV SYNCHRONOUS SEQUENTIAL CIRCUITS [12]

Latches, Flip-flops: SR, JK, D, T, and Master-Slave – Characteristic table and equation – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops –Synchronous up / down counters – Design of Synchronous sequential circuits: state diagram- State table –State minimization –State assignment - Excitation table and maps - Circuit implementation - Shift Registers - Analysis of Synchronous Sequential Circuits.

UNIT - III ASYNCHRONOUS SEQUENTIAL CIRCUITS [12]

Design of fundamental mode circuits – Design of Asynchronous Sequential Circuits – Design of Hazard Free Switching circuits. Use of Algorithmic State Machine - Design of Combinational and Sequential circuits

UNIT - V MEMORY DEVICES [12]

Classification of memories – ROM - RAM – Static and Dynamic RAM - Programmable Logic Devices - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL.

Total (L: 45 T: 15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Recall various number systems and apply Boolean laws, karnaugh map to simplify the switching functions.
CO2: Design various combinational circuits using logic gates and interpret the information using binary codes.
CO3: Design and analyze the various synchronous sequential circuits using flip-flops.
CO4: Design and implement the asynchronous sequential circuits
CO5: Classify the different memories using logic devices and Programmable Logic Devices.

Text Books :

1 Raj Kamal, Digital systems-Principles and Design, Pearson education, Second Edition, 2009.
2 M. Morris Mano, Digital Design, Pearson Education, Fifth Edition, 2013.

Reference Books :

1 Charles H.Roth, Fundamentals Logic Design, Jaico Publishing, Sixth Edition, 2010.
2 Floyd and Jain, Digital Fundamentals, Pearson Education, Eighth Edition, 2005.
3 John F.Wakerly, Digital Design Principles and Practice, Pearson Education, Third Edition, 2012.
4 Tocci, Digital Systems : Principles and applications, Pearson Education, Tenth Edition, 2011

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SEMESTER - IV

		L	T	P	C
16EE415	**SIGNALS AND SYSTEMS**	3	1	0	4

Prerequisite: *Engineering Mathematics*

Objectives:

- *To study and analyze the characteristics of continuous signals and systems.*
- *To study and analyze the characteristics of discrete signals and systems.*

UNIT - I CONTINUOUS TIME (CT) AND DISCRETE TIME (DT) SIGNALS [12]

Signal representation – Basic operations on signals - Types of signals: CT complex exponential and sinusoidal signals, DT complex exponential and sinusoidal signals, CT unit impulse and unit step function, DT unit impulse and unit step sequence –.Classification of signals : Signal Energy and Power –- Periodic signals – Even and Odd signals - Random signals.

UNIT - II CONTINUOUS TIME SYSTEMS [12]

Properties of continuous time systems – Representation of continuous time Linear Time Invariant (LTI) systems using differential equations – Block diagram representation - Convolution integral – unit step and unit impulse response of LTI system - Analysis of LTI systems using Laplace transform.

UNIT - III FOURIER SERIES ANALYSIS [12]

Fourier series representation of continuous time periodic signals – Trigonometric Fourier series - Exponential Fourier series – Convergence of Fourier series – Gibbs Phenomenon - Properties of continuous time Fourier series.

UNIT - IV CONTINUOUS TIME FOURIER TRANSFORM [12]

Continuous Time Fourier transform – Existence of Fourier transform – Fourier transform of standard signals - Properties of continuous time Fourier transform – Analysis of continuous time LTI systems using Fourier transform.

UNIT - V DISCRETE TIME FOURIER TRANSFORM [12]

Discrete Time Fourier Transform (DTFT) – Properties of DTFT – Time and frequency shifting – Conjugation - Parseval's relation - Frequency Response of first order LTI system – Inverse DTFT.

Total (L:45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Analyze the properties of Continuous and Discrete time signals.
CO2: Examine the LTI CT systems using Laplace transform.
CO3: Solve problems on CT Fourier series.
CO4: Transform Continuous time aperiodic signals using Fourier transform.
CO5: Discuss the concepts of Discrete Time Fourier Transform.

Text Books :

1 Alan V Oppenheim, Alan S. Wilskey and Hamid Nawab.S, Signals and Systems, Pearson Education , Second Edition, 2015.
2 Anand Kumar.A, Signals and Systems, PHI Publications, Third Edition, 2013.

Reference Books :

1 Krishnaveni V. and Rajeswari A., Signals & System, Wiley India Pvt.Ltd , First Edition, 2012.
2 Rodger Ziemer.E, William Tranter.H and Ronald Fannin.D, Signals and Systems-Continuous and Discrete, Pearson Education, Fourth Edition, 2015.
3 Gabel.R.A and Richard.R.A, Signals and Linear Systems, John Wiley and sons, Third edition 1995.
4 Gordan E Carlson, Signals and Linear Systems Analysis, John Wiley and sons, Second Edition, 1998.

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SEMESTER - IV

		L	T	P	C
16CS436	**DATA STRUCTURES AND ALGORITHMS**	3	0	0	3

Prerequisite: *Basic Knowledge of C Programming*

Objectives:

- *To learn the concepts of linear data structures and its applications(Linked list, Stack and Queue)*
- *To understand the design and applications of non-linear data structure(Trees and Graphs)*
- *To understand the various techniques in algorithm design*

UNIT - I LINEAR STRUCTURES [9]

Abstract Data Types (ADT) – List ADT – Array based implementation – Linked list implementation– Doubly linked lists – Applications of lists – StackADT – Queue ADT – Implementation of Stack and Queue using Array and Linked list – Applications of stacks and Queues.

UNIT - II TREE STRUCTURES [9]

Tree ADT – Tree traversals – Left child right sibling data structures for general trees – BinaryTree ADT – Expression trees – Applications of trees – Binary search tree ADT –Insertion, Deletion, Find Min & Max.

UNIT - III BALANCED TREES SPACE AND HASHING [9]

AVL Trees – B-Tree – B+ Tree – Heaps – Binary heaps – Applications of binary Heaps –Hashing – Separate Chaining – Open Addressing – Linear Probing.

UNIT - IV GRAPHS [9]

Definition – Topological sort –BreadthFirst traversal – Shortest path algorithms – Minimum Spanning tree– Prim's and Kruskal's algorithms – Depth first traversal – Bi connectivity – Euler circuits –Applications of graphs

UNIT - V ALGORITHM DESIGN AND ANALYSIS [9]

Algorithm analysis – Asymptotic notation – Recurrences – Greedy algorithms – Divide and Conquer –Dynamic programming – Back tracking – Branch and Bound.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Know the concept of list ADT and its implementation.
CO2: Gain the knowledge in binary, binary search tree with its operations.
CO3: Describe the concept of AVL tree, B tree and B+tree.
CO4: Apply shortest path and minimum spanning tree algorithm.
CO5: Describe the concept of Greedy algorithms.

Text Books :

1 M. A. Weiss, Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 2015.

Reference Books :

1 V. Aho, J. E. Hopcroft, and J. D. Ullman, Data Structures and Algorithms, Pearson Education,First Edition, Reprint 2003.
2 R. F. Gilberg, B. A. Forouzan, Data Structures, Second Edition, Thomson India, 2005
3 SartajSahni, Data Structures, Algorithms and Applications in C++, Sartaj Publishers, Second Edition, Universities Press, 2005.
4 A.K. Sharma, Data Structures using C, First Edition, Pearson Education, 2011.
5 http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html

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SEMESTER - IV

		L	T	P	C
16EE421	**ELECTRICAL MACHINES LABORATORY - I**	0	0	3	2

Prerequisite: *Electro Magnetic Theory*

Objective:

- To expose the students to the operation and testing of D.C machines, transformers and give the experimental skills

List of Experiments:

1. Open circuit and load characteristics of separately excited DC generators.
2. Open circuit and load characteristics of self-excited DC shunt generators.
3. Load characteristics of DC compound generator with differential and cumulative connection.
4. Load characteristics of DC shunt motor.
5. Load characteristics of DC compound motor.
6. Load characteristics of DC series motor.
7. Swinburne's tests on DC shut motor.
8. Speed control of DC shunt motor.
9. Load test on single phase transformer.
10. Open circuit and short circuit tests on single phase transformer.
11. Three phase transformer connection.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Analyze the performance of the separately excited and self-excited DC generators.
CO2: Estimate the performance of the series, shunt and compound DC motors.
CO3: Analyze the performance of transformers
CO4: Employ the various speed control techniques for DC motor.
CO5: Demonstrate the different three phase transformer connections.

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SEMESTER - IV

		L	T	P	C
16EE422	**ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY**	0	0	3	2

Prerequisite: *Electron Devices and Circuits Laboratory*

Objective:

- *To study various digital and linear Integrated circuits used in simple system*

List of Experiments:

1. Design an inverting & non-inverting op-amp.
2. Design the applications of op-amp: Adder, Comparator, Integrator & Differentiator.
3. Design a Schmitt trigger using op-amp.
4. Design an Astable & Monostable multivibrator using NE/SE 555 timer.
5. Perform the analysis of voltage regulator using 78XX/79XX
6. Design an optocoupler and power amplifier using LM380.
7. Design and implement a parity generator and checker.
8. Design and implement the following code converter: BCD to Excess -3, Binary to Gray, Gray to Binary.
9. Design and implement a MUX and DE-MUX.
10. Design and implement an encoder and a decoder.
11. Simulate a synchronous & asynchronous counter using VHDL programming.
12. Simulate a shift register using VHDL programming.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Design and construct the applications using op-amp.
CO2: Design an astable and monostable multivibrator using NE/SE 555 timer and analyze the voltage regulators.
CO3: Construct an optocoupler and power amplifier using LM380.
CO4: Design and implement the combinational circuits using logic gates.
CO5: Simulate a Combinational and Sequential circuits using VHDL programming.

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SEMESTER - IV

		L	T	P	C
16CS426	**DATA STRUCTURES AND ALGORITHMS LABORATORY**	0	0	3	2

Prerequisite: *Basic Knowledge of C Programming*

Objective:

- *To develop programming skills in design and implementation of data structures and their applications*

List of Experiments:

1. Singly and doubly linked lists.
2. Linked list application: Polynomial Representation – Addition, Subtraction.
3. Infix to postfix expression conversion and evaluation using stack.
4. Implementation of Queue.
5. Expression tree - preorder, inorder, and postorder traversals.
6. Implementation of Binary search tree.
7. Insertion and Deletion in AVL trees.
8. Implementation of Merge sort.
9. Implementation of Prim's algorithm.
10. Implementation of Kruskal's algorithm.

Total : 45 Periods

Course Outcomes: On completion of this course, the student will be able to:

CO1: Implement the concept of singly and doubly linked list
CO2: Know the applications of stack and queue
CO3: Understand balanced tree concepts
CO4: Know how to find the shortest path
CO5: Find the minimum spanning tree

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SEMESTER - IV

		L	T	P	C
16HR453	**CAREER DEVELOPMENT SKILLS III**	-	2	-	-

Prerequisite: *No prerequisites are needed for enrolling into the course*

Objectives:

- *To provide the opportunity for individuals to become acquainted with a wide range of occupational and educational opportunities.*
- *To assist individuals in making appropriate educational and occupational choices.*

UNIT - I WRITTEN AND ORAL COMMUNICATION – PART 1 [6]

Reading Comprehension Level 3 - Self Introduction - News Paper Review - Self Marketing - Debate- Structured and Unstructured GDs Psychometric Assessment – Types & Strategies to answer the questions Practices: Sentence Completion - Sentence Correction - Jumbled Sentences - Synonyms & Antonyms - Using the Same Word as Different Parts of Speech - Interpretation of Pictorial Representations - Editing

UNIT - II VERBAL & LOGICAL REASONING – PART 2 [6]

Syllogism - Assertion and Reasons - Statements and Assumptions - Identifying Valid Inferences - identifying Strong Arguments and Weak Arguments - Statements and Conclusions- Cause and Effect - Deriving Conclusions from Passages - Seating Arrangements Practices: Analogies - Blood Relations - Statement & Conclusions

UNIT - III QUANTITATIVE APTITUDE – PART 3 [6]

Probability - Calendar- Clocks - Logarithms - Permutations and Combinations

UNIT - IV QUANTITATIVE APTITUDE – PART 4 [6]

Algebra - Linear Equations - Quadratic Equations – Polynomials - Problem on Numbers - Ages - Train - Time and Work - Sudoku – Puzzles

UNIT - V DOMAIN PROFICIENCY [6]

Instrumentation: Storage Devices and Transducers. Construction and operation of Electrical machines, Electrodynamic fields and field equation solution, Introduction to Non conventional energy sources.

Total = 30 Periods

Course Outcomes**: **On Completion of this course, the student will be able to

CO1: *Understand the nuances of leading various text.*
CO2: *Understand and develop the etiquette necessary to present oneself in a professional setting.*
CO3: *Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.*
CO4: *Enhance the comprehension Skills in core subjects.*

Reference Books :

1 Aggarwal, R.S. A Modern Approach to Verbal and Non-verbal Reasoning, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.
2 Abhijit Guha, Quantitative Aptitude, TMH, 3rd Edition.
3 Objective Instant Arithmetic by M.B. Lal & Goswami Upkar Publications.
4 Word Power Made Easy by Norman Lewis W.R. GOYAL Publications.

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SEMESTER - V

		L	T	P	C
16EE511	**ELECTRICAL MACHINES - II**	3	0	0	3

Prerequisite: *Electro Magnetic Theory, Electrical Machines – I*

Objectives:

- *To study the theory and performance characteristics of three-phase Induction machines and Synchronous machines.*
- *To understand the starting methods and speed control of three-phase induction motors.*
- *To study the working principles of different types of single-phase induction motors.*

UNIT - I THREE PHASE INDUCTION MOTOR [9]

Constructional details - Types of rotors - Principle of operation - Slip - Equivalent circuit - Torque equations - Slip-torque characteristics - Need for starter - Types of starters: Rotor resistance, autotransformer and star-delta starters - Crawling and cogging - Double cage rotors.

UNIT - II PERFORMANCE ANALYSIS AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR [9]

Losses and efficiency - Load test - No load and blocked rotor tests - Circle diagram - Separation of no load losses - Speed control: Change of voltage, number of poles and slip - Slip power recovery scheme.

UNIT - III SINGLE PHASE INDUCTION MOTORS [9]

Constructional Details of Single Phase Induction Motor - Double Revolving Field Theory - Equivalent Circuit – Types of Starting Methods: Split Phase, Capacitor Start, Capacitor Start and Run and Shaded Pole - Working Principles: Reluctance Motor, Repulsion Motor, Stepper Motor And Universal Motor - Applications

UNIT - IV ALTERNATOR [9]

Constructional details - Types of rotors - EMF equation - Synchronous reactance - Armature reaction - Voltage regulation: EMF, MMF and ZPF methods - Synchronizing and parallel operation - Synchronizing power - Change of excitation and mechanical input - Determination of X_d and X_q using slip test - Alternator on infinite Bus bar.

UNIT - V SYNCHRONOUS MOTOR [9]

Principle of operation - Torque equation - Starting methods - Operation on infinite bus bars - V and inverted V curves - Power input and power developed equations - Current loci for constant power input, constant excitation and constant power developed - Hunting - Synchronous condenser - Applications.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the constructional details, characteristics and starting methods and important phenomenon of three phase induction motor.

CO2: Demonstrate the performance and speed control methods of three phase induction motor.

CO3: Explain the construction and starting methods of single phase induction motor and special electrical machines.

CO4: Explain construction details and analyze different methods to predetermine the voltage regulation of alternator.

CO5: Illustrate the working principle, starting methods and analyze performance of synchronous motor.

Text Books :

1 Nagrath I. J and Kothari D. P., Electric Machines, Tata McGraw Hill Publishing Company Ltd, 4th Edition, 2012.

2 Samarajit Ghosh, Electrical Machines, Pearson Education, 2nd Edition, 2012.

Reference Books :

1 A.E. Fitzgerald, Charles Kingsely Jr, Stephen D.Umans, Electric Machinery, McGraw Hill Books Company, 7th edition, 2013.

2 K. Murugesh Kumar, Electric Machines, Vikas publishing house Pvt Ltd, 2003.

3 Charless A. Gross, "Electric/Machines, CRC Press, 2010

4 M.N.Bandyopadhyay, Electric Machines Theory and Practice, PHI Learning PVT LTD, New Delhi, 2009.

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SEMESTER - V

16EE512 **CONTROL SYSTEMS**

L	T	P	C
3	1	0	4

Prerequisite: *Engineering mathematics III*

Objectives:

- *To understand the methods of representation of systems concepts and to design their transfer function models.*
- *To provide adequate knowledge in the time response of systems and steady state error analysis.*
- *To accord basic knowledge of the frequency domain analysis of control systems.*
- *To understand the concept of stability of control system and methods of stability analysis.*
- *To study the controller and the three ways of designing compensation for a control system.*

UNIT - I SYSTEM CONCEPTS [12]

Types of system – Open and closed loop systems – Basic elements in control system- Transfer function – Mechanical system: Translational and Rotational Mechanical system, Hydraulic system ,Pneumatic system – Synchros - AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT - II TIME RESPONSE ANALYSIS [12]

Standard test signals – Mathematical expression for Standard test signals - Types and Order of systems- Step response of first order system and second order damping system - Time domain specification of second order under damped systems – Error coefficients - Generalized error series – Steady state error and error constants.

UNIT - III FREQUENCY RESPONSE ANALYSIS [12]

Frequency response of the system – Bode plot – Polar plot – Constant M and N circles – Determination of closed loop response from open loop response - Correlation between frequency and time response - Gain and Phase margin specifications.

UNIT - IV STABILITY OF CONTROL SYSTEM [12]

Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

UNIT - V COMPENSATOR DESIGN AND CONTROLLERS [12]

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots - P, PI, PID controllers.

Total (L: 45 T:15) =60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Obtain the transfer function of basic elements, servo motors and gain of the system represented by block diagram/signal flow graph.

CO2: Determine the time-domain behavior and steady-state error for standard test inputs.

CO3: Find the phase margin and gain margin of the system by constructing the bode plot / polar plot and determine the closed loop response of a system from its open loop response.

CO4: Examine the stability of the system by constructing the Root locus, Nyquist stability criterion, Routh Hurwitz criterion and evaluate the effect of pole, zero addition.

CO5: Design lag, lead, lag-lead compensator by using bode plot and Study of P, PI, PID controllers.

Text Books :

1 J. Nagrath and M. Gopal, Control Systems Engineering, New Age International (p) Limited, Publishers, 4th Edition, 2006.

2 Benjamin C. Kuo, Automatic Control systems, PHI Learning, Seventh Edition, 2009.

Reference Books :

1 K. Ogata, Modern Control Engineering, 5th edition, PHI, New Delhi, 2009.

2 Norman S. Nise, Control Systems Engineering, 7th Edition, John Wiley, New Delhi, 2014.

3 Smarajit Ghosh, Control systems, Pearson Education, New Delhi, 2nd Edition, 2009

4 D.Roy choudhury, Modern control engineering, Prentice Hall of India, 2nd Edition, 2005.

5 B S Manke, Linear Control Systems with MATLAB Applications, Khanna publishers, 11th Edition, 2012.

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SEMESTER - V

		L	T	P	C
16EE513	**DIGITAL SIGNAL PROCESSING**	3	1	0	4

Prerequisite: *Knowledge on Engineering Mathematics and Signals and Systems.*

Objective:

- *To acquaint the students with Discrete Time System Analysis, Filter Designs and features of TMS processor.*

UNIT - I DISCRETE TIME SYSTEM ANALYSIS [12]

Need and advantages of Digital Signal Processing – Typical DSP System: Sampling, Quantization, Quantization Error, Nyquist rate, Aliasing effect – Z-Transform and ROC – properties of Z-Transform – Inverse Z-Transform – Solution of Difference Equation using Z-Transform – Stability Analysis – Convolution using Z-Transform.

UNIT - II DISCRETE FOURIER TRANSFORM [12]

DFT: Definition and its properties – Computation of DFT and IDFT – Computation of DFT using DIT and DIF-FFT Radix 2 algorithms – Computation of IDFT using DIT and DIF FFT algorithms.

UNIT - III DESIGN OF IIR FILTERS [12]

Realization of IIR filter: Direct form I and II, cascade and parallel forms – Analog low pass filter design: Butterworth and Chebyshev – Digital filter design: Impulse invariant method and Bilinear transformation – Warping, prewarping.

UNIT – IV DESIGN OF FIR FILTERS [12]

Amplitude and Phase response of FIR filters – Linear phase characteristics – Design of FIR filters using windows: Rectangular, Triangular, Hamming and Hanning – Realization of FIR filter: Direct form, cascade and linear realization.

UNIT - V DIGITAL SIGNAL PROCESSOR [12]

Introduction – Selection of DSP processor – Application of DSP processor – Van Neumann architecture – Harvard architecture – TMS320C50 digital signal processor: Architecture, Addressing modes and Instruction set.

Total (L: 45 T:15) =60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Analyze the discrete time system and the signal processing through DSP systems.
CO2: Solve the problems on LTI using Discrete Fourier Transform.
CO3: Design IIR filters using analog and digital filter design methods.
CO4: Design FIR filters using various windowing functions.
CO5: Explain the architecture, addressing modes and instruction sets of digital signal processor.

Text Books :

1 Anand Kumar.A, Digital Signal Processing, PHI, Second Edition, 2015.
2 John G.Prokis, Dimtris G. Manolakis, Digital Signal Processing Principles, Algorithms and Application, PHI, Fourth Edition, 2011.

Reference Books :

1 Alan V. Oppenheim, Ronald W. Schafer, John R.Back, Discrete Time Signal Processing, PHI, Second Edition, 2008.
2 Johny R. Johnson, Introduction To Digital Signal Processing, Prentice Hall, 2009.
3 Tarun Kumar Rawat, Digital Signal Processing, Oxford University Press, First Edition, 2015.
4 Salivanan.S, Vallavaraj.A, Gnanapriya.C, Digital Signal Processing, Tata McGraw Hill, Second Edition, 2011.

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SEMESTER - V

16EE514	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

Prerequisite: *Digital Electronics, Analog Integrated Circuits*

Objectives:

- *To study the architecture of 8085, 8051 and ARM Processor*
- *To study the instruction set & addressing modes of 8085, 8051 and ARM Processor*
- *To develop the programming skills on 8085 and 8051*
- *To introduce commonly used peripheral / interfacing ICs*
- *To study about the applications of 8051*

UNIT - I 8085 PROCESSOR [9]

Introduction to microprocessor – Hardware architecture of 8085 – Signals – Memory interfacing – Instruction format – Instruction set and addressing modes – Assembly language programming – Stack – Timing diagram – Interrupt structure.

UNIT - II PERIPHERAL INTERFACING [9]

Study of architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Keyboard and display controller and 8253 Timer/ Counter – Interfacing with 8085 – ADC and DAC interfacing.

UNIT - III 8051 MICROCONTROLLER [9]

Functional block diagram – Data transfer, manipulation, control & I/O instructions – Addressing modes –– Interrupt structure – Timer – I/O ports – Serial communication.

UNIT - IV MICROCONTROLLER APPLICATIONS [9]

LCD interfacing – ADC and DAC interfacing – Keyboard and display interface – Stepper motor interfacing – Closed loop control of servo motor – DC motor speed control.

UNIT - V ARM PROCESSOR FUNDAMENTALS [9]

ARM Core Introduction – Registers – Current Program Status Register – Pipeline – Exception – Interrupts – Vector Table – Architecture Revisions – ARM Instruction Set – Thumb Instruction Set – Thumb Register Usage – ARM-Thumb Interworking.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Illustrate the instruction set, addressing modes and programming of 8085 microprocessor
CO2: Demonstrate the functions of different peripheral ICs and design the interfacing logic using 8085.
CO3: Explain the architecture, interrupts and addressing modes of 8051 Microcontroller.
CO4: Design and develop the interfacing circuits for various applications using 8051 Microcontroller.
CO5: Illustrate the fundamental and instruction sets in ARM processor and simple programming.

Text Books :

1 R.S.Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram International Publishing Private Ltd., Mumbai, 2013.
2 Kenneth J Ayala, The 8051 Micro controller, Thomson Delmer Learning, 3rd Edition, 2004.
3 Steve Furbe, ARM System-on-chip Architecture, Addison-Wesley Professional, Second Edition, 2000.

Reference Books :

1 William Kleitz, Microprocessor and Microcontroller fundamental of 8085 and 8051 Hardware and Software, Prentice Hall, 1st Edition, 1998.
2 Muhammad Ali Mazidi, Janice Gilli Mazidi and R.D.Kinely, The 8051 Microcontroller and Embedded Systems, PHI Pearson Education, 2009.
3 Krishna Kant, Microprocessors and Microcontrollers, PHI Learning Private Limited, New Delhi, 2013.
4 Andrew N. Sloss, Dominic Symes, Chris Wright, ARM System Developer's Guide, Morgan Kaufmann Series in Computer Architecture and Design, 2004.

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SEMESTER - V

		L	T	P	C
16EC541	**COMPUTER NETWORKS (Common to EC & EE)**	3	0	0	3

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objectives:

- *To Gain knowledge about layers in OSI and TCP/IP model*
- *To understand the concept of data link layer protocols and connecting devices*
- *To Familiarize with the addressing and routing concepts.*
- *To know about transport layer protocols and QoS enhancement methods*
- *To learn the functions of application layer protocols and network security*

UNIT - I PHYSICAL LAYER [9]

Data communications - Networks: Network criteria, connection types, network topology, network types - Network models: OSI model - TCP/IP model - Addressing - Guided and unguided transmission media – Switching: Circuit switched networks, datagram networks, virtual circuit networks - Dialup modems - DSL - Cable TV networks - Cable TV for data transfer.

UNIT - II DATA LINK LAYER [9]

Data link control: Framing, flow control and error control - Protocols: Simple protocol, stop and wait, sliding window, Go Back N, selective repeat - HDLC - Multiple access: Random access, controlled access - IEEE 802.3: Standard Ethernet, changes in the standard, fast Ethernet, gigabit Ethernet - Connecting devices: Hub, repeater, switch, bridge, router, gateway.

UNIT - III NETWORK LAYER [9]

Logical addressing: IPv4, IPv6 addresses - Internet Protocol: Internetworking, IPv4, IPv6, transition from IPv4 to IPv6 - Address mapping - Delivery - Forwarding - Routing protocols: Intra and inter domain routing, distance vector routing, link state routing, path vector routing, multicast routing protocols.

UNIT - IV TRANSPORT LAYER [9]

Transport layer services - Multiplexing and demultiplexing - User datagram protocol - Transmission control protocol - Congestion control - Quality of Service - Techniques to improve QoS.

UNIT - V APPLICATION LAYER AND NETWORK SECURITY [9]

Domain Name System (DNS) - E-mail - FTP - WWW - HTTP – Network security: Cryptography, symmetric key and public key algorithms, digital signature, management of public keys, communication security, authentication protocols.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Understand and describe the role of communication and physical layer in data networks and the Internet.
CO2: Describe the concepts of data link layer services and protocols, multiple access protocols, Ethernet protocol and various connecting devices.
CO3: Analyze the operations of the network layer protocols and also explain the fundamental concepts of routing.
CO4: Identify the purpose of transport layer protocols and services, congestion control and QoS techniques.
CO5: Describe the application layer protocols and the need for network security.

Text Books :

1 Behrouz A. Forouzan, “Data Communication and Networking”, Tata McGraw-Hill, 5th Edition, 2013.
2 Andrew S. Tannenbaum and David J. Wetherall, “Computer Networks”, Prentice Hal, 5th Edition, 2011.

Reference Books :

1 Wayne Tomasi, “Introduction to Data Communication and Networking”, Pearson Education, 1st Edition, 2007.
2 William Stallings, “Data and Computer Communications”, Pearson Education, 8th Edition, 2014.
3 James .F. Kurouse & Keith W. Ross, “Computer Networking: A Top down Approach”, Pearson Education, 5th Edition, 2012.
4 Greg Tomsho, “Guide to Networking Essentials”, Cengage Learning, 7th Edition, 2016.

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SEMESTER - V

16EC531	**BASICS OF VLSI DESIGN**	L	T	P	C
		3	0	0	3

Prerequisites: *Electronic Devices and Circuits, Digital Electronics*

Objectives:

- *To Gain knowledge about MOS technology*
- *To Learn about operation and characteristics of inverter and design rules.*
- *To Understand the concept of CMOS logic gate design and power dissipation*
- *To Gain knowledge about storage elements and different types of dynamic logic circuits*
- *To Familiarize Verilog programming concepts and coding types*

UNIT - I INTRODUCTION TO MOS CIRCUITS [9]

Chip design hierarchy - VLSI Design flow- Basic MOS transistors: Enhancement Mode transistor action, Depletion Mode transistor action-Basic steps of fabrication process of PMOS, NMOS, CMOS and Bi-CMOS- NMOS transistor current equation – second order effects.

UNIT - II NMOS & CMOS INVERTER AND LAYOUT [9]

NMOS & CMOS inverter – Determination of pull up / pull down ratios – Body effect- threshold voltage-Latchup problem in CMOS circuits- latchup prevention -Design Rules and Layout: Lambda based and 2µm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates-stick diagram.

UNIT - III CMOS LOGIC GATE DESIGN AND POWER DISSIPATION [9]

NAND and NOR gates - Complex logic gates - Tri state circuits - Large FETs - Transmission gate and pass transistor logic – Static and dynamic power dissipation.

UNIT - IV STORAGE ELEMENTS AND DYNAMIC LOGIC CIRCUITS [9]

SR latch - Bit level register - D flip flop - Dynamic D flip flop - Static RAM cell - Clocked CMOS - Dynamic logic - Domino logic - SR logic - Dynamic memories.

UNIT - V VERILOG HDL [9]

Basic concepts - Modules and ports - Structural modeling - Data flow modeling - Behavioral modeling - Switch level modeling - Test benches - Verilog code for: adders, subtractors, multiplexer, demultiplexer, encoder, decoder, priority encoder, comparator, D-Latch, D flip flop, shift register and counter.

Total=45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Describe the basics of CMOS process technology.
CO2: Classify the CMOS and NMOS logic gates design rules and Characteristics.
CO3: Design the complex logic gates and estimate the power dissipation
CO4: Describe various memory elements and types of logic design.
CO5: Model the digital system using Verilog HDL.

Text Books :

1 John P. Uyemura, "Chip Design for Submicron VLSI: CMOS layout and simulation", Cengage Learning India Private Ltd, 11th Indian Reprint 2013.
2 Samir Palnitkar, "Verilog HDL A Guide to Digital Design and Synthesis", Pearson Education,2nd Edition, 2010.

Reference Books :

1 Neil H.E. Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", Pearson Education Asia, 2nd Edition, 2005.
2 Kamran Eshraghian, Douglas A. Pucknell and SholehEshraghian, "Essentials of VLSI Circuits and Systems", Prentice Hall of India Pvt Ltd,2013.
3 Wayne Wolf, "Modern VLSI Design System-On-Chip", PHI, 3rd Edition, 2007.
4 John P. Uyemura, "Introduction to VLSI Circuits and Systems", John Wiley & Sons, reprint 2009.
5 J.Bhasker, "Verilog HDL Primer", BS publication, 3rd Edition 2005.
6 http://nptel.ac.in/courses/108101089/
7 http://nptel.ac.in/syllabus/syllabus.php?subjectId=117108041

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SEMESTER - V

		L	T	P	C
16EE521	**ELECTRICAL MACHINES - II LABORATORY**	0	0	3	2

Prerequisite: *Electrical Machines Laboratory - I*

Objective:

- *To verify experimentally the performance and characteristics of Synchronous machines and Induction machines.*

List of Experiments:

1. Load test on three-phase squirrel cage induction motor.
2. Load test on three-phase slip ring induction motor.
3. No load and blocked rotor test on three-phase induction motor.
4. Separation of no-load losses of three-phase induction motor.
5. Loss summation method on three-phase induction motor
6. Load test on single-phase induction motor.
7. Determination of equivalent circuit of single–phase induction motor.
8. Regulation of three-phase alternator by EMF and MMF methods.
9. Regulation of three-phase alternator by ZPF method.
10. Regulation of three-phase salient pole alternator by slip test.
11. Load test on three-phase alternator.
12. V and Inverted V curves of three-phase synchronous motor.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Analyze the performance of the three phase squirrel cage and slip ring induction motor.
CO2: Analyze the performance of single phase induction motor.
CO3: Analyze the performance of three phase alternator.
CO4: Predetermine the performance of three phase alternator.
CO5: *Predetermine the performance of three synchronous motor.*

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SEMESTER - V

16EE522 **CONTROL SYSTEMS LABORATORY**

L	T	P	C
0	0	3	2

Prerequisite: *Electrical Machines Laboratory - I*

Objectives:

- *To expose the students to determine the transfer function of servomotors, DC generator & motor and give them experimental skills.*
- *To expose the students in simulation of stability analysis, first order ,second order system and compensator design using MATLAB.*

List of Experiments:

1. Determination of transfer function of DC Servomotor.
2. Determination of transfer function of AC Servomotor.
3. Analog simulation of Type - 0 and Type – 1 system.
4. Determination of transfer function of DC shunt Generator.
5. Determination of transfer function of DC shunt Motor.
6. Stability analysis of linear systems using MATLAB.
7. DC and AC position control systems.
8. Stepper motor control system.
9. Digital simulation of first order systems.
10. Digital simulation of second order systems.
11. Digital simulation of lag and lead compensator design using MATLAB.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Determine the transfer function of AC, DC Servo motors and find the position of AC ,DC servomotor using controller

CO2: Examine the time domain specifications of second order type-0 and type-1 system.

CO3: Apply the Laplace transform technique to determine the transfer function of DC shunt generator and DC motor

CO4: Analyze the performance characteristics of stepper motor for different switching position

CO5: Obtain the time domain specifications of first order , second order system and design the compensator and also analyze the stability of Linear System using MATLAB

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SEMESTER - V

		L	T	P	C
16EE523	**MICROPROCESSOR AND MICROCONTROLLER LABORATORY**	0	0	3	2

Prerequisite: *Analog and Digital Integrated Circuits Laboratory*

Objective:

- To develop the programming skills on microprocessor and microcontroller

List of Experiments:

1. Programming for 8/16 bit arithmetic operations using 8085.
2. Programming with control instructions using 8085.
   a. Maximum / Minimum of numbers
   b. Ascending / Descending order
3. Programming for Hex. / ASCII / BCD code conversions using 8085.
4. Interfacing 8251, 8253 and 8279 with 8085.
5. Interfacing D/A Converters with 8085.
6. Interfacing and programming of Traffic light control with 8085.
7. Programming for 8 bit Arithmetic operations using 8051.
8. Interfacing and programming of stepper motor control using 8051.
9. Simulate stepper motor control with 8051 Microcontroller and keil software.
10. Simulate Serial Communication with 8051 Microcontroller and keil software.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the data transfer and processing and to perform basic operations using 8085 microprocessor.
CO2: Construct and develop a program to interface the peripheral IC's and with 8085 microprocessor.
CO3: Design the control word and develop the program for traffic light Control and DC motor speed Control with 8085.
CO4: Develop a program to perform basic operations, interfacing of stepper motor and DAC using 8051 microcontroller.
CO5: Design and develop a program for 8051 microcontroller using KEIL software.

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SEMESTER - V

		L	T	P	C
16HR554	**CAREER DEVELOPMENT SKILLS IV**	-	2	-	-

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objectives:

- To helps individuals in retaining valued students as they get to know about their skills and competencies and future aspirations as well
- To help individuals develop a realistic understanding of themselves in regard to decision making and career alternatives.

UNIT - I WRITTEN AND ORAL COMMUNICATION – PART 2 [6]

Self Introduction – GD - Personal Interview Skills Practices on Reading Comprehension Level 2 – Paragraph Writing - News paper and Book Review Writing - Skimming and Scanning – Interpretation of Pictorial Representations - Sentence Completion - Sentence Correction - Jumbled Sentences - Synonyms & Antonyms - Using the Same Word as Different Parts of Speech – Editing

UNIT - II QUANTITATIVE APTITUDE - PART – 5 [6]

Geometry - Straight Line – Triangles – Quadrilaterals – Circles – Co-ordinate Geometry – Cube – Cone – Sphere

UNIT - III DATA INTERPRETATION AND ANALYSIS [6]

Data Interpretation based on Text – Data Interpretation based on Graphs and Tables. Graphs Column Graphs, Bar Graphs, Line Charts, Pie Chart, Graphs representing Area, Venn Diagram & Flow Charts.

UNIT - IV RESUME WRITING & PRESENTATION SKILLS [6]

An Introduction to the Resume - Types of Resumes - Common Resume Errors - Anatomy of a Resume – What is a Cover Letter? - Types of Cover Letters - Enhancing the Language and Style of Your Resume and Cover Letter - Assessment

Presentation Skills: Oral presentation and public speaking skills; business presentations. - Understand the Situation - Know Your Tools - Know Yourself - Organize it, Write the Script – Practice - Delivering a Presentation

UNIT - V DOMAIN PROFICIENCY [6]

Competitive exam training: Fundamentals of Transmission and Distribution systems- Control systems –Basics of power Semiconductor Devices –Digital Electronics

Total = 30 Periods

On Completion of this course, the student will be able to

CO1: Perform well in personal interviews type situation.
CO2: Understand the Quantitative Aptitude problems in geometry.
CO3: Understand the data interpretation and analysis by using various graphs.
CO4: Enhance the skills in resume writing and presentation.
CO5: *Enhance skills in competitive exam training.*

Reference Books :

1 Aggarwal, R.S. “A Modern Approach to Verbal and Non-verbal Reasoning”, Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.

2 Abhijit Guha, “Quantitative Aptitude”, TMH, 3 edition

3 Objective Instant Arithmetic by M.B. Lal & GoswamiUpkar Publications.

4 Word Power Made Easy by Norman Lewis W.R. GOYAL Publications

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SEMESTER – VI

16EE611 **ELECTRICAL MACHINE DESIGN**

L	T	P	C
3	1	0	4

Prerequisite: *Electrical Machines – I and Electrical Machines – II*

Objectives:

- *To study MMF calculation and thermal rating of various types of electrical machines.*
- *To provide sound knowledge about design of various parts of DC and AC machines.*
- *To design core, yoke, windings and cooling systems of transformers.*

UNIT - I BASIC CONSIDERATION IN DESIGN [12]

Considerations and limitations in design – Specific electric and magnetic loadings – Thermal consideration – Heat flow: Conduction, Radiation and Convection – Rating of machines.

Concept of magnetic circuit – MMF calculation for various types of electrical machines – Real and apparent flux density of rotating machines – Leakage reactance calculation for transformers, induction and synchronous machine.

UNIT - II TRANSFORMERS [12]

kVA rating of single phase and three phase transformers – Relation between output and volt per turn – Choice of specific loadings – Optimum design of transformers – Design of core, yoke and windings for core and shell type transformers – Design of tank and cooling tubes of transformers.

UNIT - III D.C. MACHINES [12]

Output equation – Main dimensions – Choice of specific loadings – Choice of number of poles – Armature design – Design of air gap – Design of commutator and brushes.

UNIT - IV THREE PHASE INDUCTION MOTORS [12]

Output equation – Main dimensions – Choice of specific loadings – Design of stator – Length of air gap - Design of squirrel cage rotor – Rotor bars and slots – Design of end rings – Design of wound rotor.

UNIT - V SYNCHRONOUS MACHINES [12]

Output equation – Main dimensions – Choice of specific loadings – Short circuit ratio – Design of stator and rotor of cylindrical pole and salient pole machines – Design of damper windings – Design of field coil – Cooling of large alternators.

Total (L: 45 T:15) = 60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Apply the concept of specific loadings and MMF to design the electrical machines.
CO2: Identify the optimal design of transformer.
CO3: Design a DC machine's armature, air-gap, commutator, brushes and investigate the choice of number of poles.
CO4: Formulate the procedure to design stator and squirrel cage rotor for three phase induction machine.
CO5: *Design stator and rotor windings of salient and non salient pole machines and identify the factors for the choice of specific loading to design synchronous machine.*

Text Books :

1 A.K. Sawhney, 'A Course in Electrical Machine Design', Dhanpat Rai and Sons, New Delhi, 2015.
2 R.K. Agarwal, 'Principles of Electrical Machine Design', S.K.Kataria and Sons, Delhi, 2014.

Reference Books :

1 S.K. Sen, 'Principles of Electrical Machine Design with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.
2 V.N. Mittle and A. Mittle, 'Design of Electrical Machines', Standard Publications Distributors, Delhi, 2013.
3 M.V. Deshpande, "Design and Testing of Electrical Machines", PHI Learning, New Delhi, 2010.
4 A.Shanmugasundaram, G.Gangadharan, R.Palani, 'Electrical Machine Design Data Book', New Age International Pvt. Ltd. 2015. *Identify the optimal design of transformer.*

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SEMESTER - VI

		L	T	P	C
16EE612	**POWER SYSTEM ANALYSIS**	3	1	0	4

Prerequisite: *Mathematics(algebraic equation, integral and differential calculus), Electric circuit analysis*

Objectives:

- *To model the power system under steady state condition*
- *To determine power system network parameters under steady state condition*
- *To find the load flow in power system network*
- *To assess fault current in a power systems under abnormal (fault) conditions*
- *To examine the response of the power systems for various disturbances*

UNIT - I INTRODUCTION [12]

Introduction to modern power system – Need for system analysis in planning and operation of power system – Basic components of a power system – Single line diagram – Per phase analysis: Generator model, transformer model, line model, load representation – Per unit representation - Per phase analysis of symmetrical three-phase systems.

UNIT - II ADMITTANCE AND IMPEDANCE CALCULATION [12]

Introduction to network equation- Primitive matrix -Formation of Y-bus matrix : Inspection method, Singular transformation method , Node elimination– Formation of Z-bus matrix using bus building algorithm- Equivalent circuit of transformer with off-nominal-tap ratio.

UNIT - III LOAD FLOW ANALYSIS [12]

Problem definition - Bus classification - Statement of load flow problem -Derivation of power flow equation- Algorithm and flow charts for Gauss Seidal method, Newton–Raphson method and Fast Decoupled load flow method – DC load flow analysis.

UNIT - IV FAULT ANALYSIS [12]

Need for short circuit study – Fault MVA - Short circuit capacity- Balanced three phase fault analysis: Bus impedance matrix, Thevenin's method - Unsymmetrical Fault Analysis: Fundamental of symmetrical components, Sequence impedance, Sequence networks, Single line to ground fault, Line to line fault, Double line to ground fault.

UNIT - V STABILITY ANALYSIS [12]

Basic concepts and definitions of stability – Distinction between steady state and transient state Swing equation – Classification of stability: Rotor angle stability, voltage stability – Mid-term and long-term stability – An elementary view of transient stability – Equal area criterion – Determination of critical clearing angle and time using modified Euler method and Runge- Kutta fourth order method.

Total (L: 45 T:15) =60 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Infer the knowledge about modeling of power systems
CO2: Determine the power system network parameters
CO3: Evaluate the load flow in power system network
CO4: Assess the power systems abnormal (fault) conditions
CO5: Examine the response of the power systems for various disturbances

Text Books :

1 S.Ramar and S.Kuruseelan, Power System Analysis, PHI learning private limited, 2013 Edition.
2 John J. Grainger and Jr.W.D. Stevenson, Power System Analysis, Tata McGraw Hill, 1st Edition, Reprint 2014.

Reference Books :

1 Nagrath.I.J, Kothari.D.P, Modern Power system Analysis, Tata McGraw Hill Pub. Co. Ltd., 3rd Edition, 2003, 16th reprint 2009..
2 Hadi Saadat, Power System Analysis, Tata McGraw Hill Publishing Company, New Delhi, 3rd Edition 2011.
3 Kundur.P, Power System stability and Control, Tata McGraw Hill Publishing Company, New Delhi, 1994.
4 Pai.M.A, Computer Techniques in Power System Analysis, Tata McGraw Hill Publishing Company, New Delhi, 2003.
5 Kimbark.E.W, Electric Power system stability, IEEE Press, 1995.

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SEMESTER - VI

		L	T	P	C
16EE613	**POWER SYSTEM PROTECTION SWITCHGEAR AND UTILIZATION**	3	0	0	3

Prerequisite : *power system analysis*

Objectives :

- *To understand the characteristics and functions of relays and protection schemes.*
- *To understand the problems associated with circuit interruption by circuit breaker.*
- *To discuss the causes of abnormal operating conditions of the switchgear.*
- *To learn the concept of electric traction and electric heating*

UNIT – I OPERATING PRINCIPLES AND RELAY CHARACTERISTICS [9]

Principles and need for protective schemes – Nature and causes of faults – Types of faults – Zones of protection and essential qualities of protection – Protection scheme – Construction and Characteristics of relays – Over current relays – Directional, distance and differential relays – Under frequency relays – Negative sequence relays – Static relays – Microprocessor based relays.

UNIT – II APPARATUS PROTECTION AND CIRCUIT INTERRUPTION [9]

Apparatus protection – Generator and transformer protection – Protection of bus bars, Transmission lines.

Physics of arc phenomena and arc interruption – Restriking voltage & Recovery voltage, Rate of rise of recovery voltage, Current chopping, Interruption of capacitive current, Resistance switching.

UNIT – III FUSES & CIRCUIT BREAKERS [9]

Fuses: Types and its specification – Fault clearing process – Interruption of current – Types of Circuit Breakers and its specification – Air blast, Air break, Oil, SF6 and Vacuum circuit breakers - Rating of circuit breakers.

UNIT IV ELECTRIC TRACTION [9]

Requirements of traction system - Systems of traction - Systems of track electrification - Speed-Time curves - Tractive effort - Power of traction motor - Specific energy consumption.

UNIT – V ELECTRIC HEATING [9]

Advantages of electric heating – Types of Heating - Resistance heating - Temperature control, Induction heating – induction furnace - Dielectric heating - Choice of voltage and frequencies for Dielectric heating.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the various faults and different types of relays for appropriate protection scheme in power system
CO2: Explain the protection about generator , transformer, busbar & transmission line and fundamentals of arcing phenomena
CO3: Describe the types of fuses and circuit breaker
CO4: Illustrate the various types of Electric traction
CO5: *Discuss the importance of Electric heating.*

Text Books :

1 Soni.M.L, Gupta.P.V, Bhatnagar.V.S, Chakrabarti.A, A Text Book on Power System Engineering, Dhanpat Rai & Co., 2009
2 Sunil S. Rao, Switchgear and Protection, Khanna publishers, New Delhi, 13th edition,2008

Reference Books :

1 Wadhwa.C.L, Electrical Power Systems, New Age International (P) Ltd., 4th edition,2006.
2 Badri Ram, Vishwakarma, Power System Protection and Switchgear, Tata McGraw Hill, 2001.
3 Openshaw Taylor E "Utilisation of Electric Energy in SI Units.", Universities Press, Hyderabad, 2011.
4 Singh, Ravindra.P, Switchgear and Power System Protection, PHI Learning Pvt. Ltd., 2009.

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SEMESTER - VI

		L	T	P	C
16EE614	**POWER ELECTRONICS AND DRIVES**	3	0	0	3

Prerequisite: *Electron Devices and Circuits, Electrical Machines - I, Electrical Machines – II.*

Objectives:

- *To know the different types of power semiconductor devices and their switching characteristics.*
- *To understand the operation, characteristics and performance parameters of converter and inverter.*
- *To study the operation, switching techniques and basic topology of DC chopper and AC chopper.*
- *To study the basic concepts of electric drives, and speed control of different DC motors.*

UNIT - I POWER SEMICONDUCTOR DEVICES [9]

Introduction – V-I and switching characteristics of power semiconductor devices: Power Diode, Thyristor, TRIAC, Power BJT, Power MOSFET, Power IGBT and GTO – safe operation area for switching devices -SCR Protection circuits – SCR firing circuits – SCR Commutation techniques.

UNIT - II CONVERTERS [9]

Principle of phase controlled converter – Single- phase half and fully controlled converter with R, RL, RLE load – Freewheeling diode – Three- phase half and fully controlled converter with R,RL,RLE load – Effect of source Inductance.

UNIT - III INVERTERS [9]

Principle of operation: Single- phase voltage source inverter, Three -phase voltage source inverters (120^0 and 180^0 mode) – Single- phase current source inverter and Three- phase current source inverter – PWM techniques: Types – Introduction to SVPWM.

UNIT - IV DC AND AC CHOPPERS [9]

DC Chopper: Step down and step up chopper – Buck – Boost Choppers - CUK Converter -Control Techniques: Time ratio control and current limit control – Types: Class A, Class B,Class C, Class D and Class E chopper.

AC Chopper: Single- phase AC voltage controllers with R and RL load – Single- phase and three- phase step up and step down cycloconverters – operation of single- phase matrix converter.

UNIT - V ELECTRIC DRIVES [9]

Introduction – Advantages of electric drives – Classification of electric drives – Basic elements of an electric drive – Speed-torque characteristics of various types of loads and drive motors – Classes of duty and selection of motors with regard to thermal overloading – Multi quadrant operation.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Describe the fundamentals and key characteristics of power semiconductors devices and firing scheme, protection and commutation techniques for SCR.

CO2: Analyze the Electrical parameter of different AC to DC phase controlled converters with various loads and summarize the effect of source inductance for various converters.

CO3: Explain the Principle of various inverter topologies and discuss the different types of PWM techniques

CO4: Make use of the DC chopper for various quadrant operations and analyze the performance of AC Choppers for various loads.

CO5: Summarize the different types of motors with speed torque characteristics and basic concept and needs of electric drives

Text Books :

1 Rashid.M.H, Power Electronics Circuits Devices and Applications, Prentice Hall, 3rd Edition, New Delhi, 2nd impression 2012.

2 Dubey.G.K, Fundamentals of Electrical Drives, Narosa Publishing House,second edition,37th reprint New Delhi, 2016.

Reference Books :

1 Bimbhra.P.S, Power Electronics, Khanna Publishers,5th Edition, reprint 2016.

2 Vedam Subramanyam, Electric Drives: Concepts and Applications, Second Edition, Tata McGraw hill Pvt. Ltd, New Delhi, 2011.

3 Sen.P.C, Power Electronics, Tata Mc Graw Hill Company, New Delhi, 30th reprint 2008.

4 Bose.B.K, Modern Power Electronics and AC Drives, Pearson Education, Pvt. Ltd, New Delhi, 2011.

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SEMESTER -VI

		L	T	P	C
16EE621	**POWER SYSTEM SIMULATION LABORATORY**	0	0	3	2

Prerequisite: *Knowledge in Object Oriented Programming with C++ and MATLAB*

Objective:

- *To study various operations and analysis used in simple power system.*

List of Experiments:

1. Computation of Parameters and Modeling of Transmission Lines.
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
3. Load Flow Analysis – I: Using Gauss-Seidel Method.
4. Load Flow Analysis – II: Using Newton-Raphson Method.
5. Load Flow Analysis – III: Using Fast-Decoupled Method.
6. Fault Analysis: Solution of Short circuit analysis.
7. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System.
8. Transient Stability Analysis of Multi–machine Power Systems.
9. Load – Frequency Dynamics of Single-Area and Two-Area Power Systems.
10. Economic Dispatch in Power Systems.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Obtain the transmission line parameters of the power system and Develop the bus admittance and impedance matrix.

CO2: Analyze the power flow in power system and Inspect the symmetrical and unsymmetrical faults.

CO3: Analyze the small signal stability limit of the single machine infinite bus system and examine the transient stability of multi-machine power system.

CO4: Analyze the load frequency dynamics of single and two area systems.

CO5: Determine the economic dispatch of generating units with and without loss.

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SEMESTER - VI

16EE622 **POWER ELECTRONICS AND DRIVES LABORATORY**

L	T	P	C
0	0	3	2

Prerequisite: *Electron Devices and Circuits Laboratory, Electrical Machines Laboratory – I, Electrical Machines Laboratory – II*

Objectives:

- *To known the characteristics of switching devices and their applications in different converters.*
- *To acquire the knowledge in converter, inverter and chopper.*

List of Experiments:

1. V-I characteristics of SCR, TRIAC.
2. V-I and transfer characteristics of MOSFET and IGBT.
3. Single- phase half and fully controlled converter.
4. Three- phase half and fully controlled converter.
5. MOSFET based step down and step up choppers.
6. IGBT based single phase PWM Inverter.
7. Single- phase cycloconverter.
8. Simulation of single- phase half and fully controlled converter.
9. Simulation of three- phase half and fully controlled converter.
10. Simulation of single- phase and three- phase Inverter.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Contrast and relate the performance of various power semiconductors.
CO2: Design and analyze the performance of different AC to DC controlled converters.
CO3: Experiment with the different chopper circuits.
CO4: Design and analyze the performance of different PWM inverters.
CO5: Design and simulate the different types of converter, inverters using MATLAB.

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SEMESTER - _VI

16EE623	**SYSTEM DESIGN LABORATORY**	L	T	P	C
		0	0	3	2

Prerequisite: *Engineering Practices ,Electron Devices and Circuits Laboratory and microprocessor and micro controller Laboratory*

Objectives:

- *To expose the students to design and fabricate simple electrical modules.*
- *To provide knowledge to* estimate the electrical quantities in industries, residential and commercial buildings.

List of Experiments:

1. Design and fabrication of ± 5V constant voltage power supply.
2. Design and fabrication of ± (0-12 V), 1A variable power supply.
3. Design and fabrication of domestic UPS.
4. Electrical estimation in small scale industries.
5. Electrical estimation in Residential / Commercial buildings
6. Realization of driver circuit to drive an electromagnetic relay using microprocessor with required protection.
7. Realization of an isolation circuit using opto coupler for microcontroller interfacing

Total : 45 Periods

Course Outcomes:

CO1: Develop and analyze the circuit model for constant and variable voltage power supply.
CO2: Build and analyze the circuit model of domestic ups.
CO3: Estimate the electrical quantities in industries, residential and commercial buildings.
CO4: Construct a driver circuit to drive an electromagnetic relay using microprocessor with required protection.
CO5: Construct and develop a circuit model of isolation circuit using opto coupler with microcontroller interface

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SEMESTER - VI

		L	T	P	C
16HR655	**CAREER DEVELOPMENT SKILLS V**	-	2	-	-

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objective:

- *To assist individuals in making appropriate educational and occupational choices. Discuss the importance of using effective action words, keywords, and positioning for a resume, describe how to showcase one's professional skill sets in a cover letter, and perform these tasks.*

UNIT - I WORLD OF TEAMS [6]

Self Enhancement – Importance of developing assertive skills – developing self confidence – developing emotional intelligence, Importance of Teamwork – Team Vs Group – Attributes of a Successful team – Barriers involved, Working with groups – Dealing with people –Group Decision Making

UNIT - II INTERVIEW,GD & PRESENTATION SKILLS [6]

Interview handling skills – self preparation checklist – Grooming tips: do's and don'ts – mock interview & feedback,GD Skills – understanding the objective and skills tested in a GD – General types of GD – Roles in a GD - do's and don'ts – Mock GD & Feedback - Practice

UNIT - III RESUME WRITING [6]

An Introduction to the Resume - Types of Resumes - The Chronological Resume - The Functional Resume - The Combination Resume - Curricula Vitae - Preparing to Write Your Resume - Common Resume Errors – Presentation - Professional Objective and Education Section – Experience / Fresher - Skills Section - Honors and Awards - Activities and Interests - Polishing Your Resume - Cover Letters

UNIT - IV BUSINESS ETIQUETTE AND ETHICS [6]

Grooming Etiquette – Telephone & Email Etiquette – Dining Etiquette - do's and don'ts in formal setting – How to Impress Ethics – Importance of ethics and Value – choice and dilemmas faced – Discussion form news headlines.

UNIT - V DOMAIN PROFICIENCY [6]

Competitive exam training: Microprocessor and Microcontroller fundamentals-Power system protection and switchgear-Design of Electrical Machines

Total = 30 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Enhance the team spirit and more in a team effectively.
CO2: Organize better and perform well in HR Interview.
CO3: Tailor their own resume according to job need
CO4: Under business etiquette and more globally.
CO5: *Perform well in competitive exam training.*

Reference Books :

1 Agarwal, R.S. "A Modern Approach to Verbal and Non-verbal Reasoning", Revised Edition 2008, Reprint 2009, S.Chand & Co Ltd., New Delhi.

2 Abhijit Guha, "Quantitative Aptitude", TMH, 3 edition

3 Objective Instant Arithmetic by M.B. Lal & GoswamiUpkar Publications.

4 Word Power Made Easy by Norman Lewis W.R. GOYAL Publications

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SEMESTER – VII

		L	T	P	C
16HS751	**PROFESSIONAL ETHICS (Common to all Branches)**	3	0	0	3

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objective:

- *To enable the student to understand the ethical principles and practices to resolve the ethical conflict situations that arise in their professional lives.*

UNIT – I ENGINEERING ETHICS [9]

Senses of 'Engineering Ethics' - Variety of Moral Issued - Types of Inquiry - Moral dilemmas - Moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and Controversy - Models of Professional roles – Professional Ideals and Virtues- Uses of Ethical Theories.

UNIT – II ENGINEERING AS SOCIAL EXPERIMENTATION [9]

Engineering as Experimentation - Engineers as responsible Experimenters - Codes of Ethics – Industrial standards- Balanced Outlook on Law - The Challenger Case Study.

UNIT – III ENGINEER'S RESPONSIBILITY FOR SAFETY [9]

Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis - Reducing Risk – Liability - The Chernobyl and Bhopal Case Studies.

UNIT – IV RESPONSIBILITIES AND RIGHTS [9]

Collegiality and Loyalty - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Intellectual Property Rights (IPR) - Discrimination.

UNIT – V GLOBAL ISSUES [9]

Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers- Consulting Engineers - Engineers as Expert Witnesses and Advisors – Honest - Moral Leadership - Sample Code of Conduct.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Understand basic perception of ethics, moral and values
CO2: Aware the current industrial standards
CO3: Identify and assess the risk and safety benefit in industry
CO4: Aware of professional rights and responsibility of an engineers
CO5: Acquire knowledge in global issues and able to apply in ethical principles in professional life.

Text Books :

1 Mike Martin and Rol and Schinzinger, "Ethics in Engineering", McGraw-Hill, 3rd edition, New York, 2014.
2 Dr.K.R.Govindan and S.Senthilkumar, "Professional Ethics", Anuradha Agencies, Revised Edition, Chennai, 224

Reference Books :

1 Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India,2nd edition, New Delhi, 2012
2 Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey,4th edition, 2009
3 Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Thompson Learning,4th edition, 2011
4 John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 5th edition, New Delhi, 2009.

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SEMESTER - VII

16EE712	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisite: *Microprocessor and Microcontroller*

Objectives:

- *To learn and understand the fundamentals of embedded systems and its PIC architecture.*
- *To study the embedded processor and networks.*
- *To understand the concept of schedule mechanism.*
- *To understand the functions of real time operating systems..*

UNIT - I INTRODUCTION TO EMBEDDED SYSTEM [9]

Definition – Embedded system Vs General computing system – Classification – Functional building blocks of embedded systems –– Embedded hardware units – PIC16F877A : Register, memory devices, ports, timer, interrupt, Instruction Set and Addressing Modes

UNIT - II PROCESSOR AND MEMORY ORGANIZATION [9]

Structural units in a processor – Selection of processor and memory selection – Processor interfacing with memory and I/O units – Shared memory - DMA – memory management

UNIT - III EMBEDDED NETWORKS [9]

Serial communication using I^2C, CAN, SPI, USB and PROFI buses – Parallel communication using PCI, PCI-X buses, Arm bus – Networks protocols introduction: HTTP, TCP, UDP, and IP.

UNIT - IV I/O PROGRAMMING AND SCHEDULE MECHANISM [9]

Transfer rate, latency; interrupt driven I/O -Non-maskable interrupts; software interrupts, writing interrupt service routine in C & assembly languages; preventing interrupt overrun; disability interrupts. Multi threaded programming - Context switching, premature & non premature multitasking, semaphores. Scheduling - Thread states, pending threads, context switching, round robin scheduling and priority based scheduling, assigning priorities, deadlock and watch dog timers.

UNIT - V REAL TIME OPERATING SYSTEM (RTOS) [9]

Introduction – Basic function of kernel – Basic function of RTOS – OS Vs RTOS – Types of RTOS –Interrupt routines in RTOS – Embedded system design process - Embedded software development process and tools.

Total = 45Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Illustrate the fundamentals of embedded system and PIC microcontroller.
CO2: Describe about structural units in embedded processor architecture and memory organization
CO3: Outline the various types of embedded network communication protocols.
CO4: Explain the concept of task scheduling mechanism.
CO5: Describe the features of Real Time Operating System.

Text Books :

1 Rajkamal.P, Embedded System – Architecture, Programming, Design, Tata McGraw Hill, Third Edition, 2016.
2 John B. Peatman, Design with PIC Microcontrollers, McGraw Hill International Limited, Singapore, 2009.

Reference Books :

1 Frank Vahid and Tony Givargi, Embedded System Design – A Unified Hardware & Software Introduction, John Wiley, 2011.
2 Steve Furbe, ARM System-on-chip Architecture, Addison-Wesley Professional, Second Edition, 2000.
3 Steve Heath, Embedded System Design, Second Edition, Elsevier, 2003.
4 Wayne wolf, Computers as components: Principles of embedded computing system design, Morgan Kaufmann publishers, Third Edition, 2012.

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SEMESTER - VII

16EE713	INDUSTRIAL AUTOMATION AND CONTROL	L	T	P	C
		3	0	0	3

Prerequisite: *Programmable logic controller, Control Engineering*

Objectives:

- *To introduce the basic concepts of PLC*
- *To study the logic fundamentals, PLC timer and counter*
- *To gain knowledge in PLC programming*
- *To understand the basic concepts of DCS*
- *To categorize the applications of PLC and DCS*

UNIT - I INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLER (PLC) [9]

Introduction - PLC Evolution – PLC Vs Computers – Block Diagram of PLC – PLC Hardware Components: I/O modules, Power Supply, CPU – PLC size and Applications – PLC Programming Languages.

UNIT - II LOGIC FUNDAMENTALS, TIMER AND COUNTER [9]

Logic functions – Boolean instructions and functions – Hardwired logic Vs Programmed Logic - Developing circuits from Boolean instructions **–** Programming Word Level Logic Instructions – PLC timer: classification and instructions – PLC counter: classification, instructions and applications.

UNIT - III PLC PROGRAMMING [9]

PLC-memory map - Program scan – Relay type instructions – Instruction addressing - Branch instructions - Internal relay instructions - EXAMINE IF CLOSED and EXAMINE IF OPEN instructions - Modes of operation – Basic relay ladder logic and its control flow chart .

UNIT - IV DISTRIBUTED CONTROL SYSTEM [9]

Distributed control system : Evolution – Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities – Low and high level operator interfaces – Operator displays – Low and high level engineering interfaces – General purpose computers in DCS – Bus Standards. Introduction to SCADA.

UNIT - V APPLICATIONS OF PLC AND DCS [9]

PLC interfaces – PLC applications: Automatic Control Of Ware House Door – Automatic Lubricating Oil Supplier – Conveyer Belt motor Control – Automatic Car Washing Machine – DCS applications: Pulp and paper environment, Petroleum and refining environment.

Total = 45Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the major components of Programmable Logic Controller (PLC) and its applications.
CO2: Summarize the logical functions, timers and counters of PLC.
CO3: Discuss the various instructions and modes of operation related to PLC.
CO4: Realize the architecture and various interfacing techniques of Distributed Control Systems.
CO5: Examine the different applications of PLC and Distributed Control Systems (DCS).

Text Books :

1 Frank D.Petruzella, Programmable Logic controllers, Mc.Graw-Hill, Third Edition,Sixth Reprint, 2013
2 Lucas M.P., Distributed Control System, Van Nostrand and Reinhold Co.Newyork, 1986.

Reference Books :

1 Gary Dunning, Introduction to Programmable Logic Controllers, Thomson, Third Edition, 2010
2 John W.Webb, Ronald A.Reis, Programmable Logic Controllers: Principles and Applications, PHI Private Ltd., Fifth Edition, 2003
3 W.Bolton, Programmable Logic Controllers, Elseveir, Fourth Edition, 2008
4 Madhuchhanda Mitra, Smarajit Sen Gupta, Programmable Logic Controllers and Industrial Automation, PRI Pvt Ltd., 2009

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SEMESTER - VII

		L	T	P	C
16EE714	**ENERGY MANAGEMENT AND AUDIT**	3	0	0	3

Prerequisite: *Transmission and Distribution*

Objectives:

- *To study the concepts behind economic analysis and Load management.*
- *To emphasize the energy management on various electrical equipments and metering.*
- *To illustrate the concept of lighting systems and cogeneration.*

UNIT - I INTRODUCTION [9]

Electricity Act – Energy Conservation Act 2003 – ISO 15001 - 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 EQUIPMENTS [9]

Systems and equipment- Electric motors in energy management – Role of Transformers, reactors, Capacitors and synchronous machines in energy management.

UNIT - IV METERING FOR ENERGY MANAGEMENT [9]

Relationships between parameters-Units of measure- 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

Course Outcomes:

CO1: Give the introduction about energy management and energy audit process.
CO2: Explain the energy cost analysis and load management.
CO3: Describe the energy management for motors, systems and electrical equipment.
CO4: Illustrate the metering techniques for energy management.
CO5: Explain the lighting systems and cogeneration.

Text Books :

1 Barun Kumar De, Energy Management, Audit and Conservation (Kindle Edition), 2e edition (28 April 2014), Vrinda Publications P Ltd., 2014.
2 Umesh Rathore, Energy Management, Reprint 2013 edition, S.K. Kataria & Sons

Reference Books :

1 Reay D.A, Industrial Energy Conservation, 1st edition, Pergamon Press, 1977.
2 Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003
3 Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
4 Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,. Logman Scientific & Technical, ISBN-0-582-03184, 1990.

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SEMESTER - VII

		L	T	P	C
16EE721	**EMBEDDED SYSTEMS LABORATORY**	0	0	3	2

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objectives:

- *To understand the architecture of embedded Systems*
- *To learn the concept of memory map and memory interface*
- *To write programs to interface memory, I/Os with processor*

List of Experiments:

1. Design a RAM/ROM, ALU design with 8051 microcontroller using Keil software.
2. Design a temperature sensor interfacing with 8051 microcontroller using Keil software.
3. Write the PIC programs for simple arithmetic operations.
4. Design an alarm clock with PIC microcontroller using MPLAB.
5. Design a elevator controller with PIC microcontroller using MPLAB.
6. Design a model train controller with PIC microcontroller using MPLAB.
7. Write the ARM programs for simple arithmetic operations.
8. Design a relay output interface with ARM processor using Keil software.
9. Design a musical tone generator interface with ARM processor using Keil software.
10. Design a graphical LCD interface with ARM processor using Keil software.

Total : 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Interface memory and write programs related to memory operations
CO2: Construct various control circuits for different applications using 8051 microcontroller.
CO3: Construct various control circuits for different applications using PIC microcontroller
CO4: Develop programs to interface memory, I/Os with processor.
CO5: *Construct various control circuits for different applications using ARM processor*

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SEMESTER - VII

		L	T	P	C
16EE722	**TECHNICAL WRITING AND PRESENTATION**	0	0	3	1

***Prerequisite**: Career Development Skills*

Objectives:

- *To encourage the students to study advanced engineering developments*
- *To prepare and present technical reports*
- *To encourage the students to use various teaching aids such as over head projectors, power point presentation and demonstrative models*

METHOD OF EVALUATION

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 5 to 8 minutes. In a session of three periods per week, 15 students are expected to present the seminar. Each student is expected to present at least twice during the semester and the student is evaluated based on that. At the end of the semester, he/she can submit a report on his / her topic of seminar and marks are given based on the report. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

50% Marks would be allocated to report/model/charts

- Amount of work involved/amount of individual's contribution in it.
- Complexity of work
- Novelty of the work
- Neatness and clarity in work
- In case of charts, the quality of sketch/diagrams/graphs/tables etc.
- In case of models, the type of materials and fabrication methods used for making it
- Amount of work done by students as compared to use of directly purchased components (fabrication from market should be discouraged/penalised)
- In case of reports language, originality (cut and paste should not be allowed/penalised), organization and presentation of material, quality of diagrams/drawings, number and quality of references.

50% Marks would be allocated to presentation

- Quality of slides/transparency prepared
- Organization and sequencing of the content
- Quality of content
- Confidence level and communication during presentation
- Handling of questions after presentation

Total = 15 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Ability to review, prepare and present technological developments

CO2: Ability to face the placement interviews

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SEMESTER – VIII

		L	T	P	C
16HS001	**PRINCIPLES OF MANAGEMENT (Common to CE, EC & EE)**	3	0	0	3

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objective:

- *To enable the student in understanding management functions, its complexity and various issue in management.*

UNIT - I OVERVIEW OF MANAGEMENT [9]

Definition of Management – Importance of management – Management functions– Levels of management – Role of managers – Management a science or an art – Evolution of Management thought: Scientific management and Administrative Principles of management – Ethical issues in Management.

UNIT - II PLANNING [9]

Planning: Meaning, purpose, Steps and Types of Plans - Management by objectives (MBO)–Decision Making: Types of Decisions, Steps in Rational Decision making, Common difficulties in Management Decision Making.

UNIT - III ORGANISING [9]

Nature and purpose of organizing : Organization structure, Process and Principles of organizing – Line & Staff authority –Departmentation –Span of Control–Centralization and Decentralization – Delegation of authority – Staffing : Sources of Recruitment, Selection process – Training methods – Performance appraisal methods.

UNIT - IV DIRECTING [9]

Creativity and Innovation – Motivation and Satisfaction: Motivation Theories – Leadership:
Leadership theories and Styles – Communication: Barriers to communication, Principles of effective Communication.

UNIT - V CONTROLLING [9]

Steps in a control Process: Need for control system, Budgetary and Non-Budgetary control techniques, Problems of the control system, Essentials of effective control system, and Benefits of control.

Total = 45 Periods

Course Outcomes: ***On Completion of this course, the student will be able to***

CO1: Understand the role and current practices of management systems.
CO2: Understand the basic concepts of planning and decision making.
CO3: Explain various methods of organizing, recruitment and training adopted in an organization
CO4: Handle employees by using various motivational and leadership styles.
CO5: Know the budget and non budgetary controlling process.

Text Book :

1 L.M.Prasad, "Principles and Practices of Management", Sultan Chand & Sons, 8th Edition, New Delhi.2013.

Reference Books :

1 P.C.Tripathi and Reddy "Principles of Management", McGraw Hill 5th Edition, New Delhi.2012.
2 Hellriegel, Slocum & Jackson, 'Management A Competency Based Approach', Thomson SouthWestern, 10th edition, 2007.
3 Harold Koontz, Heinz Weihrich and mark V Cannice, 'Management – A globalEntrepreneurial Perspective', Tata Mcgraw Hill, 12th edition, 2007.
4 Andrew J. Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.

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SEMESTER - VIII

		L	T	P	C
16EE821	**PROJECT WORK**	0	0	12	6

Prerequisite: *Minimum of seven semester of courses*

Objective:

- *To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.*
- *To train the students in preparing project reports and to face reviews and viva voce examination.*

Guidelines:

1. To start with literature review about the proposed idea of the project and executing the same in consultation with the project guide/project coordinator/Industry experts.
2. A detailed analysis/modeling/simulation/design/problem solving/experiment is a must to complete and an effort leading to paper publication or patenting is desired.
3. A working model or prototype is to be submitted for end semester evaluation.
4. A project report is required to be submitted at the end of the semester in the required/prescribed format.
5. Project work done at Industry should be duly supported by certificate from the Industry.
6. The progress of the project is evaluated based on a minimum of three reviews and end semester review.
7. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Total : 180 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify a practical problems related to Electrical industry.
CO2: Solve the problems with related to feasible solution.
CO3: Understand the project management techniques.
CO4: Understand the industrial scenarios.
CO5: Demonstrate their report writing and presentation skills.

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SEMESTER – VI

		L	T	P	C
16EE661	**INDUSTRIAL ELECTRONICS (ELECTIVE)**	3	0	0	3

Prerequisite: *Power Electronics, Power electronics and Drives.*

Objectives:

- *To get an overview of various types of power semi-conductor devices and their switching characteristics.*
- *To understand the control and firing circuits of different devices.*
- *To know the concept of types sensors and digital conversion techniques.*
- *To learn the different methods speed control of DC and AC drives using power semiconductor devices.*
- *To study the various types of special machines and applications of industrial heating control.*

UNIT - I POWER SEMICONDUCTOR DEVICES [9]

Introduction to power semiconductor devices, Power Transistor, SITs, RCT, SITH, MCT, FCT, LASCR and application.

UNIT - II FIRING AND PROTECTING CIRCUITS [9]

Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. – Over voltage, over current and gate protections; Design of snubbers.

UNIT - III S E N S O R S [9]

Smart sensors, Integrated smart sensors – definition – Interface electronics: Design, sensing elements and their parasitic effects, ADC, Accuracy over a Dynamic range - Universal ,Sensor Interface – front end circuits – DAQ board design - Digital conversion techniques.

UNIT - IV MOTOR CONTROL [9]

Introduction - Speed control methods for DC motors (phase controlled converters and choppers), three phase induction motors. (phase controlled converters)

UNIT - V STEPPER MOTORS AND HEATING CONTROL [9]

Variable reluctance, Permanent magnet and hybrid stepper motors. Resistance heating control, Induction heating control and Dielectric heating control.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Describe the various power semiconductor devices and their application.
CO2: Discuss the firing and production circuits of power semiconductor devices.
CO3: Analyze the different types of sensors and digital conversion techniques used in an industrial application.
CO4: Explicate the speed control methods of DC and AC drives using power semiconductor devices.
CO5: Explain the concept of stepper motor and heating control in an industrial application.

Text Books :

1 Rashid M.H.," Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004.
2 Power Electronics by P.C. S en, Tata McGraw - Hill Publishing, New Delhi, 2008.

Reference Books :

1 MD Singh and K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.
2 Gerord C.M. Meijer, Smart Sensor Systems, John Wiley and Sons, 2008.
3 Industrial Electronics, Noel Morris,TMH, New Delhi , 1999.
4 Industrial Electronics, T.E.Kissell, PHI Learning, New Delhi – 2011.
5 Industrial Electronics, K.Sourirajan, JJ Publications – 2000.
6 Aearnley.P.P, Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus, London, 1982.

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SEMESTER – VI

		L	T	P	C
16EE662	**FLEXIBLE AC TRANSMISSION SYSTEMS (ELECTIVE)**	3	0	0	3

Prerequisite: *Power electronics*

Objectives:

- To understand the concept of flexible AC transmission systems and tis associated problems.
- To review the static devices for series and shunt control.
- To study the operation of controllers for enhancing the transmission capability.

UNIT - I FACTS CONTROLLERS [9]

Need for FACTS controllers – Concept of FACTS – Flow of power in an AC system – Dynamic stability consideration – Basic types of FACTS controllers: Static shunt compensators, series compensators – Basic concepts of Static VAR Compensator (SVC) – Thyristor Switched Series Capacitor (TSSC) – Unified Power Flow Controller (UPFC).

UNIT - II VAR COMPENSATORS [9]

Methods of controllable VAR generation – Switching converter type VAR generators – Basic operating principle and control approaches – Voltage control by SVC – Dynamic characteristics – Design of SVC as voltage regulator – Modeling of SVC for power flow – Applications – Steady state power transfer – Prevention of voltage instability.

UNIT - III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS [9]

Principle and operation of TCSC – Operating modes of TCSC – Modeling of TCSC – Modeling for power flow studies – Applications: Improvement of system stability limit, enhancement of system damping.

UNIT - IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS [9]

Principle and operation of Static Synchronous Compensator (STATCOM) – V-I Characteristics. Applications: Enhancement of transient stability, prevention of voltage instability – Static Synchronous Series Compensator (SSSC): Operation, control of power flow, modeling of load flow studies – Comparison of different FACTS controllers.

UNIT - V CO-ORDINATION OF FACTS CONTROLLERS [9]

Controller interactions – SVC – SVC interaction – Co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Identify the conditions in conventional power system where the installation of FACTS controllers or Devices becomes vital .

CO2: Analyze the performance of a conventional transmission system and apply the principles of reactive power compensation for improvement

CO3: Illustrate the modes of operation of thyristor controlled series capacitor

CO4: Discuss the various modes of operation of thyristor based and voltage source converter based FACTS controllers.

CO5: *Explain the co-ordination of FACTS controllers.*

Text Books :

1 Mohan Mathur.R, Rajiv. K. Varma, Thyristor – Based Facts Controllers for Electrical Transmission Systems, IEEE press and John Wiley & Sons, Inc., 2011.

2 Narain G.Hingorani, Laszlo Gyugyi, Understanding Facts: Concepts and Technology of Flexible AC Transmission Systems, Standard Publishers, Delhi 2011.

Reference Books :

1 John.A.T, Flexible AC Transmission System, Institution of Electrical and Electronic Engineers (IEEE), 1999.

2 Padiyar.K.R, FACTS Controllers in Power Transmission System and Distribution, New Age International (P) Limited, New Delhi, 2009

3 Rakosh Das Begamudre, Extra High Voltage AC Transmission Engineering,New Academic Science, 4th edition 2011.

4 Miller.T.J.E, Reactive Power Control in Electric Systems, Wiley, John & Sons, 1982.

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SEMESTER – VI

		L	T	P	C
16EE663	**POWER SYSTEM TRANSIENTS (ELECTIVE)**	3	0	0	3

Prerequisite: *Power System Analysis and High Voltage Engineering*

Objectives:

- *To study the generation of switching transients.*
- *To know the mechanism of lightning strokes and the production of lightning surges.*
- *To understand the propagation, reflection and refraction of travelling waves.*
- *To learn the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.*

UNIT - I INTRODUCTION OF TRANSIENTS [9]

Review and importance of the study of transients - Causes for transients - RL circuit transient with sine wave excitation - Double frequency transients - Basic transforms of the RLC circuit transients - Different types of power system transients - Effect of transients on power systems.

UNIT - II SWITCHING TRANSIENTS [9]

Switching transients – Double frequency transients – Abnormal switching transients – Transients in switching a three phase reactor - Three phase capacitor.

UNIT - III LIGHTNING TRANSIENTS [9]

Review of the theories in the formation of clouds and charge formation - Rate of charging of thunder clouds – Mechanism of lightning discharges and characteristics of lightning strokes model for lightning stroke - Factors contributing to good line design - Protection using ground wires – Tower footing resistance - Interaction between lightning and power system.

UNIT - IV TRAVELLING WAVES ON TRANSMISSION LINE [9]

Travelling waves in transmission lines – Circuits with distributed constants – Wave equations – Reflection and refraction of travelling waves – Travelling waves at different line terminations.

UNIT - V TRANSIENTS IN INTEGRATED POWER SYSTEM [9]

The short line and kilometric fault - Distribution of voltages in a power system - Line dropping and load rejection - Voltage transients on closing and reclosing lines - Over voltage induced by faults.

Total = 45 Periods

Course Outcomes: On completion of the courses, the student can will be able to

CO1: Understand the concept of generation of switching transients.
CO2: Illustrate the various switching transient.
CO3: Examine the lighting transients.
CO4: Analyze the travelling waves on transmission line.
CO5: *Interpret the transients in integrated power system.*

Text Books :

1 Allan Greenwood, Electrical Transients in Power Systems, Wiley India Pvt. Ltd., New York, 2010.
2 M.S. Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, 10th Reprint 2006.

Reference Books :

1 R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', New Academic Science, 2011.
2 B. M. Weedy, B.J. Cory, N. Jenkins, J.B. Ekanayake and G. Strbac, 'Electric Power Systems', A John Wiley & Sons, 2012.
3 C.S. Indulkar, D.P. Kothari and K. Ramalingam, 'Power System Transients – A Statistical approach', PHI Learning Pvt. Ltd., 2010.
4 C.L. Wadhwa, 'High Voltage Engineering', New Age International, 2007.

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SEMESTER - VI

		L	T	P	C
16EE664	**SPECIAL ELECTRICAL MACHINES (ELECTIVE)**	3	0	0	3

Prerequisite: *Electrical Machines*

Objective:

- *To study the construction, working and principle of operation of various special electrical machines.*

UNIT - I STEPPER MOTORS [9]

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Torque equation – Modes of excitation – Characteristics – Drive circuits –Processor control of stepping motors – closed loop control.

UNIT - II PERMANENT MAGNET SYNCHRONOUS MOTORS [9]

Permanent magnet motors – Classifications of PMSM – Principle of operation – EMF and torque equations – Armature reaction MMF – Synchronous reactance – Sine wave motor with practical windings – Phasor diagram – Converter volt ampere requirements – Torque speed characteristics – Processor based control.

UNIT - III PERMANENT MAGNET BRUSHLESS D.C. MOTORS [9]

Permanent magnetic materials – Magnetic characteristics – Permeance coefficient – Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Commutation in DC motors, electronic commutation, difference between mechanical and electrical commutators – Power controllers – Motor characteristics and control.

UNIT - IV SYNCHRONOUS RELUCTANCE MOTORS [9]

Constructional features – Types – Axial and radial flux motors – Operating principle: Variable reluctance and hybrid motors – voltage and torque equations – Phasor diagram – Characteristics.

UNIT - V SWITCHED RELUCTANCE MOTORS [9]

Constructional features – Rotary and linear SRMs – Principle of operation – Torque production – Steady state performance prediction – Analytical method – Power converters and their controllers – Methods of rotor position sensing – Sensorless operation – close loop control of SRM – Processor based control of SRM – Applications**.**

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the construction, operating principles of various stepper motors and develop its torque equation.

CO2: Demonstrate the principle of operation of permanent magnet synchronous motors and illustrate its phasor diagram along with torque speed characteristics.

CO3: Explain the operation, performance characteristics of permanent magnet brushless dc motors and its various commutation techniques.

CO4: Illustrate the constructional features of various synchronous reluctance motors and realize its phasor diagram.

CO5: Summarize the constructional features of switched reluctance motor and illustrate the various rotor position sensing techniques.

Text Books :

1 Miller.T.J.E, Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press, Oxford, 1989.

2 Kenjo.T and Nagamori.S, Permanent Magnet and Brushless DC Motors, Clarendon Press, London, 1988.

Reference Books :

1 Krishnan.R, Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application, CRC Press, New York, 2009.

2 Aearnley.P.P, Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus, London, 1982.

3 Kenjo.T, Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 2003.

4 Bose.B.K, Modern Power Electronics & AC drives, Dorling Kindersley India, 2006.

5 J. R. Hendershot, Timothy John Eastham Miller, "Design of Brushless Permanent-magnet Machines" Motor Design Books, 2010.

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SEMESTER - VI

		L	T	P	C
16EE665	**ADVANCED CONTROL SYSTEMS (ELECTIVE)**	3	0	0	3

Prerequisite: *Control systems*

Objective:

- *To impart knowledge on Concepts of the state Space analysis and State Variable Design, Sampled Data Control System, Phase plane analysis and describing function analysis. Liapunov's stability and Popov's criterion.*

UNIT - I STATE SPACE ANALYSIS [9]

Introduction to state space analysis – Physical variable, Phase variable and Canonical variables forms - State transition matrix- controllability and observability.

UNIT - II STATE VARIABLE DESIGN [9]

Design by state feedback – output feedback – Pole assignment technique – Design of state and output feedback controllers – Design of reduced and full order observers – PI feedback – Dynamic state feedback.

UNIT - III SAMPLED DATA CONTROL SYSTEM [9]

Introduction to Sample data control systems –Sampling process, signal reconstruction, difference equation, Z-transform– Inverse Z transform, Z-transform analysis of sampled data control system, Z and S domain Relationship

UNIT - IV NON-LINEAR SYSTEMS [9]

Types of non-linearity – Typical examples – Equivalent linearization - Phase plane analysis – Limit cycles – Describing functions- Analysis using Describing functions.

UNIT - V STABILITY [9]

Stability concepts – Equilibrium points – BIBO and asymptotic stability – Direct method of Liapunov – Application to non-linear problems – Frequency domain stability criteria –Popov's method and its extensions.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Apply state variables to form state equations and analyze for controllability and observability.
CO2: Design feedback controllers and observers.
CO3: Analyze sampled data control system.
CO4: Discuss the features of phase plane analysis and describing function analysis.
CO5: Examine BIBO and asymptotic stability.

Text Books :

1 M.Gopal, "Digital control and state variable methods" Tata McGraw Hill Publishing Company Ltd., 2nd Edition 2007.
2 M.Gopal - Modern control system theory - Wiley Easter Ltd., 1989.

Reference Books :

1 I.J. Nagarth and M. Gopal - Control systems engineering - Wiley Eastern Ltd., 1993
2 K. Ogata - Digital control systems - Prentice Hall of India Pvt. Ltd,1997.
3 B.C. Kuo, "Automatic Control systems", Pearson Education, 1995.

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SEMESTER - VI

		L	T	P	C
16EE666	**MICROCONTROLLER BASED SYSTEM DESIGN (ELECTIVE)**	3	0	0	3

Prerequisite: *Microprocessor and Microcontroller*

Objective:

- *To expose the techniques and methodology in PIC16F87X and 8096.*

UNIT - I 8096 MICROCONTROLLER [9]

CPU operation – Interrupt structure – Timers – High Speed Input / Output Ports – I/O control and Status registers – Instruction Set – Addressing Modes – Simple Programming – Queues – Tables and Strings – Stack Memories – Key Switch –Parsing.

UNIT - II PERIPHERALS AND INTERFACING [9]

Analog Interface – Serial Ports – Watch dog timers – Real Time Clock – Multitasking– Bus Control – Memory Timing – External ROM and RAM expansion – PWM control– A/D interfacing.

UNIT - III PIC MICROCONTROLLER 16F87X [9]

Architecture – Features – Resets – Memory organizations – Program memory, Data memory – Instruction set – Addressing modes – Simple program and its applications.

UNIT - IV PERIPHERALS AND INTERFACING [9]

Interrupts – I/O ports – Timers – CCP modules – Master synchronous serial port – USART – ADC – I^2C

UNIT - V CASE STUDY FOR PIC16F87X AND 8096 [9]

Real Time Clock(RTC) – DC Motor Speed Control – Generation of Gating signals for Converters and Inverters – Frequency Measurement – Temperature Control

Total = 45Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Illustrate the Instruction set, addressing modes and programming of 8096 microcontroller.
CO2: Demonstrate the functions of different peripheral ICs and design the interfacing logic using 8096.
CO3: Explain the architecture, interrupts and addressing modes of PIC16F87X Microcontroller.
CO4: Describe the functions of different peripheral ICs and design the interfacing logic using PIC16F87X.
CO5: Design and develop the interfacing circuits for various applications using 8096 and PIC16F87X Microcontroller.

Text Books :

1 John B. Peatman, Design with PIC Microcontrollers, McGraw Hill International Limited, Singapore, 2009.
2 N.Senthil Kumar, M.Saravanan, S.Jeevananthan, Microprocessors and Microcontrollers, Oxford University Press, Third Edition, 2011

Reference Books :

1 Muhammad Ali Mazidi, Janice Gillipie Mazidi, Microprocessors and Microcontrollers, Pearson Education, Inc., Puplishing as printice, Fourth Edition 2013..
2 Wayne wolf, Computers as components: Principles of embedded computing system design, Morgan Kaufmann publishers, Third Edition, 2012.
3 Ajay V.Deshmukh, Microcontroller theory and applications, Tata McGraw Hill International Limited, 2007
4 Intel Manual on 16bit embedded controllers, Santa Clara, 1991

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SEMESTER - VI

		L	T	P	C
16EE667	**PROGRAMMABLE LOGIC CONTROL (ELECTIVE)**	3	0	0	3

Prerequisite: *Digital Electronics*

Objectives:

- *To know in detail above the various PLC configuration, Hardware and Software*
- *To get an overview of industrial automation.*
- *To Identify characteristics of different types of PLC's and programming devices.*

UNIT - I PLC BASICS [9]

Introduction to PLC system, advantages and disadvantages, CPU processor, Memory, I/O modules and interfacing, power supplies, programming Equipment, programming formats, construction of PLC ladder diagrams.

UNIT - II PLC PROGRAMMING [9]

Input instructions, outputs, operational procedures, programming examples using contacts and coils-Digital logic gates and plc equivalent-programming in Boolean algebra system, conversion examples Ladder Diagrams for process control: Ladder diagrams & sequence listings.

UNIT - III PLC FUNCTIONS [9]

Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers-PLC Timer function-PLC counter function.

UNIT - IV PLC INTERMEDIATE AND DATA HANDLING FUNCTIONS [9]

Basic Arithmetic and comparison function-SKIP and MASTER Control relay function-Jump function-Data move system.

UNIT - V APPLICATIONS OF PLC [9]

Bottle filling system – Elevator System- controlling of two-axis & three axis Robots with PLC-Temperature control-Valve sequencing-Conveyor belt control.

Total =45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Understand the basics of PLC system and ladder logic.
CO2: Able to develop the basic programming techniques of PLC.
CO3: Design the PLC program with registers, addressing and timer functions.
CO4: Implement any arithmetic, comparison and data handling functions using PLC's.
CO5: Realize the real time applications with PLC's.

Text Books :

1 John W. Webb and Ronald A. Reis, "Programmable Logic Controllers principles and Applications", Prentice Hall Publications, New Delhi, 2005.
2 Programmable Logic Controllers- Programming Method and Applications –JR.Hackworth & F.D Hackworth Jr. – Pearson, 2004

Reference Books :

1 Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson Delmar Learning, Second Edition, 2003.
2 Petrezeulla, "Programmable Controllers", McGraw Hill, New York, 1989
3 W. Bolton, "Programmable Logic Controllers" , Elsevier Newnes, Fourth Edition, 2006.
4 L. A. Bryan, E. A. Bryan, "Programmable Controllers-Theory and Implementation" Industrial Text Company Second Edition, 1998.

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SEMESTER - VI

		L	T	P	C
16EC681	**COMMUNICATION ENGINEERING (ELECTIVE)**	3	0	0	3

Prerequisite: *Electronic Devices and Circuits, Signal and Systems, Digital Signal Processing*

Objectives:

- *To Understand the concept of different methods of analog communication.*
- *To Gain knowledge of transmission medium and digital communication methods for high bit rate transmission.*
- *To Learn the concepts of various coding techniques.*
- *To Familiarize the basic concepts in satellite and optical fiber communication*

UNIT - I ANALOG COMMUNICATION [9]

AM – Frequency spectrum – Vector representation – Power relations – Generation of AM: DSBSC, SSBSC, VSB – AM transmitter and receiver, FM and PM – Frequency spectrum – Power relations: NBFM and WBFM, Generation of FM: Amstrong method and Reactance modulations.

UNIT - II TRANSMISSION MEDIUM [9]

Transmission lines – Types, equivalent circuit, losses, standing waves, impedance matching, radio propagation – Ground wave and space wave propagation, critical frequency, maximum usable frequency, path loss, White Gaussian noise.

UNIT - III DIGITAL COMMUNICATION [9]

Pulse Modulations: PAM, PWM, PPM – Quantization and coding: PCM, DM, ADM, DPCM – ASK, FSK, PSK, BPSK, QPSK, MSK – Applications of data communications.

UNIT - IV SOURCE CODES, LINE CODES AND ERROR CONTROL [9]

Entropy, Properties, BSC, BEC – Source coding: Shannon-Fano, Huffman coding: Noiseless coding theorem – BW – SNR trade off – Codes: NRZ, RZ, AMI - Error control codes and applications: Convolutions and block codes.

UNIT - V SATELLITE AND OPTICAL COMMUNICATION (Qualitative treatment only) [9]

Orbits: Types of satellites, look angle, satellite system link models and equations – Multiple Access Techniques: types – Intelsat and Insat – Fibers – advantages of optical fiber communication – Light propagation through fiber, fiber loss, light sources and detectors.

Total= 45 Periods

Course Outcomes: At the end of the course, the students should be able to

CO1: Explain the concept and principles of amplitude modulation, frequency and phase modulation
CO2: Describe the concept of transmission medium of communication system.
CO3: Discuss the different methods of digital communication and applications of data communication system
CO4: Illustrate the source code, line code and error control codes.
CO5: *Discuss the concept of satellite and fiber optic communication system*

Text Books :

1 Taub & Schiling, Principles of communication systems, Tata McGraw hill, 4th Edition 2008.

2 Wayne Tomasi, Advanced Electronic Communication Systems, Pearson Education, 5th Edition, Reprint 2013.

Reference Books :

1 Kennedy and Davis, Electronic communication systems, Tata McGraw hill, 4th Edition, 2008.

2 Sklar, Digital communication fundamentals and applications, Pearson Education, 2001.

3 Bary le, Memuschmidt, Digital Communication, Kluwer Publication, 2004.

4 Lathi .B.P, Modern digital and analog communication systems, Oxford University Press, 2009.

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SEMESTER - VI

		L	T	P	C
16EC683	**TELE COMMUNICATION SWITCHING AND NETWORKS (ELECTIVE)**	3	0	0	3

Prerequisite: *Computer Networks, Communication Engineering*

Objectives:

- *To Introduce the concepts of multiplexing and SONET multiplexing*
- *To Introduce the concepts of space switching, time switching and combination switching*
- *To Introduce the need for network synchronization and study synchronization issues*
- *To Study the enhanced local loop system in digital environment*
- *To Introduce a mathematical model for the analysis of telecommunication traffic*

UNIT - I MULTIPLEXING [9]

Transmission Systems, FDM Multiplexing and modulation, Time Division Multiplexing, Time Division Multiple Loops and Rings. SONET/SDH: SONET Multiplexing Overview, SONET Frame Formats SONET Operations, Administration and Maintenance, Payload Framing and Frequency Justification, Virtual Tributaries, DS3 Payload Mapping, E4 Payload Mapping, SONET Optical Standards, SONET Networks. SONET Rings: Unidirectional Path-Switched Ring, Bidirectional Line-Switched Ring.

UNIT - II DIGITAL SWITCHING [9]

Switching Functions, Space Division Switching, Time Division Switching, two-dimensional Switching: STS Switching, TST Switching, No.4 ESS Toll Switch, Digital Cross-Connect Systems, Digital Switching in an Analog Environment. Elements of SSN07 signaling.

UNIT - III NETWORK SYNCHRONIZATION CONTROL AND MANAGEMENT [9]

Timing: Timing Recovery: Phase-Locked Loop, Clock Instability, Jitter Measurements, Systematic Jitter. Timing Inaccuracies: Slips, Asynchronous Multiplexing, Network Synchronization, U.S. Network Synchronization, Network Control, Network Management.

UNIT - IV DIGITAL SUBSCRIBER ACCESS [9]

ISDN: ISDN Basic Rate Access Architecture, ISDN U Interface, ISDN D Channel Protocol. High-Data-Rate Digital Subscriber Loops: Asymmetric Digital Subscriber Line, VDSL. Digital Loop Carrier Systems: Universal Digital Loop Carrier Systems, Integrated Digital Loop Carrier Systems, Next-Generation Digital Loop Carrier, Fiber in the Loop, Hybrid Fiber Coax Systems

UNIT - V TRAFFIC ANALYSIS [9]

Traffic Characterization: Arrival Distributions, Holding Time Distributions, Loss Systems, Network Blocking Probabilities: End-to-End Blocking Probabilities, Overflow Traffic, Delay Systems: Exponential service Times, Constant Service Times, Finite Queues

Total = 45 Periods

Course Outcomes: At the end of the course, the students should be able to

CO1: Describe the various Multiplexing Network Concepts
CO2: Explain the Switching function of Switching Networks
CO3: Interpret the Network Synchronization control and management issues
CO4: Explain the Digital Subscriber Access
CO5: Analyze the various traffic issues in network.

Text Books :

1 Bellamy John, Digital Telephony, John Wily & Sons, Inc. 3rd Edition. 2000
2 J E Flood, Telecommunication switching, Traffic and Networks, Pearson Education, 3rd Edition, 2002

Reference Books :

1 Viswanathan. T., "Telecommunication Switching System and Networks", Prentice Hall of India Ltd., 1994.
2 Wayne Tomasi, Advanced electronic communications systems , PHI,5th Edition, 2004.
3 R.A.Thomson, Telephone Switching Systems, Aretch House Publishers, 3rd Edition, 2000
4 W.Stalling, Data and computer communications, Prentice Hall, 2nd Edition, 1993

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SEMESTER – VI

		L	T	P	C
16CS686	**INTERNET AND WEB TECHNOLOGY (ELECTIVE)**	3	0	0	3

Prerequisite: *Basic knowledge of Computer Architecture*

Objectives:

- *To understand the complexity of the real world objects.*
- *To learn the best practices for designing Web forms and Usability Reviews.*
- *To understand the Principles behind the design and construction of Web applications.*
- *To learn the concepts of Poja and* Java Database Connectivity
- *To develop and deploy an Enterprise Application.*

UNIT – I BASICS OF OOPS [9]

Objected Oriented Concepts – Object Oriented Programming – Advanced Concept in OOP –Relationship – Constructors – Inheritance – Abstract Classes – Polymorphism – Object Oriented Design Methodology – Approach – Best Practices. UML Class Diagrams – Interface – Common Base Class.

UNIT – II INTERNETWORKING [9]

Internetworking – Working with TCP/IP – IP address – Sub Netting – DNS – VPN – Proxy Servers – Firewalls – Client/Server Concepts - World Wide Web – Components of Web Application – MIME Types, Browsers and Web Servers – Types of Web Content – URL – HTML – HTTP Protocol – Web Applications – Performance –Application Servers – Web Security. User Experience Design – Basic UX terminology – UXD in SDLC –Rapid Prototyping in Requirements.

UNIT – III HTML AND DHTML [9]

Client Tier using HTML – Basic HTML tags – Look and feel using CSS – DHTML: Object Model and Collections – Event Model – Filters and Transition – Client Side Scripting using Java Script and Validations –Document Object Model (DOM).

UNIT – IV POJA AND JDBC [9]

Business Tier using POJO (Plain Old Java Objects) – Introduction to Frameworks – Introduction to POJO –Multithreaded Programming – Java I/O – Java Database Connectivity (JDBC).

UNIT – V JSP AND SERVLETS [9]

Presentation Tier using JSP – Role of Java EE in Enterprise applications – Basics of Servlets – Introduce server Side Programming with JSP – Standard Tag Library.

Total =45 Periods

Course Outcomes: On Completion of this course, the student will be able to:

CO1: Understand the complexity of the real world objects.
CO2: Learn the best practices for designing Web forms and Usability Reviews.
CO3: Understand the Principles behind the design and construction of Web applications.
CO4: Understand the Poja and Java Database Connectivity.
CO5: Develop and Deploy an Enterprise Application.

Text Book :

1 Douglas E Comer, “Internet Book: Everything You Need to Know About Computer Networking and How theInternet Works”, 4th Edition, Prentice Hall, 2007.
2 Jeffrey C. Jackson, “Web Technologies: A Computer Science Perspective”, Prentice Hall, 2007.

References :

1 Brain Sam Bodden, “Beginning POJOs: Lightweight Java Web Development Using Plain Old Java Objects in Spring, Hibernate and Tapestry”, 1st Edition, Apress, 2006.
2 Herbert Schildt, “Java: The Complete Reference”, Tata McGraw-Hill, 2006.
3 Michael Nash, “Java Frameworks and Components”, Cambridge University Press, 2002.
4 Phil Hanna, “JSP - The Complete reference”, Tata McGraw-Hill, 2008.
5 http://www.ietf.org.

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SEMESTER - VII

		L	T	P	C
16EE761	**SOFT COMPUTING TECHNIQUES (ELECTIVE)**	3	0	0	3

Prerequisite: *Electronic Circuits, Linear Integrated Circuits & Digital Logic Circuits*

Objectives:

- *To understand the concept of different methods of analog communication.*
- *To gain knowledge of digital communication methods.*
- *To learn the concepts of various coding techniques.*
- *To familiarize in MAC used in communication systems for enhancing the number of users.*

UNIT - I INTRODUCTION [9]

Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.

UNIT - II ARTIFICIAL NEURAL NETWORKS [9]

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principle-component analysis and wavelet transformations. Hopfield network, Self-organizing network and Recurrent network. Neural Network based controller.

UNIT - III FUZZY LOGIC SYSTEM [9]

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.

UNIT - IV EVOLUTIONARY PROGRAMMING [9]

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant -colony search techniques for solving optimization problems.

UNIT - V APPLICATIONS [9]

GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: outline the concept of Intelligent techniques.
CO2: Infer the concepts of artificial neural network.
CO3: Discuss the concepts of fuzzy logic system with Classical system.
CO4: Apply the knowledge of Evolutionary algorithm for solving optimization algorithm.
CO5: Illustrate the applications of soft Computing Techniques

Text Books :

1 Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 1999
2 KOSKO,B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd.,1994.

Reference Books :

1 KLIR G.J. & FOLGER T.A “Fuzzy sets,uncertainity and information”,Prentice _ Hall of india Pvt. Ltd., 1993.
2 Zimmerman H.J. "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 1994.
3 Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers.

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SEMESTER – VII

		L	T	P	C
16EE762	**POWER ELECTRONICS FOR RENEWABLE ENERGY SOURCES (ELECTIVE)**	3	0	0	3

Prerequisite: *power electronics, solid state drives*

Objectives:

- *To Provide knowledge about the stand alone and grid connected renewable energy Systems.*
- *To equip with required skills to derive the criteria for the design of power converters for renewable energy applications*
- *To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.*
- *To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.*
- *To develop maximum power point tracking algorithms.*

UNIT - I INTRODUCTION [9]

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources ocean, Biomass, Hydrogen energy systems : operating principles and characteristics of: Solar PV, Fuel cells, wind electrical systems-control strategy, operating area.

UNIT - II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION [9]

Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT - III POWER CONVERTERS [9]

Solar: Block diagram of solar photo voltaic system : line commutated converters (inversion mode) - Boost and buck-boost converters- selection Of inverter, battery sizing, array sizing.
Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT – IV 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 integrated PMSG and SCIG Based WECS-Grid Integrated solar system.

UNIT - V HYBRID RENEWABLE ENERGY SYSTEMS [9]

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind- PV Maximum Power Point Tracking (MPPT).

Total = 45 Periods

Course Outcomes:

CO1: Ability to understand the functions of renewable energy generation systems.
CO2: Understand the Principles behind the electrical machines for renewable energy conversion.
CO3: Analyze the performance of power converters and its types.
CO4: Analyze the performance of wind and PV systems with grid systems.
CO5: Interpret the concept hybrid systems for renewable energy sources.

Text Books :

1 Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.
2 Rai. G.D,” Solar energy utilization”, Khanna publishes, 1993.

Reference Books :

1 S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electricaal Systems”, Oxford University Press, 2009
2 Rashid .M. H “power electronics Hand book”, Academic press, 2001.

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SEMESTER - VII

16EE763	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION (ELECTIVE)	L	T	P	C
		3	0	0	3

Prerequisite: *Transmission and Distribution, Power System Protection and Switchgear*

Objectives:

- *To understand the concept, and planning of DC power transmission and comparison with AC power transmission.*
- *To analyze HVDC converters and study about compounding and regulation.*
- *To analyze harmonics and design of filters.*
- *To learn about HVDC cables and simulation tools.*

UNIT - I INTRODUCTION [9]

Introduction of DC power transmission – Comparison of AC and DC transmission – Economics of HVDC power transmission, Technical performance and reliability – Description of HVDC transmission system – Planning for HVDC transmission – Modern trends in HVDC transmission – Application of DC transmission.

UNIT - II ANALYSIS OF HVDC CONVERTERS [9]

Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuit – Converter bridge characteristics – Analysis of a 12 pulse converters – Detailed analysis of converters.

UNIT - III COMPOUNDING AND REGULATIONS [9]

General – Required regulation – Inverter compounding – Uncompounded inverter – Rectifier compounding – Transmission characteristics with the rectifier and inverter compounding – Communication link – Current regulation from the inverter side – Transformer tap changing.

UNIT - IV HARMONICS AND FILTERS [9]

Introduction – Generation of harmonics – Characteristics and uncharacteristic harmonics – Design of AC filters and DC filters – Active filters – Interference with neighboring communication lines.

UNIT - V HVDC CABLES AND SIMULATION OF HVDC SYSTEMS [9]

Introduction of DC cables – Basic physical phenomenon arising in DC insulation – Practical dielectrics – Dielectric stress consideration – Economics of DC cables compared with AC cables – Introduction to system simulation – Philosophy and tools – HVDC system simulation – Modeling of HVDC systems for digital dynamic simulation.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Ability to understand the concept of AC, DC, and HVDC transmission.
CO2: Analyze the performance of HVDC converters and its characteristics.
CO3: Interpret the concept of compounding and outline the regulation of HVDC transmission.
CO4: Ability to design the filters to eliminate the harmonics.
CO5: Ability to understand HVDC cables and modeling of HVDC system using simulation.

Text Books :

1 Padiyar, K. R., HVDC Power Transmission System, Wiley Eastern Limited, New Delhi 1992.
2 Edward Wilson Kimbark, Direct Current Transmission, Vol. I, Wiley interscience, New York, London, Sydney, 1971.

Reference Books :

1 Colin Adamson and Hingorani N G, High Voltage Direct Current Power Transmission, Garraway Limited, London, 1960.
2 Arrillaga, J., High Voltage Direct Current Transmission, Peter Pregrinus, London, 1998.
3 Rakosh Das Begamudre, Extra High Voltage AC Transmission Engineering, New Age International (P) Ltd., New Delhi, 1990.
4 Robert L. Shedden, High Voltage Direct Current Transmission, Cornell University, 1971.

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SEMESTER - VII

		L	T	P	C
16EE764	**POWER SYSTEM OPERATION & CONTROL (ELECTIVE)**	3	0	0	3

Prerequisite: *Power Plant Engineering, Transmission and Distribution, Power System Analysis.*

Objectives:

To have an overview of power system operation and control.
To model power–frequency dynamics and to design power–frequency controller.
To model reactive power–voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.

UNIT - I BASICS OF OPERATION CONTROL & ECONOMIC DISPATCH [9]

An overview of PS operation and control – Definitions – Load curves and Economics of generation – Statement of economic dispatch problem – Cost of generation – Incremental cost curve co–ordination equations without loss and with loss, solution by direct method and λ–iteration method (No derivation of loss coefficients).

UNIT - II UNIT COMMITMENT [9]

Statement of Unit Commitment problem – Constraints: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints – Solution methods – Priority–list methods – Forward dynamic programming approach – Qualitative treatment only in priority–list method using full–load average production cost.

UNIT - III REAL POWER – FREQUENCY CONTROL [9]

Basics of speed governing mechanism and modeling – Control area concept – LFC control of a single area system – Static and dynamic analysis of uncontrolled and controlled cases – Integration of economic dispatch control with LFC – Two-area system – Static analysis of uncontrolled case.

UNIT - IV REACTIVE POWER – VOLTAGE CONTROL [9]

Basics of reactive power control – Excitation systems – Modeling – Generation and absorption of reactive power – Relation between voltage, power and reactive power at a node – Method of voltage control – tap–changing transformer – System level control using generator voltage magnitude setting, tap setting of OLTC transformer.

UNIT - V COMPUTER CONTROL OF POWER SYSTEMS [9]

Importance of load forecasting - Linear State estimation - Concept of energy control centre (or) load dispatch centre and the functions – System monitoring – Data acquisition and control – System hardware configuration – SCADA and EMS functions.

Total =45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Outline the concepts of power system operation and control and analyze the concepts of economic dispatch control in power system.
CO2: Infer the concepts of unit commitment problem.
CO3: Analyze the real power and frequency control in power system network.
CO4: Discuss the reactive power and voltage control methods in power system network.
CO5: Explain the computer control of power systems.

Text Books :

1 Allen. J. Wood and Bruce F. Wollenberg, Power Generation, Operation and Control, John Wiley & Sons, Inc., 3RD Edition, 2013.
2 Abhijit Chakrabarti and Sunita Halder, Power System Analysis: Operation and Control, Prentice Hall of India, 2010, 3rd Edition.

Reference Books :

1 Kothari.D.P and Nagrath.I.J, Modern Power System Analysis, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2 Grigsby.L.L, The Electric Power Engineering, Hand Book, CRC Press & IEEE Press, 2012.
3 Kundur.P, Power System Stability and Control, MC Craw Hill Publisher, USA, 1994.
4 Olle.I.Elgerd, Electric Energy Systems theory An introduction, Tata McGraw Hill Publishing Company Ltd. New Delhi, Second Edition 2003.

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SEMESTER – VII

		L	T	P	C
16EE765	**ELECTRIC AND HYBRID VEHICLES (ELECTIVE)**	3	0	0	3

Prerequisite: *Electrical Machines – I and Electrical Machines - II*

Objective:

- *To acquaint the students with electric and hybrid vehicles, energy storage, fuel cells and solar cars*

UNIT – I HYBRID ELECTRIC VEHICLES [9]

Impact of different transportation technologies on environment and energy supply – Air pollution and global warming – History of hybrid electric, electric and fuel cell vehicles – vehicle motion and the dynamic equations for the vehicle – vehicle power plant and transmission characteristics – Fuel economy characteristics of internal combustion engine.

UNIT – II HYBRID POWER TRAIN TOPOLOGY AND DYNAMICS [9]

Basic architecture – Analysis of drive trains and power flows – Drive cycle implications and fuel efficiency estimations – Sizing of components for different hybrid drive train topologies – Topologies for electric drive-train – Fuel efficiency estimations and wheel to wheel fuel efficiency analysis – Sizing of components for different electric drive train topologies.

UNIT – III ELECTRIC PROPULSION UNIT [9]

Electric drives used in HEV/EVs, classifications and characteristics – Induction motor, permanent magnet motors, switch reluctance motors, their configurations and optimization for EV/HEVs. Induction motor drives, Permanent Magnetic Motor drives, switch reluctance motor drives – their control and applications in EV/HEVs – Losses in traction motors, inverters and efficiency maps.

UNIT – IV SIZING OF DRIVES [9]

Sizing the power electronics based on Switch Technology – Switching Frequency and Ripple capacitor design – Selection of energy storage technology – Matching the electric drive and ICE, Transmission selection and gear step selection – Sizing the propulsion motor, its torque, constant power speed ratio and machine dimensions.

UNIT – V VEHICLE POWER MANAGEMENT AND ENERGY STORAGE SYSTEMS [9]

Energy storage, battery based energy storage and simplified models of battery – Fuel cells, Super capacitor, Flywheels and their modeling for energy storage in EHV/BEV – Energy management strategies and its general architecture – Rule and optimization based Energy Management Strategies (EMS).

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explain the hybrid electric vehicles and their characteristics.
CO2: Describe the different hybrid power train topology and fuel efficiency analysis.
CO3: Enlighten the electric propulsion system and the drive motor control system.
CO4: Elucidate the selection of energy storage technology and the sizing of drives.
CO5: Describe the energy management strategies and energy storage systems.

Text Books :

1 Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design, CRC press, 2009.

2 Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010.

Reference Books :

1 James Larminie and John Lowry, Electric Vehicle Technology Explained, John Wiley & Sons Ltd, 2003.

2 Sandeep Dhameja, Electric Vehicle Battery Systems, Butterworth – Heinemann, 2002.

3 Ronald K Jurgen, Electric and Hybrid – Electric Vehicles, SAE, 2002.

4 Ron Hodkinson and John Fenton, Light Weight Electric/Hybrid Vehicle Design, Butterworth –Heinemann, 2001.

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SEMESTER - VII

		L	T	P	C
16EE766	**BIO MEDICAL INSTRUMENTATION (ELECTIVE)**	3	0	0	3

Prerequisite: *Measurement and Instrumentation*

Objectives:

- *To provide knowledge of the physiology of the heart, blood circulation & respiration.*
- *To introduce the student to the sensing and measurement devices of electrical origin.*
- *To provide an idea of instruments used for diagnosis, medical assistance & therapeutic equipments.*

UNIT - I ELECTRO PHYSIOLOGY [9]

Cell & its structure – Electrical and chemical activities – Action and resting potential – Neurons – Axons – Synapse -CNS – PNS - Propagation of electrical impulses along the nerve – Sodium pump – Cardiopulmonary system – Physiology of heart and lung.

UNIT - II BIO POTENTIAL ELECTRODES AND TRANSDUCERS [9]

Components of biomedical instrument system – Electrodes: Micro electrodes, Needle electrodes, Surface electrodes – Transducers: Piezoelectric, Ultrasonic – Passive transducers: Resistive, Capacitive, Inductive – Isolation amplifier– Pre-amplifier – Current amplifier – Chopper amplifier.

UNIT - III INSTRUMENTS USED FOR DIAGNOSIS [9]

ECG – Einthoven triangle – Leads – Electrodes – Measurement of cardiac output, heart rate and heart beat – EEG – EMG EOG– Blood flow measurements – Holter monitor– Respiratory rate measurement – Oximeter–Blood gas analyzer: pH– pCo_2 – pO_2 of blood – Glucometer.

UNIT - IV MEDICAL IMAGING [9]

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of bio telemetry systems – Patient monitoring – Sources of electric hazards and safety techniques.

UNIT - V ASSISTING AND THERAPEUTIC EQUIPMENTS [9]

Pacemaker – Defibrillators – Automated External Defibrillator – Ventilators – Nerve and muscle stimulators – Diathermy – Heart lung machine – Audio meters – Dialysers – Lithotripsy.

Total = 45 Periods

Course Outcomes**: **On Completion of this course, the student will be able to

CO1: Explain the electrophysiological activity of nerves and cardiopulmonary system of the human body.
CO2: Illustrate different types of electrodes and transducers used for the biosignal measurement.
CO3: Outline the procedure used for the measurement of electrical and non-electrical parameters of the human body.
CO4: Explain the working principle and applications of medical imaging systems
CO5: Demonstrate the usage of therapeutic and assisting equipment's in medical applications.

Text Books :

1 R. S. Khandpur, Hand Book of Biomedical instrumentation, Tata McGraw Hill Publishing Co Ltd., Second Edition, 2003.
2 Mandeep Singh, Introduction to Biomedical Instrumentation, PHI Learning Private Ltd, Second Edition, 2014

Reference Books :

1 R. Anandanatarajan, Biomedical Instrumentation and Measurements, PHI Learning Private Ltd., Second Edition, 2013
2 M.Arumugam, Biomedical Instrumentation, Anuradha Agencies, Second Edition, 2002.
3 Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education, Fourth Edition, 2013.
4 Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education, Second Edition, 2002.

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SEMESTER - VII

16EE767	FUNDAMENTALS OF NANOSCIENCE (ELECTIVE)	L	T	P	C
		3	0	0	3

Prerequisite: *Materials Physics, Engineering Chemistry*

Objectives:

- *To study the introduction to Nanoscience and Technology.*
- *To provide adequate knowledge in pattern preparation methods.*
- *To give a basic knowledge in patterning and lithography for nanoscale devices.*
- *To study about the preparation environments.*
- *To impart knowledge on the characterization techniques in nanoscience.*

UNIT - I INTRODUCTION [9]

Nanoscale Science and Technology – Implications for Physics, Chemistry, Biology and Engineering classifications of nano structured materials – Nano particles – Quantum dots, Nano wires – Ultra–thin film sulti layered materials – Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties - Introduction to properties and motivation for study (qualitative only).

UNIT - II PREPARATION METHODS [9]

Bottom–up Synthesis – Top–down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT - III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES [9]

Introduction to optical/UV electron beam and X–ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists – Dip pen lithography.

UNIT - IV PREPARATION ENVIRONMENTS [9]

Clean rooms: Specifications and design, Air and water purity, Requirements for particular processes, Vibration free environments: Services and facilities required – Working practices, Sample cleaning, Chemical purification, Chemical and biological contamination, Safety issues, Flammable and toxic hazards, Biohazards.

UNIT - V 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, SIMS – Nano indentation.

Total = 45 Periods

Course Outcomes**: **On Completion of this course, the student will be able to

CO1: Outline the physical properties of various engineering tools in nano materials
CO2: Elucidate the different types of various approaches in the preparatory
CO3: Explain the methodologies to acquire the real time implementation using nanoscale devices.
CO4: Explain the various environmental factors involved in the nano materials
CO5: Demonstrate the different characterization techniques by using medical applications.

Text Books :

1 Edelstein.A.S and Cammearata.R.C, eds., Nanomaterials: Synthesis, Properties and Applications, (Institute of Physics Publishing, Bristol and Philadelphia, 1996).
2 John Dinardo.N, Nanoscale charecterisation of surfaces & Interfaces, Second edition, Weinheim Cambridge, Wiley–VCH, 2000.

Reference Books :

1 Timp.G (Editor), Nanotechnology, AIP press/Springer, 1999.
2 Akhlesh Lakhtakia (Editor) The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations. Prentice–Hall of India (P) Ltd, New Delhi, 2007.
3 Guozhong Cao, Nanostructures and Nanomaterials –Synthesis, Properties, and Applications Imperial College Press, London (2004).

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SEMESTER – VII

		L	T	P	C
16CS005	**COMPUTER ARCHITECTURE (ELECTIVE) - (Common to CS,EC & EE)**	3	0	0	3

Prerequisite: *Basic knowledge of Digital Electronics*

Objectives:

- *To understand the basic structure and operation of a digital computer.*
- *To study the concepts of pipelining.*
- *To learn the hierarchical memory system including cache and virtual memories.*

UNIT – I BASIC STRUCTURE OF COMPUTERS [9]

Functional Units – Basic Operational Concepts – Performance – Instruction Set Architecture: Instructions and Instruction sequencing – Addressing Modes – RISC and CISC – Fixed Point and Floating Point Operations.

UNIT – II BASIC PROCESSING UNIT [9]

Fundamental Concepts – Instruction Execution – Hardware Components – Instruction Fetch and Execution Steps – Control Signals – Hardwired Control – CISC Style Processors – Micro Programmed Control – Nano Programming.

UNIT – III PIPELINING [9]

Basic Concepts – Pipeline Organization – Pipelining Issues – Data Dependencies – Memory Delays – Branch Delays – Resource Limitations – Performance Evaluation – Superscalar Operation.

UNIT – IV MEMORY SYSTEM [9]

Basic Concepts – Semiconductor RAM Memories – Read Only Memories – Memory Hierarchy– Cache Memories – Performance Considerations – Virtual Memory – Memory Management Requirements – Secondary Storage Devices.

UNIT – V I/O ORGANIZATION [9]

Accessing I/O Devices – Programmed I/O – Interrupt Initiated I/O – Direct Memory Access – Buses – Bus Arbitration – Interconnection Standards: SCSI – USB – Firewire – SATA – PCI Express – I/O Devices and Processors.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Demonstrate the instruction sets with various addressing modes.
CO2: Know how to generate control signals using control units.
CO3: Understand pipelining concepts.
CO4: Determine the performance of memory in commercial processor.
CO5: Know how to organize I/O devices.

Text Book :

1 Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, "Computer Organization and Embedded Systems", 6thEdition, McGraw Hill, 2012.

References :

1 M.Morris Mano, "Computer System Architecture", 3rd Edition, McGraw Hill Reprint, 2012.
2 William Stallings, "Computer Organization and Architecture – Designing for Performance", 8th Edition, Prentice Hall, 2010.
3 David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", 5th Edition, Elsevier, 2014.
4 www.nptel.ac.in/courses/106102062.

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SEMESTER –VII

		L	T	P	C
16CS788	**MOBILE APPLICATION DEVELOPMENT (ELECTIVE)**	3	0	0	3

Prerequisite: *Exposure to computer programming*

Objectives:

- *To expose students in mobile app development environment and introduce them to use Android SDK.*
- *To learn about building blocks of mobile apps*
- *To explore the knowledge of handling database, graphics and animation in mobile app.*
- *To know the knowledge of using multimedia, location services and sensors in mobile app.*
- *To get the knowledge of testing and publishing Android App Components.*

UNIT - I OVERVIEW OF MOBILE APP DEVELOPMENT [9]

Introduction – Mobile Platforms – Mobile App Development Approaches – Overview of Android Platform, Setting up the Mobile App Development Environment –Traversing an Android App Project Structure, Logical Components of an Android App – Android Tool Repository – Installing and Running App Devices – Mobile App Development Challenges.

UNIT - II BUILDING BLOCKS OF MOBILE APPS [9]

App user interface: Activity – Mobile UI resources – UI Elements and Events – Activity States and Life Cycle, Interaction amongst activities – Fragments – Action Bar. App Functionality Beyond User Interface: Threads –Async task – Service – Notifications – Intents – Broadcast Receivers – Telephony and SMS.

UNIT - III DATA HANDLING, GRAPHICS AND ANIMATION [9]

App Data Persistence and Access: Introduction – Flat files – Shared preferences – Relational Data – Data Sharing Across Apps – Enterprise Data. Graphics and Animation: Introduction – Android Graphics – Android Animation.

UNIT - IV MULTIMEDIA, LOCATION SERVICES AND SENSORS [9]

Multimedia: Introduction – Audio, Video and Images – Playback – Capture and Storage. Location Services: Introduction – Google Play Services – Location services – Maps. Sensors: Introduction – Sensors in Android – Android Sensor Framework – Motion Sensors – Position Sensors – Environment Sensors.

UNIT - V TESTING AND PUBLISHING [9]

Testing Android Apps: Introduction – Testing Android App Components – App Testing Landscape Overview. Publishing Apps: Introduction – Groundwork – Configuring – Packaging –Distributing.

Total = 45 Periods

Course Outcomes: On completion of this course, the student will be able to:

CO1: Familiarize with Mobile apps development aspects.
CO2: Develop mobile apps using Android as development platform with key focus on user experience design, native data handling and background tasks and notifications.
CO3: Appreciation of nuances such as native hardware play, location awareness, graphics, and multimedia.
CO4: Perform testing, signing and packaging.
CO5: Understand the distribution of mobile apps.

Text Book :

1 AnubhavPradhan and Anil V Deshpande, Composing Mobile Apps, Wiley India Pvt. Ltd, Reprint 2013.

References :

1 B.M.Harwani, Android programming Unleashed, Pearson Publication, First Edition,sams,2013
2 Carmen Delessio,LaurenDarcey and Shane Conder, Android Application Development, SAMS publication, Third Edition, 2014.
3 Reto Meier, Professional Android 4 Application Development, Wiley India Pvt Ltd, Reprint 2014.
4 https://www.youtube.com/watch?v=m20n_GAsCtM

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SEMESTER – VII

		L	T	P	C
16HS003	**DISASTER PREPAREDNESS AND MANAGEMENT (ELECTIVE)- (Common to CS, EE & IT)**	3	0	0	3

Prerequisite: *No Prerequisites needed for enrolling into the course*

Objective:

- *To make the students learn about the aspects of disaster and risk management.*

UNIT - I DISASTER AND DEVELOPMENT [9]

Introduction ,Nature and Dimension of the challenge, Linking Disaster and Development, Sustainable development, Disruption of development by disasters, causes of Disasters – Development opportunities afforded by disasters – Varied impact on states in India. HAZARDS: Definition, principles, Impact of Disasters, Levels of Disaster, Effect of Disasters, Causal factors, Phases of Disaster**.**

UNIT - II DISASTERS DIMENSIONS AND TYPOLOGY [9]

Different calamities – Typology of Disasters: Earthquakes, Tsunamis, Volcanoes, Landslides Tropical cyclones, Floods, Environmental pollution, Deforestation – Desertification, Pest Infestations, Epidemics, Chemical and industrial accidents, Trends in climatology, meteorology and hydrology - seismic activity- Case Study.

UNIT - III DISASTER PREVENTION AND CONTROL [9]

United Nations Disaster Relief Coordinator (UNDRO): Disaster relief and management, prevention, preparedness, Stand by capacity – Coordination, cooperation and leadership Continuum from relief to rehabilitation and development – Checklists and reporting formats by UNDMT and international emergency assistance requirement.

UNIT - IV DISASTER MANAGEMENT IN INDIA [9]

Issues – National policy – Historical Framework – Funding mechanisms – Calamity Relief Fund (CRF) – The Disaster management Act 2005 – Indian Agencies for disaster management – National Civil Defense Organisation

UNIT - V DISASTER PREPAREDNESS AND PLANNING [9]

Introduction, Objectives – Disaster planning, Strategies for disaster preparedness and planning – Principles, Myths, Factors influencing disaster risk - Assessing risk in a context of uncertainty - Disaster insurance – use of the media in information dissemination – Types of media and their information needs.

Total = 45 Periods

Course Outcomes: ***On Completion of this course, the student will be able to***

CO1: Understand the nature and causes of disaster
CO2: Assess risk and take steps to mitigate various types of disaster
CO3: Handle psychological trauma and stress
CO4: Approach relief and funded organization to prevent disaster
CO5: Apply recent strategies towards disasters preparedness and planning

Text Books :

1 SatishModh, Introduction to disaster management, first published , macmillian publishers India ltd, New Delhi, 2012
2 PardeepSahni, Disaster Risk Reduction in South Asia, 4th Edition ,PHI Learning, New Delhi, 2011

Reference Books :

3 M. Saravanakumar, Disaster Management, 1stEdititon, Himalaya Publishing House,2010
4 Singh, Disaster Management: Future Challenges, 1stEdititon, IK International, New Delhi,2007.
5 Arvind Kumar Disaster Management – Recent Approaches Anmol Publications, 1stEdititon, New Delhi, 2006.
6 Goel, S. L, Encyclopedia of Disaster Management, 3rd Edition, Deep & Deep Publications Pvt Ltd, New Delhi, 2010

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SEMESTER -VIII

		L	T	P	C
16EE861	**SIMULATION OF POWER ELECTRONIC SYSTEMS (ELECTIVE)**	3	0	0	3

Prerequisite: *Power Electronics*

Objectives:

- To impart knowledge on need for Simulation and Modeling of Power Electronic Systems, Circuit description using PSPICE.
- To know the Concepts of Matlab and Simulink.
- To learn the Simulation of drives using PSPICE, Matlab and Simulink.

UNIT - I Introduction [9]

Need for Simulation - Challenges in simulation - Classification of simulation programs - Overview of PSPICE, MATLAB and SIMULINK.

Mathematical Modeling of Power Electronic Systems: Static and dynamic models of power electronic switches - Static and dynamic equations and state-space representation of power electronic systems.

UNIT - II PSPICE [9]

File formats - Description of circuit elements - Circuit description – Output variables -Dot commands - SPICE models of Diode, Thyristor, Triac, BJT, Power MOSFET,IGBT and MCT.

UNIT - III Matlab and Simulink [9]

Toolboxes of MATLAB - Programming and file processing in MATLAB – Model definition and model analysis using SIMULINK - S-Functions - Converting S-Functions to blocks.

UNIT - IV Simulation using PSPICE, Matlab and Simulink [9]

Diode rectifiers -Controlled rectifiers - AC voltage controllers - DC choppers – PWM inverters – Voltage source and current source inverters - Resonant pulse inverters - Zero current switching and zero voltage switching inverters.

UNIT - V Simulation of Drives [9]

Simulation of speed control schemes for DC motors – Rectifier fed DC motors –Chopper fed DC motors – VSI and CSI fed AC motors – PWM Inverter – DC link inverter.

Total= 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Discuss the overview of simulation programs and modeling of power electronic systems.
CO2: Describe the SPICE models of various circuit elements.
CO3: Outline the programming and file processing in Matlab.
CO4: Design the various power electronic circuits using Pspice, Matlab and Simulink.
CO5: Design the various speed control schemes for electric drives.

Text Books :

1 Ramshaw. E., Schuuram D. C., “PSpice Simulation of Power Electronics Circuits – An Introductory Guide”, Springer, New York, 1996.
2 Chee-Mun Ong, "Dynamic Simulation of Electric Machinery: Using MATLAB/ Simulink", Prentice Hall PTR, New Jersey, 1998.

Reference Books :

1 Ned Mohan, "Power Electronics: Computer Simulation Analysis and Education using PSPICE", Minnesota Power Electronics Research and Education, USA, 1999.
2 Bimal K Bose, "Power Electronics and Variable Frequency Drives", IEEE Press, New Jersey, 1997.
3 "The PSpice User's Guide", Microsim Corporation, California, 1996.

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SEMESTER - VIII

		L	T	P	C
16EE862	**POWER QUALITY (ELECTIVE)**	3	0	0	3

Prerequisite: *Power Electronics, Transmission and Distribution*

Objectives:

- *To study the various issues affecting power quality.*
- *To understand the sources and effects of voltage sags and interruptions.*
- *To explore the concepts of transients.*
- *To implicit the awareness of harmonics and to know about devices for controlling harmonic distortion.*
- *To study the various methods of power quality monitoring.*

UNIT - I INTRODUCTION TO POWER QUALITY [9]

Definitions: Power quality, voltage quality – Need for power quality – Power quality issues: short duration voltage variations, long duration voltage variations, voltage imbalance, voltage fluctuations, waveform distortion, transients, power frequency variations – Power Acceptability Curves – Power quality problem evaluation.

UNIT - II VOLTAGE SAGS AND INTERRUPTIONS [9]

Sources of voltage sags and interruptions – Estimating voltage sag performance – Motor starting sags – Estimating the voltage sag severity – Devices for mitigation of voltage disturbances: Active series compensator, Static VAR compensator, Uninterruptable Power Supply (UPS), Buck-Boost regulators and Static transfer switches and fast transfer switches.

UNIT - III TRANSIENT OVERVOLTAGES [9]

Sources of transient over voltages: Capacitor switching, lightning, ferroresonance – Principle of overvoltage protection – Mitigation of overvoltage: surge arresters, isolation transformers, low pass filters and low impedance power conditioners – Lightning protection: Shielding, line arresters and cable protection – An introduction to computer analysis tools for transients, PSCAD and EMTP.

UNIT - IV HARMONICS [9]

Definitions: Harmonics, Harmonics indices, Harmonic Distortion Factor (HDF), Total Harmonic Distortion (THD), Inter harmonics, Notching – Voltage Vs Current distortion – Sources and effects of harmonic distortion – Power system response characteristics – Devices for controlling harmonic distortion: Passive and active filters – Computer tools for harmonic analysis –IEEE 5192-555 Standards for Harmonics.

UNIT - V POWER QUALITY MONITORING [9]

Need for power quality monitoring – Monitoring considerations – Power quality measurement equipment – Assessment of power quality data – Applications of expert system in power quality monitoring – Standards on power quality monitoring.

Total = 45 Periods

Course Outcomes:

CO1: Distinguish between the various categories of power quality problems, root of the power quality problems in industry and their impacts.

CO2: Explore the sources and effects of voltage sags, interruptions and solution techniques for power quality mitigation.

CO3: Illustrate the concepts of transients and its controlling overvoltage techniques.

CO4: Explain the concepts of harmonics and to know about devices for controlling harmonic distortion

CO5: Discuss the various methods and applications of expert system in power quality monitoring.

Text Books :

1 Roger C.Dugan, Mark F.McGranaghan and H.Wayne Beaty, Electrical Power Systems Quality, McGraw-Hill, New York, 2nd Edition, 2012.

2 Math H.J.Bollen, Understanding Power Quality Problems: Voltage Sags and Interruptions, IEEE Press, New York, 2000.

Reference Books :

1 Barry W.Kennedy, Power Quality Primer, McGraw-Hill, New York, 2000.

2 Sankaran.C, Power Quality, CRC Press, Washington, D.C., 2002.

3 Arrillaga.J, Watson.N.R and Chen.S, Power System Quality Assessment, John Wiley & Sons Ltd., England, 2000.

4 Arindam Ghos and Gerard Ledwich, Power Quality Enhancement using Custom Power Devices, Springer (India) Pvt. Limited, 2009.

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SEMESTER - VIII

		L	T	P	C
16EE863	**SMART GRID TECHNOLOGY (ELECTIVE)**	3	0	0	3

Prerequisite: *Microprocessor and Microcontroller, Transmission and Distribution*

Objectives:

- *To learn and Understand concepts and principles of communications technologies for smart grid*
- *To Analyze the tradeoff of different communication architectures and protocols.*
- *To Understand the data management issues associated with smart grid*
- *To Understand the security issues in smart grid and solution approaches.*

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, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives..

UNIT - II SMART GRID TECHNOLOGIES [9]

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, V2G, G2V.

UNIT - III SMART METERS AND ADVANCED METERING INFRASTRUCTURE [9]

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI Phasor measurement Unit(PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection

UNIT - IV POWER QUALITY MANAGEMENT IN SMART GRID [9]

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT - V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS [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, Cyber Security for Smart Grid.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Illustrate the fundamentals of Smart Grid System.
CO2: Describe about structural units in embedded processor architecture
CO3: Outline the various types of smart meters and advanced metering infrastructure.
CO4: Explain the concept of power quality management issues in Smart Grid.
CO5: Describe the features of high performance computing for smart grid applications

Text Books :

1 Janaka Ekanayake, “Smart grid: Technology and applications”, Wiley publication, 2012
2 Wayne wolf, Computers as components: Principles of embedded computing system design, Morgan Kaufmann publishers, Third Edition, 2012.

Reference Books :

1 Stuart Borlase “Smart Grid :Infrastructure, Technology and Solutions”,CRC Press 2012.
2 James Momoh ,”Smart grid: Fundamentals of Design and Analysis”, Wiley publication, 2012.
3 Buchholz, Bernd M., Styczynski, Zbigniew, Smart Grids – Fundamentals and Technologies in Electricity Networks, Springer publication, 2014
4 Uslar, “Standardization in Smart Grids: Introduction to IT related Methodologies, Architectures and Standards”, Wiley publication, 2013

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SEMESTER - VIII

		L	T	P	C
16EE864	**HIGH VOLTAGE ENGINEERING (ELECTIVE)**	3	0	0	3

Prerequisite: *Transmission and Distribution, Power System Protection and Switchgear*

Objectives:

- *To expose the students to the various breakdown mechanisms in gas, vacuum, liquid, solid dielectrics.*
- *To understand the generation of high voltages and high currents.*
- *To understand the measurement of high voltages and high currents.*
- *To study the various types of testing of power apparatus and insulation coordination.*

UNIT - I ELECTRIC BREAKDOWN IN GASES AND VACCUM [9]

Ionization and Decay Processes: Ionization by Collision Photo-ionization and Secondary Ionization Processes Electric Breakdown in Gases: Townsends Breakdown Mechanism - Breakdown in Electronegative Gases-Time Lags for Breakdown-Streamer Mechanism of Spark Paschen's Law Gaseous Breakdown in Non-uniform Fields-Corona Discharges Practical Considerations using Gases for Insulation Purposes - Mechanisms for Breakdown in Vacuum Insulation.

UNIT - II ELECTRIC BREAKDOWN IN LIQUIDS AND SOLIDS [9]

Electric Breakdown in Liquids: Properties of Liquid Dielectrics - Conduction and Breakdown in Pure Liquids – Conduction and Breakdown in Commercial Liquids: Suspended Particle Mechanism - Cavitation and Bubble Mechanism - Stressed Oil Volume Mechanism – Breakdown in Solids: Electromechanical Breakdown - Thermal Breakdown - Electrochemical Breakdown - Breakdown due to Treeing and Tracking - Breakdown due to Internal Discharges – Breakdown in Composite Insulation.

UNIT - III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS [9]

Generation of High DC Voltages: Greinacher Voltage Doublers Circuit - Cockcroft Walton Voltage Multiplier Circuit - Van de Graff Generator - Generation of High Alternating Voltages: Cascade Transformers - Resonant Transformers – Generation of High Frequency AC High Voltages: Tesla Coils - Generation of Impulse Voltages: Standard Lightning & Switching Impulse Wave shape - Marx Circuit – Switching Impulse Voltage Generation Circuits – Generation of Impulse Currents – Tripping and Control of Impulse Generators.

UNIT - IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS [9]

Measurement of High DC Voltages: Series Resistance Micro-ammeter - Resistance Potential Dividers - Generating Voltmeters – Measurement of High AC Voltages: Series Impedance Voltmeter - CVT - Electrostatic Voltmeters – Sphere Gaps for Measurement of High DC, AC and Impulse Voltage Measurements – Potential Dividers for Impulse Voltage Measurements – Measurement of High DC, AC and Impulse currents: DC Current Transformer - Hall Generator - Rogowski Coils - Electro Optical Technique - Magneto Optical Method – CRO for Impulse Measurements.

UNIT - V HIGH VOLTAGE TESTING AND INSULATION CO-ORDINATION [9]

Testing of Insulators – Testing of Bushings – Testing of Isolators and Circuit Breakers – Testing of Cables – Testing of Transformers – Testing of Surge Arresters – Radio Interference Measurements – Statistical Approach to Insulation Coordination.

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Ability to understand the basic concepts of various breakdown processes occurring in gases and vacuum insulations.

CO2: Ability to realize the concepts of various breakdown processes occurs in liquid and solid insulating materials.

CO3: Demonstrate the generation of high DC, AC, impulse voltages and generation of high DC, AC, and impulse currents.

CO4: Illustrate the various techniques used in the measurement of high DC, AC, impulse voltages and currents.

CO5: Apply a testing procedure to test the various high voltage electrical power apparatus.

Text Books :

1 M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, 5th Edition, New Delhi, 2013.

2 C.L.Wadhwa, 'High Voltage Engineering', New Age International Private Ltd, 3rd Edition, New Delhi, 2012.

Reference Books :

1 E.Kuffel and M.Abdullah, 'High Voltage Engineering', Pergamon Press, Oxford, London, 1970.

2 R.Arora and W.Mosch, 'High Voltage Insulation Engineering', New Age International Publishers Limited, New Delhi, 1995.

3 E.Kuffel and W.S.Zaengl, 'High Voltage Engineering: Fundamentals', 2nd Edition, Newnes, 2000.

4 Dieter Kind and Kurt Feser, 'High-Voltage Test Techniques', Newnes, 2001.

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SEMESTER - VIII

		L	T	P	C
16EE865	**COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS (ELECTIVE)**	3	0	0	3

Prerequisite: *Electrical machines I and Electrical machines II*

Objectives:

- *To introduce the importance of computer aided design method.*
- *To provide basic electromagnetic field equations and the problem formulation for CAD applications.*
- *To get familiarized with Finite Element Method as applicable for Electrical Engineering.*
- *To introduce the organization of a typical CAD package.*
- *To introduce Finite Element Method for the design of different Electrical apparatus.*

UNIT - I INTRODUCTION [9]

Conventional design procedures – Limitations – Need for field analysis based design – Review of Basic principles of energy conversion – Development of Torque/Force.

UNIT - II MATHEMATICAL FORMULATION OF FIELD PROBLEMS [9]

Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in Electric and Magnetic fields – Capacitance - Inductance- Laplace and Poisson's Equations – Energy functional.

UNIT - III PHILOSOPHY OF FEM [9]

Mathematical models – Differential/Integral equations – Finite Difference method – Finite element method – Energy minimization – Variational method- 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.

UNIT - IV CAD PACKAGES [9]

Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties- Boundary Conditions – Setting up solution – Post processing..

UNIT - V DESIGN APPLICATIONS [9]

Voltage Stress in Insulators – Capacitance calculation - Design of Solenoid Actuator – Inductance and force calculation – Torque calculation in Switched Reluctance Motor.

Total =45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Understand the basic principles of design procedure.
CO2: Able to develop the basic mathematical formulation techniques of CAD.
CO3: Understand the concept of FEM for designing electrical apparatus.
CO4: Implement any design functions using CAD.
CO5: Formulate and solve the optimum design problems with computers.

Text Books :

1 S.J Salon, 'Finite Element Analysis of Electrical Machines', Springer, YesDEE publishers, Indian reprint, 2007..
2 Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor & Francis, 2005.

Reference Books :

1 Joao Pedro, A. Bastos and Nelson Sadowski, 'Electromagnetic Modeling by Finite Element Methods', Marcell Dekker Inc., 2003.
2 P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press, 1983.
3 D.A.Lowther and P.P Silvester, 'Computer Aided Design in Magnetics', Springer Verlag, New York, 1986.
4 S.R.H.Hoole, 'Computer Aided Analysis and Design of Electromagnetic Devices', Elsevier, New York, 1989.

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SEMESTER - VIII

		L	T	P	C
16EE866	**DIGITAL IMAGE PROCESSING (ELECTIVE)**	3	0	0	3

***Prerequisite**: Digital Signal Processing*

Objectives:

- *To study the image fundamentals and mathematical preliminaries necessary for image processing.*
- *To impart knowledge on image enhancement and restoration techniques.*
- *To study the methods of image segmentation, recognition and compression*

UNIT - I DIGITAL IMAGE FUNDAMENTALS [9]

Introduction –Elements of digital image processing systems -Elements of visual perception, brightness, contrast, hue, saturation - Color image fundamentals - Color models -Mach Band effect - Image sampling and Quantization, Dither.

UNIT - II IMAGE ENHANCEMENT [9]

Basic Gray Level Transformations - Histogram equalization and specification - Spatial averaging- Smoothing filters-Sharpening filters - Median, Geometric mean, Harmonic mean, Contraharmonic mean filters, Homomorphic filtering Application to medical images.

UNIT - III IMAGE RESTORATION [9]

Image restoration - degradation model, Noise models- Unconstrained and Constrained restoration, Inverse filtering-Wiener filtering, Geometric transformations-Spatial transformations, Gray Level interpolation. Application to medical images.

UNIT - IV IMAGE SEGMENTATION AND RECOGNITION [9]

Image segmentation – Line and Edge detection – Edge linking and boundary detection – Region growing, Region splitting and Merging – Image Recognition – Patterns and pattern classes –Matching by minimum distance classifier – Matching by correlation.

UNIT - V IMAGE COMPRESSION [9]

Need for data compression – Redundancy – Huffman, Arithmetic coding, Run Length Encoding, Shift codes,– Vector Quantization – Transform coding – JPEG, MPEG and GIF standards.

Total = 45 Periods

Course Outcomes**: **On Completion of this course, the student will be able to

CO1: Explain the basic concepts of image signal, sampling and quantization.
CO2: Discuss the effect of quality enhancement techniques on images.
CO3: Illustrate the methodology of image restoration algorithms.
CO4: Describe the procedure of image segmentation and recognition methods to digital images.
CO5: Apply image compression algorithms to digital Images.

Text Books :

1 Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson India Education Services Pvt. Ltd., Third Edition, 2014.
2 Anil K. Jain, Fundamentals of Digital Image Processing, Pearson India Education Services Pvt. Ltd., First Edition, 2015.

Reference Books :

1 S.Jayaraman, S. Esakkirajan, T.Veerakumar, "Digital Image Processing, Tata Mc Graw Hill, Third Edition, 2009.
2 Malay K.Pakhira, Digital Image Processing and Pattern Recognition, PHI Learning Private Limited, First Edition, 2015
3 David Salomon, "Data Compression – The Complete Reference", Springer Verlang, Fourth Edition, 2006.
4 C. Rafael Gonzalez, E. Richard Woods, Steven Eddins, Digital Image Processing using MATLAB, Pearson India Education Services Pvt. Ltd., 2010.

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SEMESTER - VIII

		L	T	P	C
16EE867	**MICRO ELECTRO MECHANICAL SYSTEMS (ELECTIVE)**	3	0	0	3

Prerequisite: *Linear Integrated Circuits, Digital Logic Circuits, VLSI Design*

Objectives:

- *To integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices.*
- *To understand the rudiments of Micro fabrication techniques.*
- *To identify and understand the various sensors and actuators.*
- *To different materials used for MEMS and applications of MEMS.*

UNIT - I INTRODUCTION TO MICROSYSTEMS [9]

Intrinsic Characteristics of MEMS – Energy Domains and Transducers – Sensors and Actuators– Introduction to Micro fabrication – Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending – Torsional deflection.

UNIT - II SENSORS AND ACTUATORS- I [9]

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor– Comb drive devices – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Applications – Magnetic Actuators – Micromagnetic components– Case studies of MEMS in magnetic actuators.

UNIT - III SENSORS AND ACTUATORS-II [9]

Piezoresistive sensors – Piezoresistive sensor materials – Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT - IV MICROMACHINING [9]

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies – Basic surface micromachining processes – Structural and Sacrificial Materials –Acceleration of sacrificial Etch – Striction and Antistriction methods – Assembly of 3D MEMS – Foundry process.

UNIT - V POLYMER AND OPTICAL MEMS [9]

Polymers in MEMS – Polimide – SU–8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA –Parylene – Fluorocarbon – Application to Acceleration, Pressure, Flow and Tactile sensors –Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS

Total = 45 Periods

Course Outcomes: On Completion of this course, the student will be able to

CO1: Explore the basics of semiconductors and solid mechanics to fabricate MEMS devices
CO2: Explain the various sensors used in MEMS
CO3: Identify and understand the various actuators
CO4: Explain the concepts of Micromachining and different materials used for MEMS
CO5: Categorize the various applications of MEMS

Text Books :

1 Chang Liu, Foundations of MEMS, (ILLINOIS ECE Series), Pearson Education International, (2nd Edition) 2011.

2 Tai–Ran–Hsu, MEMS & Microsystems: Design, Manufacture, and Nanoscale Engineering, 2nd Edition, John Wiley and Sons , New Delhi, 2008.

Reference Books :

1 Nadim Maluf, Kirt Williams, Introduction to Microelectromechanical Systems Engineering, Artech House, 2004.

2 Mohamed Gad–el–Hak, Editor, The MEMS Handbook, CRC Press Baco Raton, 2000.

3 Julian W. Gardner, Vijay K. Varadan, Osama O.Awadelkarim,Micro Sensors Mems and Smart Devices, John Wiley & Son Ltd, 2002.

4 James J.Allen, Micro Electro Mechanical System Design, CRC Press Published in 2005.

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SEMESTER -VIII

		L	T	P	C
16EE868	**ROBOTICS AND INDUSTRIAL AUTOMATION (ELECTIVE)**	3	0	0	3

Prerequisite: *Electrical Machines, Special Electrical Machines*

Objectives:

- *To give a basic knowledge of robots and their types.*
- *To study in detail the power sources, sensors, manipulators, actuators, grippers*
- *Involved with robots and kinematics.*

UNIT - I INTRODUCTION [9]

Robotics and Automation - Definition and Origin of Robotics - Historical Development – Basic structure of Robots - Complete Classification of Robots - Fundamentals about Robot Technology - Asimov's laws of Robotics - Dynamic Stabilization of Robotics - Basic Robot Configurations and their Relative Merits and Demerits.

UNIT - II POWER SOURCES AND SENSORS [9]

Types of Drive Systems - Hydraulic, Pneumatic and Electric Drives Block Diagram Approach -Determination of HP of Motor and Gearing Ratio - Variable Speed Arrangements – Path Determination - Micro Machines in Robotics - Machine Vision - Ranging, Laser, Acoustic, Magnetic, Fiber Optic, Tactile and Intelligent Sensors Definition and Use.

UNIT - III MANIPULATORS AND GRIPPERS [9]

General Description of Robot Manipulator - Construction of Manipulators - Manipulator Motions - Manipulator Dynamics and Force Control - Electronics and Pneumatic Manipulator Control Circuits - End Effectors - Mechanism of Gripping - U Various Types of Grippers – Design Considerations.

UNIT - IV KINEMATICS AND PATH PLANNING [9]

Robot kinematics - Kinematic Equations, Forward and Inverse Kinematics - Solution of Inverse Kinematics Problem - Multiple Solution Jacobian Work Envelope - Hill Climbing Techniques - Robot Programming Languages.

UNIT - V APPLICATIONS [9]

Selection of Robot - Robot Applications in Industry - Design a Modern Robot for Manufacturing and Non-Manufacturing Industry - Robot Cell Design - Future Applications and Challenges.

Total = 45 Periods

Course Outcome: ***On Completion of this course, the student will be able to***

CO1: Explain the robot technology as their fundamental principles, laws and robot configurations
CO2: Illustrate the various drive systems ,power sources and the concepts of sensors to control the robots
CO3: outline the design configurations of manipulators , grippers and end effector mechanism in robots
CO4: Outline the robot kinematics ,programming language and the concepts of path planning for robotics
CO5: Understand the wide range of robotic application of manufacturing and non-manufacturing sector

Text Books :

1 Mikell P. Groover,,Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill, Singapore, 1996.
2 Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998

Reference Books :

1 Deb S.R., Robotics Technology and Felxible Automation, 2nd edition, John Wiley, USA 2010.
2 Asfahl C.R., Robotics and Manufacturing Automation, 2nd edition, John Wiley, USA 1992.
3 Mc Kerrow P.J., Introduction to Robotics, Addison Wesley, USA 1991.
4 Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering - An Integrated Approach, Prentice Hall of India, New Delhi, 1994

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SEMESTER – VIII

		L	T	P	C
16CS003	**OPERATING SYSTEMS (ELECTIVE)- (Common To CS, EC & EE)**	3	0	0	3

Prerequisite: *Basic knowledge of Computer Architecture*

Objective:

- *To gain the Knowledge about the operating systems concepts such as process, CPU scheduling, deadlocks, process synchronization, memory management, disk and file.*

UNIT – I BASIC OPERATING SYSTEMS CONCEPTS [9]

Introduction to Operating Systems – Computer System Architecture: Single Processor Systems – Multiprocessor Systems Operating System Structure – Process Memory and Storage Management – Protection and Security – Computing Environments – OperatingSystem Services – System Calls: Types of System Calls – System Programs – Process: Process Concept – Process Scheduling – Operation on Processes – Cooperating Process - Inter Process Communication.

UNIT – II THREADS AND CPU SCHEDULING [9]

Threads: Overview – Multithreading Models – Thread Issues – CPU Scheduling: Basic Concepts – Scheduling Criteria – Scheduling Algorithms – Multiple Processor Scheduling – Real-Time CPU Scheduling – Process Synchronization: The Critical Section Problem – Peterson's Solution – Synchronization Hardware – Semaphores – Classic Problems of Synchronization.

UNIT – III DEADLOCKS AND MEMORY MANAGEMENT [9]

Deadlocks :System Model – Deadlock Characterization – Methods for Handling Deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock Detection – Recovery from Deadlock – Memory Management: Background – Swapping – Contiguous memory Allocation – Segmentation – Paging – Structure of the Page Table.

UNIT – IV VIRTUAL MEMORY AND FILE SHARING INTERFACE [9]

Virtual Memory: Demand Paging – Copy-on-Write – Page Replacement – Allocation of Frames – Thrashing – File Concepts: Access Methods – Directory Structure – File System Mounting – File Sharing – Protection

UNIT – V FILE SYSTEM STRUCTURE AND STORAGE STRUCTURE [9]

File System Structure – File System Implementation: Directory Implementation – Allocation Methods – Free space Management – Mass Storage Structure : Disk Structure – Disk Scheduling – Disk Management – Swap-Space Management – RAID structure – I/O Systems: I/O Hardware – Kernel I/O Subsystem – Case Study: The Linux System.

Total =45 Periods

Course Outcomes: On Completion of this course, the student will be able to:

CO1: Identify the components and their functionalities in the operating system
CO2: Determine the efficiency of CPU scheduling algorithms.
CO3: Evaluate the performance of various memory management techniques.
CO4: Be familiar with virtual memory and file access methods.
CO5: Study the performance of disk management and file system

Text Book :

1 Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons,9thEdition, 2013.

References :

1 Andrew S. Tanenbaum, "Modern Operating Systems", Prentice Hall, 3rd Edition, 2008.
2 D. M. Dhamdhere, "Operating Systems", Tata McGraw-Hill Education India, 2nd Edition, 2006.
3 Paul J. Deitel and David R. Choffnes, "Operating Systems", Prentice Hall, 3rd Edition, 2003.
4 http://nptel.ac.in/courses/106108101.

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SEMESTER VIII

		L	T	P	C
16HS002	**TOTAL QUALITY MANAGEMENT (ELECTIVE)- (Common to AU, CE, EE, IT & ME)**	3	0	0	3

Prerequisite: *No prerequisites are needed for enrolling into the course.*

Objective:

- *To understand the Total Quality Management concept, tools available to achieve quality in every process of operations.*

UNIT - I INTRODUCTION [9]

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM implementation steps – Quality council-Importance of leadership and motivation in TQM - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT - II TQM PRINCIPLES [9]

Quality statements - Customer perception of quality – Customer complaints, Customer retention. Employee involvement , Empowerment, Team and Teamwork, Recognition and Reward - Continuous process improvement – Juran trilogy, PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT - III STATISTICAL PROCESS CONTROL [9]

The seven traditional tools of quality – Measurement of central tendency and dispersion, population and sample, normal curve, control chart (X,R,p) for variable and attributes, process capability - Seven new management tools – Six-sigma Concepts.

UNIT - IV TQM TOOLS [9]

Bench marking – reason , process – Quality circles concepts - FMEA – stages, types– Quality Function Deployment (QFD) – Taguchi quality loss function –TPM – concepts, improvement needs –Performance measures-criteria – Quality Cost.

UNIT - V QUALITY SYSTEMS [9]

Need for ISO 9000 – ISO 9001-2008, ISO 14000 Quality System – elements, implementation, Documentation. Quality auditing – concepts, requirements and benefits, non conformance report – Case studies of TQM implementation in manufacturing and service sectors.

Total = 45 Periods

Course Outcomes: ***On Completion of this course, the student will be able to***

CO1: Explore TQM framework to improve the quality of the products and services.
CO2: Apply TQM principles for continuous process improvement
CO3: Interpret statistical tools to control and improve the quality of the products and services.
CO4: Implement the tools and techniques to improve the quality concept
CO5: Understand the quality system in manufacturing and service sectors**.**

Text Book :

1 Dale H.Besterfiled, et at., “Total Quality Management”, Pearson Education Asia,Third Edition, Indian Reprint 2006.

Reference Books :

1 Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”,Prentice Hall (India) Pvt. Ltd., 2006
2 Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India)Pvt. Ltd.,2006.
3 James R. Evans and William M. Lindsay, “The Management and Control of Quality”,6th Edition, South-Western (Thomson Learning), 2005.
4 Subburaj R, Total Quality Management, Tata McGraw Hill, New Delhi 2005