

NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai & Accredited by NAAC)

K.R.NAGAR, KOVILPATTI – 628 503

www.nec.edu.in

REGULATIONS – 2015 CURRICULUM & SYLLABUS

B. E. – ELECTRICAL AND ELECTRONICS ENGINEERING
Accredited by NBA

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

Promoting active learning, critical thinking coupled with ethical values to meet the global challenges.

MISSION

- To instill state-of-the-art technical knowledge and research capability that will prepare our graduates for professionalism and life-long learning.
- To update knowledge to meet industrial and real world challenges.
- To inculcate social and ethical values.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. Excel in industrial or graduate work in Electrical Engineering and allied fields.
2. Practice their profession conforming to ethical values and active participation in the affairs of the profession.
3. Adapt to evolving technologies and stay current with their profession.

PROGRAM OUTCOMES (POs)

POs describe the expectation of students to know by the time of graduation from the programme. At the time of graduation, our EEE graduates are expected to:

1. Apply knowledge of mathematics, natural science, engineering fundamentals, power electronics and drives, power and energy systems, high voltage engineering, control and instrumentation, applied electronics to the solution of complex problems in Electrical and Electronics Engineering.
2. Identify, formulate, research literature and analyze complex Electrical and Electronics Engineering problems in power electronics and drives, power and energy systems, high voltage engineering, control and instrumentation, applied electronics problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. Design solutions and design systems/components/processes for complex problems in power electronics and drives, power and energy systems, high voltage engineering, control and instrumentation, applied electronics problems that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4. Conduct investigations of complex power electronics and drives/ power and energy systems/high voltage engineering/control and instrumentation/ applied electronics problems using research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
5. Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex power electronics and drives, power and energy

systems, high voltage engineering, control and instrumentation engineering, applied electronics problems with an understanding of the limitations.

6. Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex electrical and electronics engineering problems.
7. Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex electrical and electronics engineering problems in societal and environmental contexts.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of electrical and electronics engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Demonstrate knowledge and understanding of engineering management principles and economic decision making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PREAMBLE OF THE CURRICULUM & SYLLABI

The Curriculum and Syllabi under Regulations 2015 is designed keeping in mind the Outcome Based Education (OBE) and Choice Based Credit System (CBCS). The course content of each course shall be fixed in accordance with the Program Educational Objectives (PEOs), Program Outcomes (POs) and Course Outcomes (COs).

The CBCS enables the students to earn credits across programmes and provides flexibility for slow and fast learners in registering the required number of credits in a semester. The CBCS facilitates transfer of credits earned in different departments / Centers of other recognized / accredited universities or institutions of higher education in India and abroad either by studying directly or by online method.

The curriculum of **EEE programme** is designed with total number of credits **173 (130** for Lateral entry) and shall have the following category of courses in the curriculum.

1. **Foundation courses**

- a. **Common Foundation Courses (CFC)** include Mathematics, Basic Sciences, Engineering Sciences and Skill Based Courses.
 - b. **Specific Foundation Courses (SFC)** include the basic courses specific to a programme of study.
2. **Programme Core Courses (PCC)** include the core courses relevant to the chosen programme of study and the Employability Enhancement courses such as Project, Seminar and Inplant training/ Internship.
 3. **Programme Elective Courses (PEC)** include the elective courses relevant to the chosen programme of study.
 4. **Open Elective Courses (OEC)** include Inter-disciplinary and Trans-disciplinary courses. The students shall study Inter-disciplinary courses offered in other Engineering/Technology Programmes

through regular mode and Trans-disciplinary courses through self study mode.

5. **Mandatory courses (MAC)** include the courses recommended by the regulatory bodies such as AICTE, UGC etc as given below:
 - a. Technical English / Professional English
 - b. Professional Ethics and Human Values
 - c. Environmental Science and Engineering
 - d. Communication Skills Laboratory

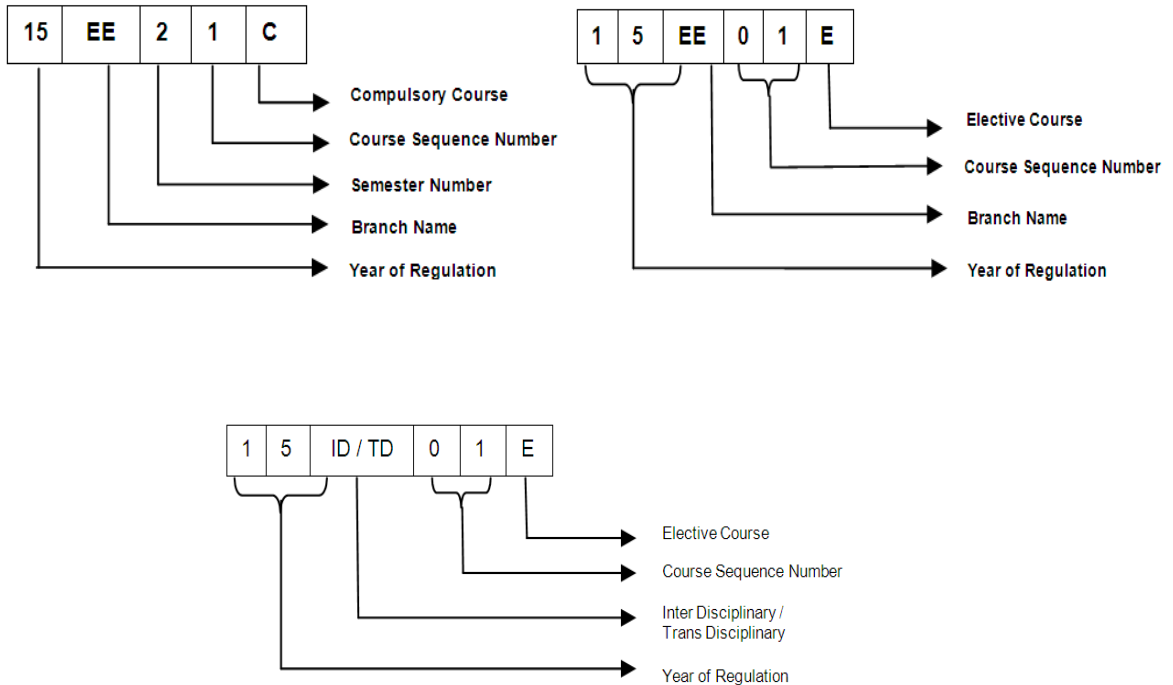
6. Every student shall undergo one Interdisciplinary and one Transdisciplinary course.

Performance in each course of study shall be evaluated based on Continuous Assessment throughout the semester and end semester examination at the end of the programme. Keeping in mind the content of the courses and delivery methods, different question paper patterns are suggested.

QP - Question Pattern

Question pattern	1 mark	2 marks	4 marks	10 marks	12 marks	16 marks	20 marks	Total
A	--	--	--	--	--	--	1 Qn Compulsory & 4 Qns (either or type)	100
B	--	10	--	--	--	1 Qn Compulsory & 4 Qns (either or type)	--	100
C	10	--	10 out of 12	1 Qn Compulsory & 4 Qns (either or type)	--	--	--	100
D	10	10	5 out of 6	1 Qn Compulsory & 4 Qns (either or type)	--	--	--	100
E	--	10	5 out of 6	--	1 Qn Compulsory & 4 Qns (either or type)	--	--	100
F	--	--	--	--	--	--	5 out of 8	100
G	--	5	--	2 Qns (either or type)	--	--	--	30

FORMAT FOR COURSE CODE



B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING
REGULATIONS – 2015
CURRICULUM AND SYLLABUS
SEMESTER – I

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	MAC	15SH11C	Technical English*	3	0	0	3	B
2.	CFC	15SH12C	Mathematical Foundations for Engineers*	3	2	0	4	B
3.	CFC	15SH13C	Engineering Physics*	3	0	0	3	B
4.	CFC	15SH14C	Engineering Chemistry*	3	0	0	3	B
5.	CFC	15SH15C	Introduction to Engineering*	2	0	0	2	A
6.	CFC	15SH16C	Engineering Graphics*	2	0	2	3	A
PRACTICAL								
7.	CFC	15SH17C	Engineering Physics and Engineering Chemistry Laboratory*	0	0	2	1	
8.	CFC	15SH18C	Engineering Practice Laboratory*	0	0	2	1	
TOTAL				16	2	6	20	

SEMESTER – II

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	MAC	15EE21C	Professional English*	3	0	0	3	B
2.	SFC	15EE22C	Calculus, Probability and Statistics@	3	2	0	4	B
3.	SFC	15EE23C	Semiconductor Physics#	3	0	0	3	B
4.	SFC	15EE24C	Circuit Theory	3	2	0	4	B
5.	CFC	15EE25C	C Programming for Engineers*	3	0	0	3	B
6.	MAC	15EE26C	Environmental Science and Engineering*	3	0	0	3	A
PRACTICAL								
7.	SFC	15EE27C	Semiconductor Physics and Environmental Chemistry Laboratory #	0	0	2	1	
8.	CFC	15EE28C	C Programming Laboratory*	0	0	2	1	
9.	SFC	15EE29C	Electric Circuits Laboratory	0	0	2	1	
TOTAL				18	4	6	23	

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course,
PCC – Programme Core Course, XEC - X Stands for P or O (PEC – Programme Elective Course,
OEC – Open Elective Course) *Common to all B.E. / B.Tech., Programmes, @Common to EEE and EIE,
#Common to ECE and EEE

SEMESTER – III

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	SFC	15EE31C	Fourier Series and Transforms	2	2	0	3	B
2.	SFC	15EE32C	Electromagnetic Theory	3	2	0	4	B
3.	PCC	15EE33C	Electronic Circuits	3	0	0	3	E
4.	PCC	15EE34C	DC Machines and Transformer	2	2	0	3	B
5.	PCC	15EE35C	Linear Integrated Circuits and its Applications	3	0	0	3	B
6.	PCC	15EE36C	Digital Logic Circuits	3	0	0	3	B
PRACTICAL								
7.	PCC	15EE37C	DC Machines and Transformer Laboratory	0	0	2	1	
8.	PCC	15EE38C	Integrated Circuits Laboratory	0	0	2	1	
9.	PCC	15EE39C	Electronic Circuits Laboratory	0	0	2	1	
TOTAL				16	6	6	22	

SEMESTER – IV

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	SFC	15EE41C	Complex, Discrete and Numerical Analysis	3	2	0	4	B
2.	PCC	15EE42C	AC Rotating Machines	2	2	0	3	B
3.	PCC	15EE43C	Control Engineering	3	2	0	4	B
4.	PCC	15EE44C	Measurements and Instrumentation	3	0	0	3	E
5.	PCC	15EE45C	Electrical Power Systems	3	2	0	4	B
6.	MAC	15EE46C	Professional Ethics and Human Values*	3	0	0	3	A
PRACTICAL								
7.	PCC	15EE47C	AC Rotating Machines Laboratory	0	0	2	1	
8.	PCC	15EE48C	Control and Instrumentation Laboratory	0	0	2	1	
9.	MAC	15EE49C	Communication Skills Laboratory*	0	0	2	1	
TOTAL				17	8	6	24	

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EIE, #Common to ECE and EEE

SEMESTER – V

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	PCC	15EE51C	Power System Protection, Operation and Control	3	2	0	4	B
2.	PCC	15EE52C	Power Electronics	3	0	0	3	B
3.	PCC	15EE53C	Architecture, Programming and Applications of Microprocessor and Microcontroller	3	0	0	3	E
4.	SFC	15EE54C	Data Structures and Algorithms	3	0	0	3	B
5.	PCC	15EE55C	Digital Signal Processing and its Applications	3	2	0	4	B
6.	XEC		Elective –I	3	0	0	3	
PRACTICAL								
7.	PCC	15EE56C	Power Electronics Laboratory	0	0	2	1	
8.	PCC	15EE57C	Microprocessor and Microcontroller Laboratory	0	0	2	1	
9.	SFC	15EE58C	Data Structures and Algorithms Laboratory	0	0	2	1	
TOTAL				18	4	6	23	

SEMESTER – VI

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	PCC	15EE61C	High Voltage Engineering	3	0	0	3	E
2.	PCC	15EE62C	Electrical Energy Utilization and Conservation	3	0	0	3	B
3.	SFC	15EE63C	Object Oriented Programming	3	0	0	3	B
4.	PCC	15EE64C	Design of Electrical Apparatus	3	0	0	3	B
5.	MAC	15EE65C	Project Management and Finance*	3	0	0	3	B
6.	XEC		Elective – II	3	0	0	3	
PRACTICAL								
7.	PCC	15EE66C	Power System Simulation and High Voltage Laboratory	0	0	2	1	
8.	SFC	15EE67C	Object Oriented Programming Laboratory	0	0	2	1	
9.	PCC	15EE68C	Product Development Laboratory	0	0	4	2	
10.	PCC	15EE69C	Comprehension	0	0	2	1	
TOTAL				18	0	10	23	

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SEMESTER – VII

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	PCC	15EE71C	Smart Grid	3	0	0	3	
2.	XEC		Elective –III	3	0	0	3	
3.	XEC		Elective –IV	3	0	0	3	
4.	XEC		Elective –V	3	0	0	3	
5.	XEC		Elective –VI	3	0	0	3	
6.	XEC		Elective –VII	3	0	0	3	
PRACTICAL								
6.	PCC	15EE72C	Mini Project	0	0	8	4	
7.	PCC	15EE73C	Research Paper and Patent Review – Seminar	0	0	2	1	
TOTAL				18	0	10	23	

SEMESTER – VIII

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	XEC		Elective - VIII	3	0	0	3	
PRACTICAL								
2.	PCC	15EE81C	Project Work	0	0	20	10	
3.	PCC	15EE82C	Internship / Inplant Training	0	0	4	2	
TOTAL				3	0	24	15	

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course,
PCC – Programme Core Course, XEC - X Stands for P or O (PEC – Programme Elective Course,
OEC – Open Elective Course) *Common to all B.E. / B.Tech., Programmes, @Common to EEE and EIE,
#Common to ECE and EEE

PROGRAMME ELECTIVE COURSES (PEC)

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Power Electronics And Drives								
1.	PEC	15EE01E	Switched Mode Power Conversions	3	0	0	3	B
2.	PEC	15EE02E	Special Electrical Machines	3	0	0	3	B
3.	PEC	15EE03E	Power Electronics for Renewable Energy Systems	3	0	0	3	B
4.	PEC	15EE04E	CAD of Electrical Apparatus	3	0	0	3	B
5.	PEC	15EE05E	Solid State Drives	3	0	0	3	B
Power and Energy Systems								
6.	PEC	15EE06E	Advanced Switchgear	3	0	0	3	B
7.	PEC	15EE07E	Solar Photovoltaic Fundamentals and Applications	3	0	0	3	B
8.	PEC	15EE08E	Energy Auditing and Management	3	0	0	3	B
9.	PEC	15EE09E	Power Quality	3	0	0	3	B
10.	PEC	15EE10E	Energy Studies	3	0	0	3	B
High Voltage Engineering								
11.	PEC	15EE11E	Electromagnetic Interference and Electromagnetic Compatibility	3	0	0	3	E
12.	PEC	15EE12E	Insulation Technology	3	0	0	3	E
13.	PEC	15EE13E	Flexible AC Transmission	3	0	0	3	B
14.	PEC	15EE14E	EHV AC Power Transmission	3	0	0	3	B
15.	PEC	15EE15E	High Voltage DC Transmission	3	0	0	3	B
Control and Instrumentation								
16.	PEC	15EE16E	Linear and Nonlinear Control Systems	3	0	0	3	B
17.	PEC	15EE17E	Logic and Distributed Control System [@]	3	0	0	3	C
18.	PEC	15EE18E	Advanced Control Theory	3	0	0	3	B
19.	PEC	15EE19E	Soft Computing for Electrical Engineering	3	0	0	3	B
20.	PEC	15EE20E	MEMS and NEMS	3	0	0	3	B
Applied Electronics								
21.	PEC	15EE21E	DSP based System Design	3	0	0	3	B
22.	PEC	15EE22E	Microprocessors, PC hardware and interfacing	3	0	0	3	B
23.	PEC	15EE23E	Advanced Microprocessor and Microcontroller	3	0	0	3	B
24.	PEC	15EE24E	Real Time Operating Systems	3	0	0	3	B
25.	PEC	15EE25E	Automotive Electrical and Electronics	3	0	0	3	B

Open Elective Course (OEC)
Group – I (Inter-disciplinary courses)

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Any one of the following course is compulsory								
1.	OEC	15ID01E	Product Design and Development	3	0	0	3	A
2.	OEC	15ID02E	Disaster Management	3	0	0	3	A
3.	OEC	15ID03E	Energy Engineering	3	0	0	3	A
4.	OEC	--	Other Programme Courses	3	0	0	3	As specified for the Chosen Course

Group-II (Trans-disciplinary courses) - Self Study Course

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Any one of the following course is compulsory								
1.	OEC	15TD01E	Indian Business Laws	0	0	0	3	F
2.	OEC	15TD02E	Leadership and Personality Development	0	0	0	3	F
3.	OEC	15TD03E	International Business Management	0	0	0	3	F
4.	OEC	15TD04E	Basics of Marketing	0	0	0	3	F
5.	OEC	15TD05E	Retailing and Distribution management	0	0	0	3	F
6.	OEC	15TD06E	International Economics	0	0	0	3	F
7.	OEC	15TD07E	Indian Economy	0	0	0	3	F
8.	OEC	15TD08E	Rural Economics	0	0	0	3	F
9.	OEC	15TD09E	International Trade	0	0	0	3	F
10.	OEC	15TD10E	Global Challenges and issues	0	0	0	3	F
11.	OEC	15TD11E	Indian Culture and Heritage	0	0	0	3	F
12.	OEC	15TD12E	Indian History	0	0	0	3	F
13.	OEC	15TD13E	Sustainable Development and Practices	0	0	0	3	F
14.	OEC	15TD14E	Women in Indian Society	0	0	0	3	F
15.	OEC	15TD15E	Indian Constitution	0	0	0	3	F
16.	OEC	15TD16E	Bio Mechanics in Sports	0	0	0	3	F

15SH11C

TECHNICAL ENGLISH
(Common to all B.E. / B.Tech. Degree Programmes)

L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: acquire the basics of English communication skills. (K3)
- CO2: apply the basic language skills to understand various aspects of technical writing. (K3)
- CO3: understand main ideas, specific details and implied meaning while listening and develop the factual & imaginative information. (S4)
- CO4: coordinate and communicate in a wide range of situation. (S4)
- CO5: integrate and apply the acquired skills in real life situation. (S4)

UNIT I

9

Parts of Speech - Sentence Structure (SV/SVO/SVC/SVIODO) - Identifying the kinds of sentences (Statement, Interrogative, Imperative, Exclamatory & Negative) - Informal writing (Diary writing & letter to friend / parent / siblings) - Self Introduction -Listening for general information.

UNIT II

9

Transformation of words into different grammatical forms- Converting one kind of sentence into another sentence (Statement, Interrogative, Imperative, Exclamatory & Negative) - Technical Vocabulary - Tense Usage (Present tense- Past tense - Future tense - Writing passages in all tenses) -Letter writing (Permission letter & Requisition letter) - Listening for specific information.

UNIT III

9

Personality Adjective - Concord - Letter Writing: Invitation / Acceptance letters - Itinerary Writing (with valued points/ situation) - Phonetics (Vowels - Consonants - Diphthongs) - Listening and filling up the information - Process Description (with valued points).

UNIT IV

9

IF Conditionals - British & American Vocabulary - Letter Writing (Declining / Thanking letters) - Email writing (with valued points) - Instruction Writing - Listening and giving opinion on the pictures.

UNIT V

9

Reading comprehension - Error Spotting (Article, Preposition, Modals and Concord) - Presenting article based on newspaper reading- Situational Conversation - Listening and writing dialogues – Checklists.

L: 45 TOTAL: 45 PERIODS

Suggested Activity: Each student should read the suggested fiction for oral assignment

TEXT BOOKS

1. Rizvi. M. Ashraf, "Effective Technical Communication", 1st Edition, The Mc Graw Hill Education Private Limited, New Delhi, 2005.
2. Dutt P. K., Rajeevan G. and Prakash C.L.N., "A Course in Communication Skills", 1st Edition, Cambridge University Press, India, 2007.

REFERENCES

1. John Sinclair, "Collins Cobuild English Grammar", 3rd Edition, Collins Publishers, London, 2011.
2. Jan Svartvik, Sidney Greenbaum, Geoffery Leech, Randolph Quirk "A Comprehensive Grammar of the English Language", 2nd Edition, Longman Inc., Newyork, 2014.
3. Micheael Vince, Peter Sunderland, "Advanced Language Practice with Key", 3rd Edition, Macmillan Publishers Limited, Italy, 2003.

Listening files: Audio files from net sources,
Softwares: ODLL, Globberena.

15SH12C MATHEMATICAL FOUNDATIONS FOR ENGINEERS

(Common to all B.E. / B.Tech. Degree Programmes)

L T P C

3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: make use of orthogonal transformation. (K3)
- CO 2: use the basic concepts of three dimensional geometry in engineering. (K2)
- CO 3: obtain maxima and minima of real valued functions. (K3)
- CO 4: solve ordinary differential equations. (K3)
- CO 5: solve partial differential equations. (K3)

UNIT I MATRICES

15

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Independency and dependency of Eigen vectors – Properties of Eigen values and Eigen vectors (excluding proofs) - Diagonalisation of a matrix by orthogonal transformation- Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation and its nature.

UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY 15

Direction cosines and Direction ratios- Planes and Lines - Equations of plane and line - Intersection of two planes - Shortest distance between two lines - Equation of a sphere - Plane section of a sphere - Tangent Plane - Orthogonal spheres.

UNIT III FUNCTIONS OF SEVERAL VARIABLE 15

Euler's theorem on homogeneous functions of two variables - Taylor's Series - Jacobians - Maxima and Minima - Constrained Maxima and Minima by the method of Lagrange multipliers.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 15

Solutions of higher order linear differential equations with constant coefficients - Cauchy's and Legendre's linear equations - Solutions of simultaneous first order linear equations with constant coefficients - Method of variation of parameters.

UNIT V PARTIAL DIFFERENTIAL EQUATIONS 15

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

L: 45 T: 30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.

REFERENCES

1. Bali.N.P. and Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Publications Private Limited, 2011.
2. George B.Thomas, Jr. Ross L.Finney, "Calculus and Analytic Geometry", 9th Edition, Dorling Kindersley Private Limited, 2010.
3. Sharma.G.S and Sarna.I.J.S, "Engineering Mathematics", 10th Edition, CBS Publishers and Distributors, New Delhi, 2005.
4. James C. Robinson, "An Introduction to Ordinary Differential Equations", Cambridge University Press, 2004.
5. Anthony Croft, Robert Davison, Martin Hargreaves James Flint, "Engineering Mathematics: A Foundation for Electronic, Electrical, Communications and System Engineers", 4th Edition, Pearson Education Private Limited, 2013.

softening – internal conditioning – external conditioning – domestic water treatment – desalination.

UNIT II CORROSION AND ITS CONTROL 9

Chemical corrosion – electrochemical corrosion – mechanism – different types of electrochemical corrosion – factors influencing corrosion – corrosion control methods.

UNIT III ENGINEERING POLYMERS 9

Polymers – polymerization – free radical mechanism – plastics – thermo plastics and thermosetting plastics – processing and moulding of plastics – special polymers: fire retardant, conducting, photonic and electro luminescent polymer; composites – polymer matrix composites.

UNIT IV NANO MATERIALS 9

Nanoparticles – synthesis of CNT – precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation – toxic effect of nano materials- properties and applications.

UNIT V ANALYTICAL TECHNIQUES 9

Principle, instrumentation and applications of UV-Visible and IR spectroscopy; chromatography: instrumentation and working of gas chromatography and HPLC; conductivity measurements – pH measurements – applications.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Jain P.C. and Jain. M., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2013.
2. Dara S.S. and Umare S.S., "A text book of Engineering Chemistry", S.Chand and Company Limited, New Delhi, 2013.
3. Chawla.S, "A text book of Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2015.

REFERENCES

1. Ahmed Z., "Principles of corrosion engineering and corrosion control", Butterworth Heinemann, 2006.
2. Ebewele R.O., "Polymer science and Technology", CFC Press, Newyork, 2000.
3. Charless P. P. and Frank O. J. , "Introduction to nano technology" John Wiley & Sons, 2008

15SH16C

ENGINEERING GRAPHICS

(Common to all B.E./B.Tech. Degree Programmes)

L T P C

2 0 2 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: use the drawing instruments effectively. (K2, S4, A3)

CO 2: draw the projections of points, straight lines, planes.
(K2, S3, A3)

CO3: construct the projections of various solids in different positions.
(K3, S3, A3)

CO 4: draw the sectional views of various solids and construct the true shape of the section. (K3, S3, A3)

CO 5: identify and draw the surface areas of simple solids. (K3, S3, A3)

CO 6: draw perspective views of simple solids and draw the orthographic views of simple objects. (K3, S3, A3)

UNIT I PROJECTION OF POINTS, LINES AND PLANE SURFACES

12

Drawing Instruments- IS specifications on lines- drawing sheets- Printing letters and dimensioning- scales - First angle projection. (Not for examination).

Projections of points and straight lines located in the first quadrant- Determination of true lengths and true inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes

UNIT II PROJECTION OF SOLIDS

12

Projections of simple solids - axis inclined to one reference plane - change of position method.

UNIT III SECTION OF SOLIDS

12

Sectioning of simple solids - cutting planes inclined to one reference plane and perpendicular to the other.

UNIT IV DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS

12

Development of lateral surfaces of simple and truncated solids - Principles of isometric projection and view of simple solids - truncated prism and pyramids.

UNIT V PERSPECTIVE PROJECTIONS AND ORTHOGRAPHIC PROJECTIONS 12

Perspective projection of cube, prisms and pyramids by visual ray method and vanishing point method. Orthographic projection – simple objects with straight and curved surfaces.

L: 30 P: 30 TOTAL: 60 PERIODS

TEXT BOOKS

1. Bhatt N.D, “Engineering Drawing”, 53rd Edition, Charotar Publishing House, 2014.
2. Natrajan K.V, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.

REFERENCES

1. Kumar M.S, “Engineering Graphics”, D.D. Publications, 2007.
2. Venugopal K and Prabhu Raja V, “Engineering Graphics”, New Age International Private Limited, 2008.
3. Shah M.B and Rana B.C, “Engineering Drawing”, Pearson Education, 2005.
4. Gopalakrishna K.R, “Engineering Drawing”, 32nd Edition, Subhas Publications, 2005.
5. Dhananjay Jolhe A, “Engineering Drawing with an Introduction to AutoCAD”, Tata McGraw Hill Publishing Company Limited, 2008.
6. Basant Agarwal and Agarwal C.M, “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

15SH17C ENGINEERING PHYSICS AND ENGINEERING CHEMISTRY LABORATORY L T P C
(Common to all B.E./B.Tech. Degree Programmes) **0 0 2 1**

PART A – ENGINEERING PHYSICS LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: demonstrate the properties of light waves. (K3, S3)
- CO2: interpret the production of ultrasounds and how the velocity of ultrasounds varies with respect to medium.(K3, S3)
- CO3: illustrate the mechanical and electrical properties of materials. (K3, S3)

LIST OF EXPERIMENTS

1. Determination of thickness of a thin wire – Air wedge method.
2. Determination of velocity of sound and compressibility of the liquid – Ultrasonic Interferometer.
3. Determination of Dispersive power of a prism using Spectrometer.
4. Determination of Young's modulus – Uniform bending method.
5. Torsional pendulum – Determination of Moment of Inertia of the disc and Rigidity modulus of the material of the wire.
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.
7. Calibration of voltmeter / ammeter using potentiometer.
8. Determination of Frequency of A.C. mains using Sonometer.
9. Determination of the angular divergence of a laser beam using He-Ne laser or diode laser.
10. Determination of temperature coefficient of resistance.

P:15 TOTAL: 15 PERIODS

PART B - ENGINEERING CHEMISTRY LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: estimate the amount of hardness of the water sample (K5, S3)
- CO 2: determine the rate of corrosion (K5, S3)
- CO 3: synthesize a polymer and to determine molecular weight of the polymer (K6, S3)
- CO 4: synthesize silver nano particles (K6,S3)
- CO 5: quantify different ions by different analytical techniques (K5,S3)

LIST OF EXPERIMENTS

1. Estimation of hardness of water sample by EDTA method
2. Rate of corrosion- weight loss method
3. Synthesis of urea-formaldehyde resin
4. Determination of molecular weight of a polymer – Oswald's viscometer
5. Synthesis and characterization of silver nano particles.
6. Estimation of iron (Fe^{2+}) in water sample by dichrometry
7. Estimation of hydrochloric acid by conductometric method
8. Estimation of mixture of acids by conductometric method
9. Determination of purity of simple organic compounds using HPLC- (Demo).

P: 15 TOTAL: 15 PERIODS

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.

REFERENCES

1. Harris D.C., "Quantitative Chemical Analysis: International Edition", 8th Edition, W.H. Freeman, 2010.
2. Mendham J., "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson Publisher, 2009.
3. Vogel A.I., "Vogel's Textbook of Quantitative Chemical Analysis", 5th Edition, Longman Scientific & Technical, 1989.

15SH18C ENGINEERING PRACTICE LABORATORY L T P C
 (Common to all B.E./B.Tech. Degree Programmes) **0 0 2 1**

PART A - MECHANICAL LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: prepare basic carpentry jobs (at least three joints). (K3,S2, A2)
- CO 2: prepare the welded joint (minimum three) using arc and gas welding. (K3, S2, A2)
- CO 3: Machine metals using lathe, shaper and drilling machine (each one job). (K3, S2, A2)

UNIT I CARPENTRY PRACTICES 5
 Study of carpentry tools – preparation of joints like half lap, Tee and dove tail in wood.

UNIT II WELDING 5
 Study of welding tools – Preparation of welded joints with Mild steel specimen like lap, butt and tee joints using ARC and Gas welding. (any one exercise should be given using Gas welding among three)

UNIT III BASIC MACHINING PRACTICES 5
 Simple turning and taper turning using lathe – use of shaper and drilling machine for basic operations (Minimum three exercises should be given for students)

P: 15 TOTAL: 15 PERIODS

TEXT BOOK

1. Bawa H.S, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.

REFERENCES

1. Ramesh Babu V, "Engineering Practices Laboratory Manual", Revised Edition, VRB Publishers Private Limited, Chennai, 2014.
2. Jeyachandran K, Natarajan S. and Balasubramanian S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3. Jeyapooan T, Saravanapandian M. and Pranitha S, "Engineering Practices Lab Manual", Vikas Publishing House Private Limited, 2006.
4. Rajendra Prasad A and Sarma PMMS, "Workshop Practice", Sree Sai Publication, 2002
5. Kanniah P and Narayana KL, "Manual on Workshop Practice", Scitech Publications, 1999.

PART – B ELECTRICAL AND ELECTRONICS LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: develop simple residential wiring circuits. (K6)
- CO 2: calculate the basic electrical quantities. (K4)
- CO 3: identify the value of resistance using appropriate methods. (K4, A4)
- CO 4: realize the fundamentals of Boolean algebra using digital logic gates. (A4)
- CO 5: practice soldering to design PCB for electronic circuits. (A5)

I. ELECTRICAL ENGINEERING PRACTICE 8

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

II. ELECTRONICS ENGINEERING PRACTICE 7

1. Study of Electronic components and equipments – Resistor, colour coding, measurement of AC signal parameters (peak-peak, rms period, frequency) using CRO
2. Study of logic gates AND, OR, XOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

P: 15 TOTAL: 15 PERIODS

REFERENCES

1. Jeyachandran K, Natarajan S and Balasubramanian S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
2. Jeyapoovan T, Saravanapandian M and Pranitha S, "Engineering Practices Lab Manual", Vikas Publishing House Private Limited, 2006.
3. Bawa H.S, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A and Sarma P.M.M.S., "Workshop Practice", Sree Sai Publication, 2002.
5. Kannaiah P and Narayana K.L, "Manual on Workshop Practice", Scitech Publications, 1999.

15EE21C

PROFESSIONAL ENGLISH

L T P C

(Common to all B.E. / B.Tech. Degree Programmes)

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: contribute the lingual power to frame sentences in different context. (A2)
- CO 2: write effectively in any Professional context. (A2)
- CO 3: acquire the skills related to Group discussion. (A2)
- CO 4: communicate and respond in different social and professional contexts. (A3)
- CO 5: recall the acquired skills in solving competitive exam. (K3)

UNIT I

9

Phrasal Verbs (Based on root words: call, come, get, look, put, run, and take) - Foreign Words and Phrases (from the given list) - Listening to audio files and finding the technical words and framing different sentences - Channel conversion- Descriptive writing on various charts.

UNIT II **9**
Idioms and Phrases (with animal names from the given list) - Report writing (types-structure- stages in report writing- model report) - Job Application Letter with curriculum vitae.

UNIT III **9**
One word substitution (from the list given) Group Discussion (Why is GD a part of selection process? - Structure of GD – Strategies in GD – Team Work - Body Language - Video Samples-GD).

UNIT IV **9**
Choosing a suitable connotation (from the given list) - Note making – Preparing Circular and Minutes of meeting – Listening to TED Talks – Giving opinion on the given TED Talks and interviewing the TED talkers.

UNIT V **9**
Error Spotting (Tense, Relative Pronouns, Conjunctions, Sentence Structure, Adverb Placement) Sentence Completion - Reading comprehension.

L: 45 TOTAL: 45 PERIODS

Activity: Each student should read the suggested fiction for oral assignment.

TEXT BOOK

1. Tyagi Kavita and Padma Misra, “Advanced Technical Communication”, 1st Edition, PHI Learning Private Limited, New Delhi, 2011.

REFERENCES

1. Smith-Worthington, Darlene & Sue Jefferson. “Technical Writing for Success”, 1st Edition, Cengage Mason, USA, 2007.
2. Bovee, Courtland L., John V.Thill. “Business Communication Today”, 12th Edition, Pearson Education, New Delhi, 2013.
3. Anderson, Paul V. “Technical Communication: A Reader - Centered Approach”, 8th Edition, Cengage, New Delhi, 2013.

Listening files: Audio files from net sources and softwares: ODLL, Globerena.

TEXT BOOKS

1. Grewal.B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Ronald E.Walpole, Raymond H.Myres, Sharon L.Myres, Keying E. Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education Private Limited, 2011.
3. Gupta S.C, and Kapoor V.K, "Fundamentals of Mathematical Statistics: A modern approach", 10th Edition, Sultan Chand & Sons, Delhi.

REFERENCES

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.
2. Richard Arnold Johnson, Irwin Miller, John E Freund, "Miller and Freund's Probability and Statistics for Engineers", 8th Edition, Pearson Education Private Limited, 2013.
3. Robert V.Hogg, Joseph W.Mckean, Allen Thornton Craig, "Introduction to Mathematical Statistics", 6th Edition, Pearson Education Private Limited, 2005.

15EE23C

SEMICONDUCTOR PHYSICS

(Common to ECE & EEE)

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: explain the basics of semiconductors.(K2)
- CO 2: discuss the V - I characteristics of diode and apply the diode concept in rectifiers. (K2)
- CO 3: compare the characteristics of various transistors.(K3)
- CO 4: describe the operation and characteristics of different types of semiconductor devices (K2)
- CO 5: express the properties and applications of the optical materials. (K2)

UNIT I SEMICONDUCTORS

9

Intrinsic semiconductor – carrier concentration – determination of bandgap energy - Extrinsic semiconductors – carrier concentration - Hall effect.

UNIT II PN JUNCTION DIODE AND ITS APPLICATIONS

9

Theory of PN junction diode - Energy Band Structure - Biasing of PN Junction - Forward bias and Reverse bias - current equation - Space charge and diffusion capacitances – effect of temperature and breakdown mechanism, Zener diode and its characteristics , Applications – Half wave and Full wave rectifiers, Shunt Regulator.

15EE24C

CIRCUIT THEORY

L T P C

3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: describe the basic concepts of electric circuits.
- CO 2: illustrate the network theorems for DC and AC circuits.
- CO 3: explain the concepts of resonant circuits.
- CO 4: analyze the dynamic behavior of electric circuits
- CO 5: analyze the three phase electric circuits.

UNIT I BASIC CIRCUITS ANALYSIS 15

Ohm's Law – Kirchoff's laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits.

UNIT II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS 15

Network reduction: voltage and current division, source transformation – Star-delta conversion - Thevenin's and Norton's Theorem – Superposition Theorem – Maximum Power Transfer Theorem – Reciprocity Theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 15

Series and parallel resonance – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling – Single tuned circuits.

UNIT IV TRANSIENT RESPONSE ANALYSIS 15

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and AC with sinusoidal input.

UNIT V ANALYSIS OF THREE PHASE CIRCUITS 15

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

L: 45 T: 30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Sudhakar A and Shyam Mohan S.P., "Circuits and Network Analysis and Synthesis", 4th Edition, Tata McGraw Hill, 2007.
2. William H. Hayt Jr Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", 6th Edition, Tata McGraw Hill publishers, New Delhi, 2002.

REFERENCES

1. John Bird, "Electrical Circuit Theory and Technology", 4th Edition, Newnes Publication, 2010.
2. Paranjothi S.R., "Electric Circuits Analysis", 2nd Edition, New Age International Limited, New Delhi, 2000.
3. Joseph A.Edminister, Mahmood Nahri, "Electric Circuits", Schaum's series, Tata McGraw Hill, New Delhi, 2001.
4. Chakrabati A., "Circuits Theory (Analysis and synthesis)", Dhanpath Rai and Sons, New Delhi, 2008.
5. Charles K.Alexander, Mathew N.O.Sadik, "Fundamentals of Electric Circuits", 2nd Edition, McGraw Hill, 2003.

15EE25C**C PROGRAMMING FOR ENGINEERS****L T P C**

(Common to all B.E. / B.Tech. Degree Programmes)

3 0 0 3**COURSE OUTCOMES**

Upon completion of this course, the students will be able to

- CO 1: recognize the system fundamentals and the role of hardware components of the Computer. (K3)
- CO 2: apply the basic concepts and solve simple problems by analyzing the logics of conditional statements and looping constructs. (K3)
- CO 3: handle similar types of data using array and utilize their functionality. (K3)
- CO 4: appreciate the call by value and call by reference features in functions. (K5)
- CO 5: design programs involving their own derived data types, pointers, memory allocation concepts. (K4)
- CO 6: handle the file contents with access permissions. (K3)

UNIT I COMPUTER FUNDAMENTALS**10**

Introduction – Characteristics of Computers – Evolution of Computers – Computer Generations – Classification of Computers – Basic Computer organization – Number Systems – Problem Analysis – Algorithms – Flow charts – Computer Software – Types of Software.

UNIT II BASIC C PROGRAMMING**9**

Overview of C Program – Constants, Variables and Data Types – Operators and Expressions – Managing Input and Output operations – Decision Making and Branching –Decision making and Looping.

UNIT III ARRAYS AND FUNCTIONS 9

Arrays: One dimensional arrays – Two dimensional arrays – Multi dimensional arrays. Character arrays and Strings: Declaring and initializing String Variables – Comparison of two strings – String handling functions. User defined Functions: Definition – Declaration – Function calls – Category of Functions – Recursion - Storage Classes.

UNIT IV STRUCTURES AND POINTERS 9

Structures and Unions: Definition – Declaration – Accessing structures – Initialization of structures – Arrays of structures – Arrays within Structure – Structures within Structures -Structures and functions - Unions. Pointers: Initialization – Pointers and arrays- Array of pointers – Pointers as function arguments – Pointers to functions – Pointers and Structure.

UNIT V FILES AND DYNAMIC MEMORY ALLOCATION 8

File management in C – Defining and opening a file – closing a file - Input and Output operations on file – Error handling during IO operations – Random access to files – Command line Arguments. Dynamic memory allocation: Allocating a block of memory - Allocating a multiple block of memory – Releasing the used space – Altering the size of a block.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Ashok.N.Kamthane, “Computer Programming”, Pearson Education, India, 2008.
2. E. Balagurusamy, “Programming in ANSI C”, 6th Edition Multicolor, 2013.

REFERENCES

1. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, 1st Edition, Oxford University Press, 2009
2. Stephen G.Kochan, “Programming in C”, 3rd Edition, Pearson Education, India, 2005.
3. Brian W.Kernighan and Dennis M.Ritchie, “The C Programming Language”, Pearson Education Inc., 2005.

15EE26C ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

(Common to all B.E. / B.Tech. Degree Programmes)

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: explain the structure and function of ecosystem. (K2)

- CO 2: recognize the values of biodiversity and natural resources and the ways to protect the biodiversity of his /her locality. (K2)
- CO 3: explain the causes and effects of pollution. (K2)
- CO 4: describe social issues related to the environment and the environment act. (K2)
- CO 5: identify the nutrients in food and impact of metals on human health. (K2)

UNIT I ENVIRONMENT AND ECOSYSTEMS 9

Scope and importance of environment – need for public awareness – ecosystem – structure and function of an ecosystem – energy flow in the ecosystem – forest and aquatic ecosystems – Field study of simple ecosystems – pond and forest.

UNIT II BIODIVERSITY AND NATURAL RESOURCES 9

Biodiversity: genetic, species and ecosystem diversity – threats to biodiversity – endangered and endemic species in India – conservation of biodiversity; forest resources: use and over-exploitation – deforestation - dams and their effects on forests and tribal people – water resources: use and overutilization of surface and ground water – role of an individual in conservation of natural resources.

UNIT III ENVIRONMENTAL POLLUTION 9

Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution and nuclear hazards – solid waste management – e-waste – toxic substances in e-waste – risks related to toxic substances – role of an individual in prevention of pollution.

UNIT IV SOCIAL ISSUES, HUMAN POPULATION AND ENVIRONMENTAL LAW 9

Water conservation – rain water harvesting – climate change – global warming, acid rain, ozone layer depletion – population growth – population explosion – family welfare programme; environment laws: the water (prevention and control pollution) act, 1974-the air (prevention and control of pollution) act, 1981-environmental (protection) act,1986-the wild life (protection) act 1972.

UNIT V FOOD AND HUMAN HEALTH 9

Carbohydrates, amino acids, proteins, lipids and vitamins in balanced diet food; disease caused by deficiency of carbohydrates, amino acids, proteins, lipids and vitamins - food adulteration - simple test for food

adulterants; environmental toxicology: metals in environment- impacts of lead, arsenic, cadmium, mercury and chromium on human health.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Miller G. and Spoolman S, "Environmental Science", 14th Edition, Brooks/Cole Publishing Co., 2012.
2. Maczulak A.E., "Environmental Engineering", Facts on file Inc., 2009
3. Han D, "Concise Environmental Engineering", PhD & Ventus Publishing ApS, 2012

REFERENCES

1. Weller K. "Environmental Science and Biological Engineering", 1st Edition, WIT Press, 2015
2. Strange C. "Environmental Science and production" Nason Trest Publisher, 2010

**15EE27C SEMICONDUCTOR PHYSICS AND ENVIRONMENTAL
CHEMISTRY LABORATORY L T P C**
(Common to ECE and EEE) 0 0 2 1

PART A – SEMICONDUCTOR PHYSICS LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: demonstrate the properties of optical materials. (K2, S3)
- CO 2: analyze the characteristics of semiconducting materials and devices. (K3,S3)
- CO 3: design the rectifier using PN diode (K3,S3)

LIST OF EXPERIMENTS

1. (a) Determination of wave length of Laser source.
(b) Particle size determination using Diode Laser.
(c) Determination of Numerical aperture and acceptance angle of an optical fiber.
2. Determination of Band Gap of a semiconductor material.
3. V-I Characteristics of PN junction diode/ Zener diode.
4. Transistor Characteristics of BJT (CB & CE) and FET.
5. V-I Characteristics of UJT/Photo diode/ Photo Transistor.
6. V- I Characteristics of SCR.
7. Characteristics of LED/LCD/LDR.

8. Half Wave and Full Wave Rectifiers.

P:15 TOTAL: 15 PERIODS

PART - B ENVIRONMENTAL CHEMISTRY LABORATORY

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: quantify the amount of acidity, alkalinity, DO and COD present in water sample. (K5,S3)
- CO 2: analyse the ions present in the soil. (K4,S3)
- CO 3: quantify the amount of chloride ion in water sample. (K5,S3)
- CO 4: identify the adulteration in food samples. (K1,S3)
- CO 5: estimate the amount of metal ions in water sample. (K5,S3)

LIST OF EXPERIMENTS

1. Estimation of acidity of Water sample.
2. Estimation of alkalinity of Water sample.
3. Determination of Dissolved Oxygen (DO) in water sample (Winkler's method).
4. Determination of COD in water sample.
5. Soil Analysis: Determination of colour, pH, nitrate, phosphate, chloride and sulphate ions.
6. Soil analysis: Estimation of Na/K/Ca in soil.
7. Estimation of chloride ion in water sample by argentometric method.
8. Simple adulteration test in food samples.
9. Estimation of copper in water sample by EDTA method.
10. Estimation of nickel in water sample.

P:15 TOTAL: 15 PERIODS

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.

REFERENCES

1. Harris D.C. "Quantitative Chemical Analysis: International Edition", 8th Edition, W.H.Freeman, 2010
2. Mendham J. "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson Publisher, 2009.
3. Vogel A.I., "Vogel's Textbook of Quantitative Chemical Analysis", 5th Edition, Longman scientific & Technical, 1989.

15EE28C

C PROGRAMMING LABORATORY

(Common to all B.E. / B.Tech. Degree Programmes)

L T P C

0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: solve the given problem using the syntactical structures of C language. (K3)
- CO 2: develop, execute and document computerized solution for various logic based problems using the flow control features of C language. (K3)
- CO 3: enhance the programming skills in C by discriminating constants, variables and arrays and the functionality. (K3)
- CO 4: learn about the connection between function return values and variables. (K5)
- CO 5: develop programs using string manipulation and file manipulation functions. (K3)

Simple programs

1. Solve problems such as temperature conversion, student grading, interest calculation.
2. Solving the roots of a quadratic equation
3. Designing a simple arithmetic calculator. (Use switch statement)
4. Given distance traveled by a vehicle as $d = ut + \frac{1}{2}at^2$, where 'u' and 'a' are the initial velocity and acceleration. Calculate the distance traveled for different time intervals

Programs using different control structures

5. Performing the following operations:
 - a. Generate Pascal's triangle.
 - b. Construct a Pyramid of numbers.
6. Generation of the first 'n' terms of the Fibonacci sequence and prime sequence.
7. Computing Sine series and Cosine series.
8. Finding the 2's complement of a binary number.

Programs using arrays

9. Performing the following operations:
 - a. Matrix addition.
 - b. Transpose of a matrix.
 - c. Matrix multiplication by checking compatibility.

Programs using string manipulation

10. Performing the following operations to a string:
 - a. To insert a sub-string into main string at a given position.
 - b. To delete 'n' characters from a given position in a string.
 - c. To replace a character of string either from beginning or ending or at a specified location.

Programs using functions

11. Performing the following operations: (Use recursive functions)
 - a. To find the factorial of a given integer.
 - b. To find the GCD (Greatest Common Divisor) of two given integers.
 - c. To solve Towers of Hanoi problem.

Programs using files

12. Performing the Student Information Processing using Structures and File handling concepts.

P: 30 TOTAL: 30 PERIODS

15EE29C

ELECTRIC CIRCUITS LABORATORY

**L T P C
0 0 2 1**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: illustrate the basic concepts of electric circuits.
- CO 2: relate the physical observations in network theorems of electrical circuits to theoretical principles.
- CO 3: examine the electric circuits using mesh and nodal analysis.
- CO 4: analyze the dynamic behavior of electric circuits using PSIM.
- CO 5: compute the frequency response of resonant and tuned circuits.

LIST OF EXPERIMENTS

1. Verification of Ohm's laws and Kirchoff's laws
2. Verification of Thevenin's and Norton's theorem
3. Verification of Superposition theorem
4. Verification of Maximum Power Transfer theorem
5. Verification of Reciprocity theorem
6. Measurement of self inductance of a coil
7. Verification of mesh and nodal analysis
8. Transient response of RL and RC circuits for DC input
9. Frequency response of series and parallel resonance circuits
10. Frequency response of single tuned coupled circuits

P: 30 TOTAL: 30 PERIODS

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.

REFERENCES

1. Bali.N.P. and Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Publications Private Ltd., 2011.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Private Limited, New Delhi, 2007.
3. Jain.R.K. and Iyengar.S.R.K., "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Private Limited, 2007.

15EE32C

ELECTROMAGNETIC THEORY

L T P C

3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: apply vector calculus for static electric and magnetic fields. (K3)
- CO2: analyze the concepts of electrostatic fields and boundary conditions for different mediums. (K4)
- CO3: examine the concepts of magnetostatic fields and boundary conditions for different mediums. (K4)
- CO4: formulate the Maxwell's equations. (K5)
- CO5: employ the Maxwell equations for electromagnetic wave propagation. (K3)

UNIT I

INTRODUCTION

15

Sources and effects of electromagnetic fields – Vector fields – Different co-ordinate systems – Vector calculus – Gradient, Divergence and Curl – Divergence theorem – Stoke's theorem.

UNIT II

ELECTROSTATICS

15

Coulomb's Law – Electric field intensity – Field due to point and continuous charges – Gauss's law – Electric potential – Electric field and equipotential plots – Electric field in free space, conductors, dielectric – Dielectric polarization – Dielectric strength – Electric field in multiple dielectrics – Boundary conditions – Poisson's and Laplace's equations – Capacitance – Energy density.

UNIT III MAGNETOSTATICS 15
Lorentz Law of force, magnetic field intensity – Biot Savart’s Law – Ampere’s Law – Magnetic field due to straight conductors, circular loop, infinite sheet of current – Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization – Magnetic field in multiple media – Boundary conditions – Scalar and vector potential – Magnetic force – Inductance – Energy density – Magnetic circuits.

UNIT IV ELECTRODYNAMIC FIELDS 15
Faraday’s laws – Induced EMF – Transformer and motional EMF – Forces and Energy in quasi-stationary Electromagnetic Fields – Maxwell’s equations (differential and integral forms) – Displacement current – Relation between field theory and circuit theory.

UNIT V ELECTROMAGNETIC WAVES 15
Electromagnetic wave equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors – Skin depth – Poynting vector – Transmission lines – Line equations – Input impedances – Standing wave ratio and power.

L: 45; T: 30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Mathew N. O. Sadiku, “Elements of Electromagnetics”, 6th India Edition, Oxford University press Inc., 2014.
2. Ashutosh Pramanik, “Electromagnetism – Theory and Applications”, Prentice Hall Private Limited, New Delhi, 2009.

REFERENCES

1. Joseph. A. Edminister, “Theory and Problems of Electromagnetics”, 3rd Edition, Schaum Series, Tata McGraw Hill Private Limited, 2010.
2. William. H. Hayt, “Engineering Electromagnetics”, Tata McGraw Hill Private Limited, 2011.
3. Kraus and Fleish, “Electromagnetics with Applications”, 5th Edition, Tata McGraw Hill Private Limited, 2010.

15EE33C

ELECTRONIC CIRCUITS

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: analyze the different BJT Biasing Circuits and its applications. (K4)

CO2: determine small signal parameters for amplifiers. (K5)

CO3: describe the operation of Feedback amplifiers. (K2)

CO4: discuss the operation of Pulse circuits. (K2)

CO5: design rectifiers, filters and voltage regulators. (K5)

UNIT I TRANSISTOR BIASING AND STABILITY ANALYSIS 9

Need for BJT Biasing Circuits – Load line – Operating point – Stability Factors – biasing circuits – Variation of quiescent point – Bias compensation: Diode, Thermistor compensations – Biasing circuits for JFET.

UNIT II AMPLIFIERS 9

CE, CB and CC Amplifiers – h -Parameters – Simplified CE hybrid model – Frequency response – Low and high frequency analysis – Classification of amplifiers – Complementary symmetry (class B) push-pull amplifier – Darlington connection.

UNIT III FEEDBACK AMPLIFIER AND OSCILLATORS 9

Differential amplifiers: Common mode and differential mode – CMRR – Feedback amplifiers – Condition for oscillation – Oscillators – LC, RC phase shift and crystal oscillators

UNIT IV PULSE CIRCUITS 9

RC integrator – Differentiator– Clipper – Clamper – Multivibrators – Schmitt triggers – UJT Relaxation oscillator

UNIT V RECTIFIERS AND POWER SUPPLIES 9

Rectifiers – Analysis of output voltage and ripple voltage – Filter – Voltage regulators – Voltage doublers– Switched mode power supply (SMPS) – Dual Power supply.

L: 45; TOTAL: 45 PERIODS**TEXT BOOKS**

1. David Bell, "Electronic Devices and Circuits", Prentice Hall Private Limited, 2007

UNIT IV TRANSFORMERS 12

Principle of operation – Constructional features of single phase and three phase transformers – EMF equation – Phasor diagram – Equivalent circuit – Regulation – Three phase transformer connections – Parallel operation of single phase and three phase transformer – Auto transformers.

UNIT V TESTING OF DC MACHINES AND TRANSFORMERS 12

Losses and efficiency – Condition for maximum efficiency – Testing of DC machines: Brake test, Swinburne's test, Retardation test, Hopkinson's test – Testing of transformer: polarity test, load test, open circuit and short circuit test, Sumpner's test – All day efficiency.

L: 30; T: 30; TOTAL: 60 PERIODS

TEXT BOOKS

1. Nagrath. I.J and Kothari. D.P., "Electric Machines", Tata McGraw Hill Private Limited, 2010.
2. Bimbhra. P.S., "Electrical Machinery", Khanna Publishes, 7th Edition, 2011.

REFERENCES

1. Fitzgerald. A.E., Charles kingsely Jr and Stephen D. Umans, "Electric Machinery", Tata McGraw Hill Private Limited, 2013
2. Theraja. B.L. and Theraja. A.K., "A text book on Electrical Technology", Volume-II, S.Chand and Company Limited, 2009.
3. Sen. P.C., "Principles of Electrical Machines and Power Electronics", John Wiley and Sons, 2014.
4. Murugesh Kumar. K, "Electric Machines", Vikas Publishing House Private Limited, 2010.
5. Irving L. Kosow, "Electric Machinery and Transformers", 2nd Edition, Reprint, Prentice Hall Private Limited, 2007.
6. Stephen J. Chapman, "Electric Machinery Fundamentals", 4th Edition, Tata McGraw Hill Private Limited, 2005.
7. Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall Private Limited, 2003.

15EE35C LINEAR INTEGRATED CIRCUITS AND ITS APPLICATIONS

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: describe the IC fabrication procedure for basic electronic circuits. (K2)

CO2: infer the characteristics of OP-AMP ICs. (K2)

CO3: design and construct the basic applications of Op-amp. (K5)

CO4: interpret the internal functional blocks and the applications of special ICs. (K3)

CO5: illustrate the operation of application ICs. (K3)

UNIT I IC FABRICATION 9

IC classification – Various processes in monolithic IC technology – Fabrication of diodes, capacitance, resistance and FETs

UNIT II CHARACTERISTICS OF OP-AMP 9

Ideal OP-AMP – DC and AC Characteristics – Inverting and Non-inverting Amplifier – Differential amplifier – Summer, differentiator and integrator.

UNIT III APPLICATIONS OF OP-AMP 9

Instrumentation amplifier – Filters – Comparators – Multivibrators – Peak detector, Sample and Hold circuit – D/A converters – A/D converters.

UNIT IV SPECIAL ICs 9

555 timers – Monostable and Astable Multivibrators – Schmitt Triggers – Voltage Controlled Oscillator – Phase Locked Loops – Applications.

UNIT V APPLICATION ICs 9

IC voltage regulators – LM78XX, 79XX – Variable voltage regulators switching regulators LM317, 723 – LM 380 power amplifier, ICL 8038 function generator– Opto couplers

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Ramakant A. Gayakward, "Op-amps and Linear Integrated Circuits", 4th Edition, Pearson Education, 2007.
2. Roy Choudhary. D, Sheil B. Jani, "Linear Integrated Circuits", 7th Edition, New Age, 2014.

REFERENCES

1. Jacob Millman, Christos C. Halkias, "Integrated Electronics – Analog and Digital circuits system", Tata McGraw Hill Private Limited, 2003.
2. Robert F. Coughlin, Fredrick F. Driscoll, "Op–amp and Linear ICs", 4th Edition, Pearson Education, 2002.
3. David A. Bell, "Op–amp & Linear ICs", 2nd Edition, Prentice Hall Private Limited, 1997.
4. K.R.Botkar, "Integrated Circuits," 10th Edition ,Khanna Publishers, 2010.

15EE36C DIGITAL LOGIC CIRCUITS**L T P C
3 0 0 3****COURSE OUTCOMES**

Upon completion of this course, the students will be able to

- CO1: devise the number systems and simplify Boolean functions. (K5)
- CO2: illustrate the various combinational circuits. (K3)
- CO3: design the synchronous and asynchronous circuits. (K5)
- CO4: analyze the characteristics of digital ICs and memory devices. (K4)
- CO5: develop VHDL coding for simple circuits. (K5)

UNIT I BOOLEAN ALGEBRA AND COMBINATIONAL CIRCUITS 9

Review of number systems – Binary codes – Boolean simplification using K-maps and Quine McCluskey method – Parity checker – Design of combinational circuits.

UNIT II ANALYSIS AND DESIGN OF SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Realization of Flip-flops – SR, D, JK and T – Level Triggering – Edge Triggering – Analysis of synchronous sequential circuits: Moore and Mealy model – Design of synchronous sequential circuits – Shift Registers – Counters.

UNIT III ANALYSIS AND DESIGN OF ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Analysis of asynchronous sequential logic circuits – Transition Table – Flow Table – state assignment – Asynchronous design problem.

UNIT IV DIGITAL INTEGRATED CIRCUITS 9

Characteristics of digital ICs – Digital logic families: TTL, ECL, NMOS, CMOS – Memories: ROM, PROM, EPROM, PLD, PAL, PLA and FPGA – Trouble shooting.

UNIT V VHDL

9

RTI Design – Behavior, Data flow and Structural modeling – Data Types – Operators – Packages – Sub programs – Test Benches.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Morris Mano. M, "Digital Design", 5th Edition, Pearson Education, 2012.
2. Donald P. Leach, Albert Paul Malvino, Goutam Sha, "Digital Principles and Applications", 6th Edition, Tata McGraw Hill Private Limited, 2007.

REFERENCES

1. Charles H. Roth, "Fundamentals Logic Design", 6th Edition, Jaico Publishing House, 2006.
2. Floyd and Jain, "Digital Fundamentals", 10th Edition, Pearson Education, 2005.
3. John F. Wakerly, "Digital Design Principles and Practice", 4th Edition, Pearson Education, 2005
4. Ronald J. Tocci, "Digital Systems: Principles and applications", 10th Edition, Pearson Education, 2009.
5. RajKamal, "Digital systems –Principles and Design", 2nd Edition, Pearson Education, 2007.
6. Salivahanan. S and Arivazhagan. S, "Digital Circuits and Design", 4th Edition, Vikas Publishing House Private Limited.
7. Roth. C. H, "Digital Systems Design using VHD", Thomson Asia, 2007.

15EE37C DC MACHINES AND TRANSFORMER LABORATORY

L T P C

0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: describe to performance of DC generators. (K2)
- CO 2: summarize the characteristics of DC motors under loaded conditions. (K2)
- CO 3: predict the performance of DC motors. (K6)
- CO 4: apply the speed control in DC shunt motor. (K3)
- CO 5: analyze the performance of transformers. (K4)

LIST OF EXPERIMENTS

1. Study of starters.
2. Open circuit and load characteristics of DC Series generator.
3. Open circuit and load characteristics of self – excited DC shunt generators.
4. Load characteristics of DC compound generator.
5. Load characteristics of DC shunt and compound motor.
6. Load characteristics of DC series motor.
7. Swinburne's test and speed control of DC shunt motor.
8. Hopkinson's test on DC motor–Generator set.
9. Load test on single phase transformer.
10. Open circuit and short circuit tests on single phase transformer.
11. Load test on three phase transformer.
12. Sumpner's test on transformers
13. Separation of no load losses in single phase transformer.
14. Study of Parallel operation of single phase transformer.

P: 30; TOTAL: 30 PERIODS

15EE38C INTEGRATED CIRCUITS LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: construct adder, subtractor and code converters. (K3)
- CO 2: design and realize the basic applications of Op–amp and timer. (K5)
- CO 3: design and implement the 4–bit modulo counters as synchronous and asynchronous types. (K5)
- CO 4: illustrate the various combinational and sequential circuits. (K2)
- CO 5: examine the behavior of special ICs. (K4)

LIST OF EXPERIMENTS

1. Study of Basic Digital IC's.
2. Implementation of Boolean Functions and Adder/ Subtractor circuits.
3. (a) Code converters
(b) Encoders and Decoders.
4. Counters: synchronous and Asynchronous.
5. Shift Registers: SISO, SIPO, PISO, PIPO modes.
6. Multiplexer/ De–multiplexer
7. Timer IC application: Astable and Monostable operation.

8. Application of Op–Amp: inverting and non–inverting amplifier, Voltage follower, Adder, Comparator, Integrator and Differentiator.
9. Analog to Digital Converter and Digital to Analog Converter:
10. Study of VCO and PLL ICs

P: 30; TOTAL: 30 PERIODS

15EE39C ELECTRONIC CIRCUITS LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: analyze the characteristics of transistor for various configurations. (K4)
- CO 2: design transistor based amplifiers and oscillators. (K5)
- CO 3: design a power supply with filters and regulators. (K5)

LIST OF EXPERIMENTS

1. Analysis of transistor parameters under CE, CC and CB configuration.
2. Design and implementation of various transistor biasing.
3. Frequency response of Common Emitter Amplifier.
4. Complementary symmetry push–pull amplifier
5. Differential amplifier
6. RC Phase Shift Oscillator.
7. Multivibrators and relaxation oscillators
8. JFET and UJT characteristics with application
9. Half Wave and Full Wave Rectifiers with filters.
10. Zener and series voltage regulators
11. Diode Clippers and Clampers.
12. Study of Switched Mode Power Supply

P: 30; TOTAL: 30 PERIODS

L: 45; T: 30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004.

REFERENCES

1. Trembly J.P and Manohar.R,"Discrete Mathematics Structures with Applications to Computer Science",Tata McGraw Hill Private Limited, New Delhi, 35th Reprint 2008.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Private Limited,New Delhi, 2007.
3. Jain M.K, Iyengar S.R.K, Jain R.K., "Numerical Methods for Scientific and Engineering Computation", 5th Edition, New age international (P) Ltd., Publishers, Reprint 2009.
4. Kenneth H.Rosen, "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Private Limited, New Delhi, Special Indian Edition, 2011.

15EE42C

AC ROTATING MACHINES

L T P C

2 2 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: analyze the performance of synchronous machines. (K4)
- CO2: examine the performance of three phase induction machines. (K4)
- CO3: discuss the starting and speed control methods of three phase induction motors. (K2)
- CO4: describe the performance of single phase induction motor. (K2)
- CO5: summarize the features of special machines. (K2)

UNIT I

SYNCHRONOUS GENERATOR

12

Constructional details – Types of rotors – EMF equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF, ZPF and ASA methods – Synchronizing and parallel operation – Synchronizing power and synchronizing torque – Change of excitation and mechanical input – Salient Pole Machine: Two reaction theory – Phasor diagram using X_d and X_q – Determination of direct and quadrature axis synchronous reactance using slip test.

- UNIT II SYNCHRONOUS MOTOR 12**
Principle of operation – Torque equation – Current loci for constant power input, constant excitation and constant power developed – Equivalent circuit – V-curves and Inverted V-curves – Power input and power developed equations – Starting methods – Operation on infinite bus bars – Hunting – Synchronous condensers.
- UNIT III THREE PHASE INDUCTION MOTOR 12**
Constructional details – Types of rotors – Principle of operation – Slip – Slip-torque characteristics – Condition for maximum torque – Losses and efficiency – Load test – No load and blocked rotor tests – Equivalent circuit – Phasor diagram – Circle diagram – Separation of no load losses – Double cage rotors – Induction generator – Synchronous induction motor.
- UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 12**
Need for starters – Types of starters – Cogging and Crawling – Speed control – Change of voltage, rotor resistance, number of poles and slip – Cascaded connection – Slip power recovery scheme – Electrical Braking.
- UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 12**
Constructional details of single phase induction motor – Double revolving field theory – Types – operation – Equivalent circuit – Performance analysis – Starting methods of single-phase induction motors – Special machines – Universal motor, reluctance motor, repulsion motor, hysteresis motor, stepper motor and AC series motor.

L: 30; T: 30; TOTAL: 60 PERIODS

TEXT BOOKS

1. Kothari. D.P and Nagrath. I.J, “Electric Machines”, Tata McGraw Hill Private Limited, Reprint 2010.
2. Mehta. V.K and Rohit Mehta, “Principle of Electrical Machines”, S. Chand Publishers, 2009.

REFERENCES

1. Fitzgerald. A.E, Charles Kingsley, Stephen D. Umans, “Electric Machinery”, Tata McGraw Hill Private Limited, 2013.
2. Theraja. B.L, Theraja. A.K, “A text book on Electrical Technology”, Volume-II, S. Chand Company and Ltd, 2009.
3. Gupta. J.B, “Theory and Performance of Electrical Machines”, S. K. Kataria and Sons, 2009.

4. Murugesh Kumar. K, “Electric Machines”, Vikas Publishing House Private Ltd, 2010.
5. Rajput. R.K, “A Text Book of Electrical Machines”, Firewall Media, 2008.

15EE43C

CONTROL ENGINEERING

L T P C

3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: develop the mathematical model of systems. (K3)
- CO2: describe the transient and steady state response of linear time invariant system. (K2)
- CO3: analyze the open loop and closed loop frequency responses of systems. (K4)
- CO4: examine the stability Analysis of linear control systems. (K4)
- CO5: determine the performance of compensator design and controller tuning. (K5)

UNIT I MODELING OF SYSTEMS

15

Concepts of feedback – Transfer function: electrical, mechanical and electro mechanical systems – Analogous system – Block diagram reduction technique – Signal flow graph representation – state space model from transfer function.

UNIT II TIME RESPONSE ANALYSIS

15

Standard test signals – Time response –First order and second order system – Time domain specifications – Steady state error and error constants – Generalized error series – State transition matrix – Solution of state equation.

UNIT III FREQUENCY DOMAIN ANALYSIS

15

Frequency domain specifications – Correlation between frequency and time domain specifications – Bode plot – Polar plot – Closed loop frequency response.

UNIT IV STABILITY ANALYSIS

15

Characteristic equation – Routh Hurwitz criterion – Absolute and Relative stability – Root Locus – Nyquist stability criterion – Stability analysis of state model – controllability and observability.

UNIT V COMPENSATOR DESIGN AND CONTROLLER TUNING 15

Performance criteria – Lag, Lead and Lag–Lead compensator design using bode plots – Controller and its classification – PID controller – Concepts of controller tuning – Ziegler-Nichols technique – Pole placement by state feedback.

L: 45; T: 30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Nagrath I.J and Gopal M., “Control Systems Engineering”, New Age International Publishers, 5th Edition (Reprint), 2016.
2. Gopal M., “Control Systems:Principles and Design”, 4th Edition, Tata McGraw Hill Private Limited, New Delhi, 2012.

REFERENCES

1. Benjamin C. Kuo, “Automatic Control systems”, Pearson Education, New Delhi, 2009.
2. K. Ogata, “Modern Control Engineering”, 5th Edition, Prentice Hall Private Limited, New Delhi, 2010.
3. Richard.C. Dorf and Robert H. Bishop, “Modern Control Systems”, Addison – Wesley, 2011.
4. Salaivahanan. S, Rengaraj. R, Venkatakrisnan. G. R., “Control Systems Engineering”, Pearson India Education Services Pvt. Ltd., 2015.

**15EE44C MEASUREMENTS AND INSTRUMENTATION L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: outline the fundamental concepts of measurement system. (K1)
- CO2: explain the operation of various types of measuring instruments. (K2)
- CO3: choose the suitable bridge circuits for measuring electrical parameters. (K3)
- CO4: identify the appropriate transducers for measurement of non electrical parameters. (K2)
- CO5: summarize the operations of various digital electronic instruments and display devices. (K2)

UNIT I INTRODUCTION 9

Concepts of Measurement and instrumentation – Basic elements of measurement systems – Units, Standard and Calibration – Static and Dynamic Characteristics – Classification of error – Error analysis.

UNIT II	MEASURING INSTRUMENTS	9
Principle and types of analog meters – Moving iron instruments – Moving coil instruments – Extension of meter range – Wattmeters: Dynamometer type, induction type – Induction type energy meters – Instruments transformer – Types and its applications.		
UNIT III	BRIDGES	9
AC, DC Galvanometer – Measurement of resistance, inductance and capacitance – Measurement of frequency – Megger.		
UNIT IV	TRANSDUCERS	9
Active and Passive Transducer – Resistive transducer – Potentiometer – Strain gauge – Inductive transducer – LVDT – Capacitive transducer – Piezo–electric transducers – RTD, thermistor, thermocouple – Applications of transducers in flow, temperature and pressure.		
UNIT V	DIGITAL INSTRUMENTS AND DISPLAY DEVICES	9
Digital voltmeters – Ramp and integrating – Digital multimeter – Digital Energy meter – Power quality analyzer – Dot matrix display – LED and LCD displays – Digital storage Oscilloscope – Data Acquisition system – Data logger .		

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Doebelin. E, "Measurement Systems: Application and Design", 6th Edition, Tata McGraw Hill Private Limited, 2012.
2. Sawhney. A.K, "A Course in Electrical and Electronics – Measurement and Instrumentation", 19th Edition, Dhanpal Rai & Sons, New Delhi, 2014.

REFERENCES

1. Helfrick, Albert. D and Copper. W.D, "Electronics Instrumentation and Measurement Techniques", Prentice Hall Private Limited, New Delhi, 2010.
2. Rangan. C.S, Sharma. G.R and Mani. V.S, "Instrumentation Devices and Systems", 2nd Edition, Tata McGraw Hill Private Limited, 2010.
3. Kalsi. H.S, "Electronic Instrumentation", Tata McGraw Hill Private Limited, 2011.
4. Arun K. Ghosh, "Introduction to Measurements and Instrumentation", 2nd Edition, Prentice Hall Private Limited, New Delhi, 2011.

15EE45C ELECTRICAL POWER SYSTEMS L T P C
3 2 0 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: explain the structure of electric power systems and grounding. (K2)
- CO2: design the electrical parameters and analyze the performance of Transmission line. (K5)
- CO3: calculate the voltage grading and efficiency of insulators and cables. (K4)
- CO4: compute the various methods of power flow Analysis. (K3)
- CO5: analyze the different types of fault in power system. (K4)

UNIT I INTRODUCTION 15

Structure of electric power system – Comparison of AC and DC system – HVDC links – Substations – Bus–bar arrangements – System and equipment grounding – Neutral grounding and types.

UNIT II TRANSMISSION LINE PARAMETERS AND PERFORMANCE ANALYSIS 15

Transmission line Resistance – Inductance and Capacitance calculations for single and three phase transmission lines with single and double circuit lines – Self and mutual GMD – Stranded and bundled conductors – Skin and proximity effects. Classification of transmission lines – Transmission efficiency and voltage regulation – Ferranti effect – Corona.

UNIT III INSULATORS AND CABLES 15

Insulators – Types – Voltage distribution in string insulator and grading – Improvement of string efficiency – Underground cables – Constructional features of LT and HT cables – Capacitance of single core and three core cables – Dielectric stress and grading – Thermal characteristics.

UNIT IV POWER FLOW ANALYSIS 15

Basic components of a power system – Single line diagram: Generator, Transformer, Transmission line and load representation for different power system studies – Formation of Y-bus and Z-bus – Importance of power flow analysis – classification of buses – Gauss-Seidel method – Newton-Raphson method.

UNIT V FAULT ANALYSIS 15

Importance of short circuit analysis – Analysis using Thevenin's theorem – Fault analysis using Z–bus – Computations of short circuit capacity, post fault voltage and currents – Introduction to symmetrical components –

Sequence impedances – Sequence circuits of synchronous machine, transformer and transmission lines – Sequence networks analysis of unsymmetrical fault.

L: 45; T: 30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Wadhwa C.L., “Electric Power Systems”, New Age International (P) Ltd., 2014.
2. Kothari D.P. and Nagrath I.J., “Power System Engineering”, Tata McGraw Hill Private Limited, New Delhi, 2014.

REFERENCES

1. Singh S.N., “Electric Power Generation, Transmission and Distribution”, Prentice Hall Private Limited, New Delhi, 2008.
2. Mehta V. K. and Rohit Mehta, “Principles of Power System”, S.Chand Company & Ltd, New Delhi, 2006.
3. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill Private Limited, 2003.
4. Rebennack, S., Pardalos, P.M., Pereira, M.V.F., Iliadis, N.A., “Handbook of Power Systems – I”, Energy system, Springer, 2010.

15EE46C	PROFESSIONAL ETHICS AND HUMAN	L	T	P	C
	VALUES	3	0	0	3
	(Common to all Programmes)				

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: recognize the core human values that shape the ethical behavior of an engineer. (K2)
- CO2: expose awareness on professional ethics. (K2)
- CO3: analyze the engineering ethical breach from past study. (K2)
- CO4: distinguish and apply safety, responsibility and rights in workplaces. (K2)
- CO5: discuss about the global issues with regard to ethics. (K2)

UNIT I	HUMAN VALUES	9
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Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - Commitment - Empathy - Self-Confidence - Character – Spirituality.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy - Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies. 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 - Moral leadership - sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE), India, etc.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill Private Limited, New York 1996.
2. Govindarajan M, Natarajan S and Senthil Kumar VS, "Engineering Ethics", Prentice Hall Private Limited, New Delhi, 2004.

REFERENCES

1. Charles D and Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall Private Limited, New Jersey, 2004 (Indian Reprint)
2. Charles E Harris, Michael S Protchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.

4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford 2001.

15EE47C AC ROTATING MACHINES LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: compute the regulation of Three Phase Alternator using various methods. (K3)
- CO 2: evaluate the performance characteristics of AC motors. (K6)
- CO 3: explain the various starting methods of AC motors. (K2)
- CO 4: predict the performance characteristics of AC motors. (K3)

LIST OF EXPERIMENTS

1. Study of AC Motor Starters.
2. Regulation of Three Phase Alternator by EMF methods.
3. Regulation of Three Phase Alternator by MMF methods.
4. Regulation of Three Phase Alternator by ZPF methods.
5. Regulation of Three Phase Alternator by ASA methods.
6. Regulation of Three Phase Salient Pole Alternator by Slip test.
7. Parallel operation of two Alternators.
8. V and Inverted V curves of Three Phase Synchronous Motor.
9. Load test on Three Phase Induction Motor.
10. Predetermination of performance characteristics of three phase induction motor by circle diagram and equivalent circuit.
11. Separation of No-load losses of Three Phase Induction Motor.
12. Load test on Single Phase Induction Motor.
13. Equivalent Circuit of Single Phase Induction Motor.

P: 30; TOTAL: 30 PERIODS

15EE48C CONTROL AND INSTRUMENTATION LABORATORY

L T P C

0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: construct transfer function models for electro – mechanical systems. (K5)
- CO2: choose appropriate method for measurement of electrical and non electrical Parameters. (K3)
- CO3: apply direct loading method to calibrate energy meter. (K3)
- CO4: evaluate time, frequency domain specifications and stability of system. (K6)
- CO5: design of compensators for the given specifications. (K5)

LIST OF EXPERIMENTS

1. Transfer function of AC Servo motor
2. Mathematical modeling of armature and field controlled DC Servo motor
3. AC position control system
4. DC position control system
5. Study of displacement and pressure transducers
6. AC bridges
7. DC bridges
8. Measurement using data acquisition card.
9. Extension of range of voltmeter and ammeter.
10. Calibration of three phase energy meter direct loading.
11. Stability analysis of linear system by root locus method.
12. Time Response analysis of First and Second order systems.
13. Design and implementation of lead and lag compensator.
14. Temperature measurement using thermocouple.

P: 30; TOTAL: 30 PERIODS

15EE49C COMMUNICATION SKILLS LABORATORY

(Common to all B.E. / B.Tech., Programmes)

L T P C

0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: interpret any passage after listening and interact at different situations fluently (K2)

CO2: excel appropriately in competitive and professional contexts. (K3)

CO3: acquire the sub-skills required for paper presentations and group discussions which will help them to excel in their workplace. (K3)

Unit I

Lab session:

- i) Listening to audio files:
 - Conversations
 - Speech
 - TED Talks

- ii) Listening and responding to any audio files:
 - Drawing the map
 - Picture completing task
 - Transferring data to Graph.

Practice session: On the spot Speaking activities: Just a minute speech, Picture description.

Unit II

Lab session: Read and understand the comprehension passages given in competitive examinations.

Practice session: Giving opinions and suggestions, analyzing a social issue.

Unit III

Lab session: Listening to audio files related to soft skills.

Practice session: Practicing Power point presentation, Group discussion and Interview skills.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Rizvi.M.Ashraf, "Effective Technical Communication", First Edition, The MC Graw Hill Education Private Limited, Companies, New Delhi, 2010.
2. Sangeetha Sharma and Binod Mishra, "Communication Skills for Engineers and scientists", Prentice Hall Private Limited, Delhi, 2009

breakers – Routine test and type test – Concept of gas insulated substation.

L: 45; T: 30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Kothari. D. P and Nagrath. I.J, “Power System Engineering”, Second Edition, Tata McGraw Hill Private Limited, New Delhi, 2014.
2. Allen. J. Wood and Bruce F. Wollenberg, “Power Generation, Operation and Control”, John Wiley & Sons, Inc., 2013.

REFERENCES

1. Grigsby. L.L, “The Electric Power Engineering, Hand Book”, CRC Press & IEEE Press, 3rd Edition, 2012.
2. Kundur. P, “Power System Stability and Control”, Tata McGraw Hill Private Limited, USA, .
3. Chakrabarti & Halder, “Power System Analysis: Operation and Control”, Prentice Hall Private Limited, 2010
4. Sunil S. Rao, “Switchgear and Protection”, Khanna Publishers, New Delhi, Thirteenth Edition 2008.
5. Ravindranath. B and Chander. N, “Power System Protection and Switchgear”, Newage International Publishers, 2011
6. Soni. M.L, Gupta. P.V, Bhatnagar. V.S, Chakrabarti. A, “A Text Book on Power System Engineering”, Dhanpat Rai and Company, 2009.
7. Badri Ram, Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw Hill Private Limited, 2nd Edition 2013.

15EE52C

POWER ELECTRONICS

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: distinguish various types of power semiconductor devices. (K2)
- CO2: analyze the operation of phase controlled rectifiers. (K3)
- CO3: discuss the various topologies of DC–DC switching regulators. (K2)
- CO4: describe the different modulation techniques of pulse width modulated inverters. (K2)
- CO5: explain the operation of AC voltage controller and Cycloconverter. (K2)

UNIT I

POWER SEMI–CONDUCTOR DEVICES

9

Basic structure and characteristics of SCR, DIAC, TRIAC, GTO, and Power BJT, Power MOSFET and IGBT – Firing and commutation circuit of SCR– Driver and Snubber circuits.

- UNIT II PHASE-CONTROLLED CONVERTERS 9**
2-pulse, 3-pulse and 6-pulse converters – Performance parameters – Effect of source inductance – Power factor control – Dual converters.
- UNIT III DC TO DC CONVERTERS 9**
Step-down and step-up chopper – Time ratio control and current limit control – Switching mode regulators – Buck, Boost, Buck-Boost and Cuk regulator – Concepts of resonant switching.
- UNIT IV INVERTERS 9**
Single phase and three phase voltage source inverters – PWM techniques – Voltage and harmonic control – Series resonant inverter – Multilevel Inverter – Current source inverter– Uninterrupted power supply topologies.
- UNIT V AC TO AC CONVERTERS 9**
Single phase AC voltage controllers – Integral cycle control – Multistage sequence control – Single and three phase cycloconverters.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Rashid M.H., “Power Electronics: Circuits, Devices and Applications”, Pearson Education, Prentice Hall Private Limited, New Delhi, 4th Edition, 2014.
2. Bimbra P.S., “Power Electronics”, Khanna Publishers, 4th Edition, 2012.

REFERENCES

1. Singh M. D and Khanchandani K. B., “Power Electronics”, 3rd Edition, Tata McGraw Hill Private Limited, New Delhi, 2008.
2. Ashfaq Ahmed, “Power Electronics for Technology”, Pearson Education, Indian reprint, 2003.
3. Philip T. Krein, “Elements of Power Electronics”, Oxford University Press, 2014.
4. Ned Mohan, Tore M. Undeland, William P. Robbins, “Power Electronics: Converters, Applications and Design”, 3rd Edition, John Wiley and sons, 2007.
5. Bimal K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, 2005.

**15EE53C ARCHITECTURE, PROGRAMMING AND
 APPLICATIONS OF MICROPROCESSOR L T P C
 AND MICROCONTROLLER 3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: illustrate the architecture of Microprocessor (8085/8086). (K4)
- CO2: develop programs based on the instruction sets of 8085. (K5)
- CO3: design and implement peripheral device interfacing with 8085. (K5)
- CO4: illustrate the architecture of 8051 Microcontroller. (K4)
- CO5: develop application circuits by programming towards simple project development. (K5)

UNIT I INTRODUCTION TO MICROPROCESSORS 9

Architecture of 8085 – Pin outs and signals – Memory interfacing – I/O ports and data transfer concepts – Timing Diagram – Interrupt structure – 8086 processor (Architecture and modes of operation only).

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

Instruction set and addressing modes – Programming: Loop structure with counting & Indexing – Lookup table – Subroutine instructions.

UNIT III PERIPHERAL INTERFACING 9

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter – Interfacing with 8085 – A/D and D/A converter– Traffic light interfacing.

UNIT IV 8051 MICRO CONTROLLER 9

Functional block diagram – Instruction set – Addressing modes – Interrupt structure – Timer – I/O ports – Serial communication.

**UNIT V MICROCONTROLLER PROGRAMMING AND
 APPLICATIONS 9**

Arithmetical programming – key board interface – LED & LCD display interface – Design of PID controller – Interfacing DC Servo motor – Stepper motor control – Washing machine control.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Senthilkumar N., Saravanan M. and Jeevananthan.S, "Microprocessor and Microcontrollers", Oxford University Press, 2011.

2. Krishna Kant “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall Private Limited, New Delhi, 2007.

REFERENCES

1. Ankaj Gupta, “Microcontroller and Embedded System”, S.K.Kataria and Sons Publishers 2013.
2. Muhammad Ali Mazidi and Janice Gilli Mazidi, Kinely. R, “The 8051 Micro Controller and Embedded Systems (Using Assembly Language and C)”, PHI Pearson Education, 2011.
3. Ramesh Gaonkar, “Microprocessor Architecture Programming and Application”, CBS Publishers 2011.
4. Walter A Tribal and Avtar Singh, “The 8088 & 8086 Microprocessors”, Pearson Education, 2007.
5. Singh B.P. and Renu Singh, “Advanced Microprocessors and Microcontrollers”, New Age International Private Limited, 2009.

15EE54C DATA STRUCTURES AND ALGORITHMS L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: analyze and apply different sorting and searching techniques to solve the problem. (K4)
- CO2: implement basic linear data structures using static and dynamic memory allocation.(K3)
- CO3: recognize the data organization and applications of binary trees and binary search trees. (K3)
- CO4: identify an appropriate hashing function and heap for an application. (K4)
- CO5: apply suitable algorithms for solving problems related to shortest path, network link analysis, and minimum spanning tree. (K3)

UNIT I SORTING AND SEARCHING ALGORITHMS 9

Sorting – Internal and External Sorting: Bubble Sort – Insertion Sort – Merge Sort – Quick Sort – Radix Sort, Searching: Linear Search – Binary Search.

UNIT II LINEAR STRUCTURES 9

Definition – Types – Applications of Data Structures – Abstract Data Types (ADT) – List ADT – Array-based implementation – Linked List implementation – Doubly-linked lists – Applications of lists – Stack ADT –

TEXT BOOKS

1. Proakis J.G. and Manolakis D.G, "Digital Signal Processing Principles, Algorithms and Applications", 4th Edition, Pearson Education, New Delhi, 2006.
2. Venkataramani B. & Bhaskar M, "Digital Signal Processor Architecture, Programming and Application", Tata McGraw Hill Private Limited, 2002.

REFERENCES

1. Alan V. Oppenheim, Ronald W. Schafer and John R. Buck, "Discrete – Time Signal Processing", Pearson Education, New Delhi, 2003.
2. Salivahanan S., Vallavaraj A. and Gnanapriya C., "Digital Signal Processing", Tata McGraw Hill Private Limited, New Delhi, 2003.
3. Johnny R.Johnson, "Introduction to Digital Signal Processing", Prentice Hall Private Limited, 2002.
4. Mitra S.K., "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill Private Limited, New Delhi, 2001.
5. Hamid A. Toliyat, Steven G.Campbell, "DSP based Electro – mechanical motion control", CRC press, 2004.
6. Texas Instruments Manual for TMS320LF2407 Processor.

15EE56C

POWER ELECTRONICS LABORATORY

L T P C

0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: illustrate the characteristics of various power semiconductor devices. (K3)
- CO2: demonstrate the operation of converter fed drives. (K3)
- CO3: analyze the basic topologies of DC–DC converters. (K4)
- CO4: make use of different PWM techniques for inverters. (K3)
- CO5: evaluate the performance of AC voltage controller and Cycloconverter. (K6)

LIST OF EXPERIMENTS

1. Characteristics of SCR, TRIAC and DIAC
2. Characteristics of MOSFET and IGBT
3. AC to DC fully controlled converter
4. AC to DC half controlled converter
5. Step down and Step up chopper
6. IGBT based PWM inverter
7. Series and Parallel inverter

15EE58C DATA STRUCTURES AND ALGORITHMS LABORATORY

L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: apply the concepts of sorting and searching techniques. (K3)
- CO2: implement linear and non linear data structures using static and dynamic memory allocation. (K3)
- CO3: apply the operations of stack and queue to solve problem. (K3)
- CO4: implement hashing function and heap for an application. (K3)
- CO5: apply suitable algorithms to solve shortest path problems. (K3)

LIST OF EXPERIMENTS

1. Write a program to sort the array of n numbers using insertion sort.
2. Write a program to search the position of a given value in the array of n numbers using binary search.
3. a. Implement the following operations using singly linked list
 - i) Insert the element at given location
 - ii) Delete the particular element
 - iii) Display.b. Implement the following operations using doubly linked list
 - i. Insert at begin
 - ii. Insert at end
 - iii. Delete at begin
 - iv. Delete at end
 - v. Display.
4. Represent a polynomial as a linked list and write functions to add the following polynomial and display the resultant polynomial.
 $4X^4+3X^3+X+5$, $3X^3+2X^2+X+3$.
5. Using Stack ADT, write a program to convert infix expression into postfix expression which includes '(', ')', '+', '-', '*', and '/' .
6. Create a double ended queue with 3 elements. Insert two elements at the rear end (Inject) and insert two elements at the front end (Push). Delete an element from the front end (Pop) and rear end (Eject). Display the queue after each operation and number of elements in the queue.
7. Write a program to implement an expression tree. Produce its pre-order, in-order, and post-order traversals.

8.
 - i. Implement basic binary search tree operations.
 - ii. While deleting the node with two children, replace it with either in-order successor or in-order predecessor based on choice.
9. Construct binary heap and perform the following :
 - i) Delete an item (with random priority)
 - ii) Delete minimum element
 - iii) Sort Heap
10. Implement hashing with open addressing. Resolve the collision with Linear probing
11. Write a program to find a minimum spanning tree using prims and kruskals algorithm in the following weighted graph.
12. For the given route map with cost of transportation between different cities, write a program to find the shortest route from a source to all the other cities.

P:30; TOTAL: 30 PERIODS

**LIST OF EQUIPMENTS AND COMPONENTS FOR A BATCH OF 30 STUDENTS
(PER BATCH)**

HARDWARE

- 30 Systems with core i5 Processor

SOFTWARE

- Turbo C++/GCC Compiler – to be installed in all PCs.
- OS – LINUX/ Windows 2000/ Windows XP/ NT

15EE61C HIGH VOLTAGE ENGINEERING

**L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: summarize the different mediums of high voltage insulations. (K2)
- CO2: choose appropriate method to generate HVAC, HVDC and Impulse voltage and Current. (K3)
- CO3: identify the suitable measurement techniques of HVAC, HVDC and impulse voltages and currents. (K4)
- CO4: apply the various testing methods on HV equipments. (K3)
- CO5: outline the design, planning and layout of HV laboratories. (K4)

UNIT I INTRODUCTION 9

Introduction to HV technology – Advantages of transmitting electrical power at high voltages – Electric field stresses – Gas / Vacuum as insulator – Liquid dielectrics, Solids and composite dielectrics – Need for generating high voltages in laboratory –Applications of high voltages: Particle Accelerators – Electrostatic precipitators – X-ray machines.

UNIT II GENERATION OF HIGH VOLTAGES AND CURRENTS 9

Generation of high direct current voltages – Generation of high alternating voltages – Generation of impulse voltages – Generation of impulse currents – Tripping and control of impulse generators.

UNIT III MEASUREMENT OF HIGH VOLTAGES AND CURRENTS 9

Measurement of high direct current voltages – Measurement of high alternating voltages – Measurement of high impulse voltages – Measurement of high direct currents – Measurement of high alternating and Impulse currents – Oscilloscope measurements for high voltages and currents.

UNIT IV TESTING TERMINOLOGY AND METHOD 9

Non destructive testing – Measurement of dielectric constant and loss factor – Partial discharge measurement – Definitions of technical terms and specifications of reference atmospheric conditions – Testing of insulator, transformer, surge diverter

UNIT V DESIGN, PLANNING AND LAYOUT OF HV LABORATORIES 9

Test facilities provided in HV laboratories – Activities and studies in HV labs – Classifications of HV labs – Size and ratings of large size HV labs – Grounding of impulse testing laboratories – Insulation coordination.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Naidu. M.S, and Kamaraju. V, “High Voltage Engineering”, 5th Edition, Tata McGraw Hill Private Limited, 2013.
2. Kuffel. E, Zaengl. W.S and Kuffel. J, “High Voltage Engineering: Fundamentals”, 2nd Edition, Elsevier, 2000.

REFERENCES

1. Wadhwa. C.L, “High Voltage Engineering”, 3rd Edition, New Age Internationals (P) Limited, 2012.

UNIT IV INDUSTRIAL HEATING AND WELDING 9
Role of electric heating for industrial applications – Types – Electric arc furnaces – Electric welding –Welding generator, Welding transformer and the characteristics

UNIT V ELECTRIC TRACTION 9
Merits of electric traction – Requirements of electric traction system – Supply systems –Mechanics of train movement – Traction motors and control – Braking – Recent trends in electric traction.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Wadhwa. C.L, "Generation, Distribution and Utilization of Electrical Energy", New Academic Science, Turn bridge Wells, 3rd Edition, 2013.
2. Gupta. B.R, "Generation of Electrical Energy", S. Chand & Company Limited, 14th Edition, 2011.

REFERENCES

1. Partab. H, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Company, NewDelhi, 2014.
2. Openshaw Taylor. E, "Utilization of Electrical Energy in SI Units", Orient Longman Private Limited, 2003.
3. Gupta. J.B, "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 8th Edition, 2009.
4. Gupta, Soni and Bhatnagar, "A Course in Electrical Power", Dhampat Rai and Sons, 2005.
5. Abbi. Y.P and Shashank Jain, "Handbook on Energy Audit and Environment Management", 2006.

15EE63C OBJECT ORIENTED PROGRAMMING L T P C
3 0 0 3

COURSE OUTCOMES

Upon Completion of this course, the students will be able to

- CO1:recognize and use object oriented programming constructs to write object oriented programs. (K3)
- CO2:adopt appropriate constructor and overloading mechanisms to develop the application. (K4)
- CO3:understand the role of inheritance, polymorphism, dynamic binding and generic structures in building reusable code. (K5)

CO4:demonstrate exception handling mechanisms to handle runtime errors and generic programming design. (K3)

CO5:Implement rich data handling through files and streaming. (K6)

UNIT I BASIC CONCEPTS 9

Object oriented programming concepts – objects – classes – methods and messages – abstraction and encapsulation – inheritance – abstract classes – polymorphism. Introduction to C++ – Classes and objects: classes – structures and classes – unions and classes – friend functions – friend classes – inline functions – parameterized constructors – static class members – scope resolution operator – nested classes – local classes – passing objects to functions – returning objects – object assignment. Arrays, Pointers, References and Dynamic Allocation Operators: Arrays of Objects – Pointers to Objects – Type Checking – This Pointer – Pointers to Derived Types – Pointers to Class Members – References – Dynamic Allocation Operators.

UNIT II FUNCTION OVERLOADING AND CONSTRUCTORS 9

Function Overloading – Overloading Constructors – Copy Constructors – Finding the Address of Overloaded Functions – Overload Anachronism – Default Function Arguments – Function Overloading and Ambiguity. Operator overloading: Creating a member Operator Function – Operator Overloading Using Friend Function – Overloading New and Delete – Overloading Special Operators – Overloading Comma Operator.

UNIT III INHERITANCE AND POLYMORPHISM 9

Inheritance: Base–Class Access Control – Inheritance and Protected Members – Inheriting Multiple Base Classes – Constructors, Destructors and Inheritance – Granting Access – Virtual Base Classes. Polymorphism: Virtual Functions – Virtual Attribute and Inheritance – Virtual Functions and Hierarchy – Pure Virtual Functions – Using Virtual Functions – Early vs. Late Binding. Run–Time Type ID and Casting Operators: RTTI – Casting Operators – Dynamic Cast.

UNIT IV TEMPLATES AND EXCEPTION HANDLING 9

Templates: Generic Functions – Applying Generic Functions – Generic Classes – Type name and Export Keywords – Power of Templates. Exception Handling: Fundamentals – Handling Derived Class Exceptions – Exception Handling Options – Understanding terminate() and unexpected() – uncaught exception() Function – Exception and bad exception Classes – Applying Exception Handling.

UNIT V I/O STREAMS 9

Streams and formatted I/O – Overloading << and >>. File: File Classes – File Operations. Namespaces: Namespaces – std namespace. Standard Template Library: Overview – Container Classes – General Theory of Operation – Lists – String Class – Final Thoughts on STL.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Herbert Schildt, “C++: The Complete Reference”, 4th Edition, Tata McGraw Hill Private Limited, 2006.
2. Paul Deitel, Harvey Deitel, “C++ How to Program”, 8th Edition, Prentice Hall Private Limited, 2012.

REFERENCES

1. Ira Pohl, “Object Oriented Programming using C++”, 2nd Edition, Pearson Education, Reprint 2004.
2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, “C++ Primer”, 4th Edition, Pearson Education, 2005.
3. B. Stroustrup, “The C++ Programming language”, 3rd Edition, Pearson Education, 2004.
4. E. Balagurusamy, “Object Oriented Programming with C++”, Tata McGraw Hill Private Limited, 2008.

**15EE64C DESIGN OF ELECTRICAL APPARATUS L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: formulate Specific Electrical and Magnetic loadings for various electrical DC and AC Machines. (K5)
- CO2: devise main dimensions (D, L) of armature and field systems for D.C. machines. (K5)
- CO3: design overall Dimensions of single and three phase transformers core, windings and Cooling systems for transformers. (K5)
- CO4: design main dimensions of squirrel cage and Slip ring induction machines. (K5)
- CO5: estimate enhanced dimensions of stator of AC machines. (K6)

UNIT I INTRODUCTION 9

Major considerations and Limitations in Electrical Machine Design – Electrical Engineering Materials – Space factor – Specific Electrical and

Magnetic loadings – Heating and Cooling of Electrical Machines– Reason for generation of heat in electrical machines – Rating of machines – Standard specifications.

UNIT II DC MACHINES 9

Output Equation – Main Dimensions – Magnetic circuit calculations – Carter's Coefficient – Net length of Iron – Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes – Design of field winding.

UNIT III TRANSFORMERS 9

Output Equations – Main Dimensions – Window space factor – Design of core and windings – Overall dimensions – No load current – Magnetizing current – Temperature rise in Transformers – Design of Tank with cooling tubes – Methods of cooling of Transformers.

UNIT IV INDUCTION MOTORS 9

Output equation – Main dimensions – Length of air gap– Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of poly phase machines – Magnetizing current – Short circuit current .

UNIT V SYNCHRONOUS MACHINES 9

Choice of loadings – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor – Design of damper winding – Design of field winding – Design of turbo alternators – Design considerations to reduce harmonics

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Sawhney A.K. and Chakrabarti A, "A Course in Electrical Machine Design", Dhanpat Rai & Sons, 2015.
2. Balbir Singh, "Electrical Machine Design", Vikas Publishing House.

REFERENCES

1. Sen S.K., "Principles of Electrical Machine Designs with Computer Programmes", Oxford and IBH Publishing Co. Pvt. Ltd., 2009.
2. Deshpande, "Design and Testing of Electrical Machines", Prentice Hall Private Limited.

3. Rai H.M., "Electrical Machine Design", 3rd Edition, Sathiya Prakashan Publications, 2004.
4. Clayton A.E., "Performance & Design of Direct current Machines", English Language Book society and Sri Isaac Pitman & sons Ltd., 1995.
5. Say .M.G, "The Performance and Design of Alternating current Machines", Isaac Pitman & sons Ltd.

15EE65C	PROJECT MANAGEMENT AND FINANCE	L	T	P	C
		3	0	0	3
	(Common to all Programmes)				

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: explain the concept of operational and project management. (K2)
- CO2: define the scope of a project and develop the project plan. (K2)
- CO3: evaluate the technical, business and social environment related to the project. (K3)
- CO4: formulate and manage project team successfully. (K5)
- CO5: monitor and control projects using tools and techniques. (K3)

UNIT I BASIC CONCEPT 9

Concept and categories of project - Project development cycle - Concept, tools and techniques of project management - Logistics and supply chain management - Forms of project organizations.

UNIT II PROJECT FORMULATION 9

Project identification, formulation and preparation. Market and demand estimation - Market survey techniques - Demand forecasting. Materials management - Analysis of materials input, technology, production, plant capacity, location and site, civil works, charts, layouts and work schedule. Cost of project - Means of financing, estimates of cost - Financial projections.

UNIT III PROCESS OF PROJECT APPRAISAL 9

Technical, Economic, Financial, Legal and Social appraisal of the Industrial Projects. Problems due to rate of discount, wage-rate, exchange rates, treatment of taxes, social cost-benefits - treatment of risk and uncertainty - sensitivity analysis and probability approach - Single as well as multiple projects - Big data analytics - PLM and SLM.

**UNIT IV PROJECT TEAM FORMULATION AND 9
MAXIMIZING PARTICIPATION**

Project Team frame works - Project Team cultures - Barriers and challenges - Selecting Team Members - Key skills of effective project leaders - Giving / receiving feedback from different members of the project.

**UNIT V IMPLEMENTATION, MONITORING AND 9
CONTROL OF PROJECTS**

Project scheduling, network techniques for resource, cost budgeting and scheduling - project management teams and coordination - Monitoring and post implementation, evaluation of the project - ERP - Project financing.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Gopalakrishnan P and Ramamoorthy VE "Textbook of Project Management", Macmillan Publications, 2014.
2. Maylor "Project Management", 3rd Edition, Pearson Education, 2010.

REFERENCES

1. Gido, "Effective project management", 3rd Edition, Cengage Learning, 2008.
2. Gray and Larson, "Project Management: The Managerial Process", 3rd Edition, Tata McGraw Hill Private Limited, 2010.
3. Choudhury S, "Project Management", 1st Edition, Tata McGraw Hill Private Limited, 2007.

**15EE66C POWER SYSTEM SIMULATION AND HIGH VOLTAGE
LABORATORY L T P C
0 0 2 1**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: evaluate the parameters of power system using various methods of Load flow analysis. (K6)
- CO2: estimate the fault current for different type of faults. (K6)
- CO3: analyze the breakdown mechanism of gaseous dielectrics.(K4)
- CO4: choose appropriate method to generate High voltage AC, DC and Impulse. (K3)
- CO5: analyze the field distribution in single and multiple dielectrics. (K4)

LIST OF EXPERIMENTS

1. Generation and measurement of AC, DC and Impulse voltage
2. Analysis of gaseous dielectric breakdown under AC Voltage
3. Analysis of gaseous dielectric breakdown under DC Voltage
4. FEM Simulation of single and composite dielectrics field distribution
5. Measurement of dielectric strength of liquid dielectric
6. Simulation of Lightning and Switching Impulse voltage generator
7. Computation of Parameters and Modelling of Transmission Lines
8. Formation of Bus Admittance and Impedance Matrices and Solution of Networks
9. Load Flow Analysis : Solution of Load Flow And Related Problems Using Gauss–Seidel and Newton–Raphson Methods
10. Symmetrical and unsymmetrical Fault Analysis
11. Transient stability analysis of single machine infinite bus system (SMIB).
12. Load – Frequency Dynamics of Single– Area and Two–Area Power Systems

P: 30; TOTAL: 30 PERIODS

15EE67C OBJECT ORIENTED PROGRAMMING LABORATORY

L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: design object oriented programs with static members and friend functions using C++. (K3)
- CO2: implement C++ programs with operator overloading and type conversions. (K3)
- CO3: develop class templates for various data structures like stack, queue and linked list. (K3)
- CO4: apply function templates concepts in standard sorting algorithms such as bubble sort, insertion sort, merge sort and quick sort. (K3)
- CO5: construct simple test applications using dynamic polymorphism. (K3)

LIST OF EXPERIMENTS

1. Design C++ classes with static members, methods with default arguments, friend functions. (For example, design matrix and vector

- classes with static allocation, and a friend function to do matrix–vector multiplication).
2. Implement Matrix class with dynamic memory allocation and necessary methods. Give proper constructor, destructor, copy constructor, and overloading of assignment operator.
 3. Implement complex number class with necessary operator overloading and type conversions such as integer to complex, double to complex, complex to double etc.
 4. Overload the new and delete operators to provide custom dynamic allocation of memory.
 5. Develop C++ class hierarchy for various types of inheritances.
 6. Design a simple test application to demonstrate dynamic polymorphism and RTTI.
 7. Develop a template of linked–list class and its methods.
 8. Develop templates of standard sorting algorithms such as bubble sort, insertion sort and quick sort.
 9. Design stack and queue classes with necessary exception handling.
 10. Write a C++ program that randomly generates complex numbers (use previously designed Complex class) and writes them two per line in a file along with an operator (+, –, *, or /). The numbers are written to file in the format (a + ib). Write another program to read one line at a time from this file, perform the corresponding operation on the two complex numbers read, and write the result to another file (one per line).

P: 30; TOTAL: 30 PERIODS

LIST OF EQUIPMENTS AND SOFTWARE FOR A BATCH OF 30 STUDENTS

HARDWARE

- 30 Systems with core i5 Processor

SOFTWARE

- Turbo C++/GCC Compiler – to be installed in all PC's.
- OS – LINUX/ Windows 2000/ Windows XP/ NT

15EE68C PRODUCT DEVELOPMENT LABORATORY L T P C
0 0 4 2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: understand the integration of customer requirements in product design.
- CO 2: Apply structural approach to concept generation, selection and testing.
- CO 3: Understand various aspects of design such as industrial design, design for manufacture.

The objective of this course is to make the students learn methodologies for identifying customer needs, developing new product concepts, prototype development, estimation of manufacturing costs, and developing business plans to support the development and marketing of these products. A student or a team of students shall develop their own products based on the users need, build simple prototypes of their design, and write development plans for the products.

P: 60 TOTAL: 60 PERIODS

15EE69C COMPREHENSION L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: recognize the Basics of Electrical and Electrical Engineering. (K2)
- CO2: prepare for Engineering Competitive exams. (K3)

Course Content

Electric Circuits and Fields: Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thevenin's, Norton's and Superposition and Maximum Power Transfer theorems, two-port networks, three phase circuits; Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions; Ampere's and Biot-Savart's laws; inductance; dielectrics; capacitance.

Signals and Systems: Representation of continuous and discrete-time signals; shifting and scaling operations; linear, time-invariant and causal systems; Fourier series representation of continuous periodic signals; sampling theorem; Fourier, Laplace and Z transforms.

Electrical Machines: Single phase transformer – equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers – connections, parallel operation; auto-transformer; energy conversion principles; DC machines – types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors – principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines – performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

Power Systems: Basic power generation concepts; transmission line models and performance; cable performance, insulation; corona and radio interference; distribution systems; per-unit quantities; bus impedance and admittance matrices; load flow; voltage control; power factor correction; economic operation; symmetrical components; fault analysis; principles of over-current, differential and distance protection; solid state relays and digital protection; circuit breakers; system stability concepts, swing curves and equal area criterion; HVDC transmission and FACTS concepts.

Control Systems: Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Niquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation; state space model; state transition matrix, controllability and observability.

Electrical and Electronic Measurements: Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; measurement of voltage, current, power, energy and power factor; instrument transformers; digital voltmeters and multimeters; phase, time and frequency measurement; Q-meters; oscilloscopes; potentiometric recorders; error analysis.

Analog and Digital Electronics: Characteristics of diodes, BJT, FET; amplifiers – biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers – characteristics and applications; simple active filters; VCOs and timers; combinational and sequential logic circuits; multiplexer; Schmitt trigger; multi-vibrators; sample and hold circuits; A/D and D/A converters; 8-bit microprocessor basics, architecture, programming and interfacing.

Power Electronics and Drives: Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs – static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters – fully controlled and half controlled; principles of choppers and inverters; basis concepts of adjustable speed dc and ac drives.

P: 30; TOTAL: 30 PERIODS

15EE71C

SMART GRID

L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: explain the design of smart grid architecture. (K2)
- CO2: outline the communication technologies used in smart grid. (K1)
- CO3: explain the Smart Grid technologies, different smart meters. (K2)
- CO4: summarize the renewable energy resources and storages integrated with smart grid (K2)
- CO5: explain the power electronics converters for integration of renewable energy in smart grid. (K2)

UNIT I SMART GRID ARCHITECTURAL DESIGN 9

Introduction – Comparison of Power grid with Smart grid – Power system enhancement – Communication and standards – General View of the Smart Grid Market Drivers – Stakeholder Roles and Function – Measures – Representative Architecture – Functions of Smart Grid Components – Wholesale energy market in smart grid – smart vehicles in smart grid.

UNIT II SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY 9

Communication and Measurement – Monitoring, Phasor Measurement Unit (PMU), Smart Meters, Wide area monitoring systems (WAMS) – Advanced metering infrastructure – GIS and Google Mapping Tools.

UNIT III 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.

UNIT IV RENEWABLE ENERGY AND STORAGE 9

Renewable Energy Resources – Sustainable Energy Options for the Smart Grid – Penetration and Variability Issues Associated with Sustainable Energy Technology – Demand Response Issues –Electric Vehicles and Plug-in Hybrids – PHEV Technology – Environmental Implications – Storage Technologies – Grid integration issues of renewable energy sources.

UNIT V POWER ELECTRONIC CONVERTERS FOR RENEWABLE ENERGY INTEGRATION IN SMART GRID 9

Power electronic converters-Current source converters – Voltage source converters – Power electronics in the Smart Grid – Renewable energy generation and integration – Fault current limiting-Shunt compensation – Series compensation.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. James Momoh, “Smart Grid: Fundamentals of design and analysis”, John Wiley & sons Inc, IEEE press 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, John Wiley & sons Inc, 2012.

REFERENCES

1. Fereidoon P. Sioshansi, “Smart Grid: Integrating Renewable, Distributed & Efficient Energy”, Academic Press, 2012.
2. Clark W.Gellings, “The smart grid: Enabling energy efficiency and demand response”, Fairmont Press Inc, 2009.
3. Non-Conventional Energy Sources, G.D. Rai, Khanna Publishers, New Delhi, 1999.
4. Peter S. Fox-Penner, “Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities”, Island Press.
5. Ali Keyhani, Mohammad N. Marwali, Min Dai, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley.
6. Tony Flick and Justin Morehouse, “Securing the Smart Grid”, Elsevier Inc.

15EE72C

MINI PROJECT

L T P C
0 0 8 4

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: identify an innovative or creative idea / concept / solution to a problem.(K2)
- CO2: design and develop the working model.(K5)
- CO3: practice the project along with team members.(K3)
- CO4: prepare reports to interpret the results.(K3)
- CO5: explain the ideas effectively through presentation.(K2)

COURSE DESCRIPTION

- A mini–project which is relevant to the branch of interest of the student or a simulation model developed by the student with the guidance of a faculty member.
- An Evaluation committee formed by the HOD will review the activities and the marks are awarded as follows: Report (40%), Presentation (30%) and oral Examination (30%)

P: 120; TOTAL: 120 PERIODS

15EE73C

RESEARCH PAPER AND PATENT REVIEW – SEMINAR

L T P C
0 0 2 1

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: explain the concepts published in reputed journals on their area of interest. (K2)
- CO2: examine patents and the procedure available in the database. (K2)

COURSE DESCRIPTION

The student shall give at least one technical presentation on recent research publications and patents related to specialization. The presentation will be assessed by a committee constituted by the Head of the Department. The students shall submit a report at the end of the semester.

P: 30; TOTAL: 30 PERIODS

15EE81C

PROJECT WORK

L T P C
0 0 20 10

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: select a good project and able to work in a team leading to development of hardware / software product. (K2)

CO2: prepare a good technical report and able to present the ideas with clarity. (K3)

COURSE DESCRIPTION

A Project topic must be selected either from published lists or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

P: 300; TOTAL: 300 PERIODS

15EE82C INTERNSHIP / INPLANT TRAINING

L T P C
0 0 4 2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: recognize the requirement of the industry and cope up with the industrial scenario (K2)
- CO2: prepare a report about the work experience in industry. (K3)
- CO3: explain effectively through technical presentation. (K2)

COURSE DESCRIPTION

A. INTERNSHIP

- Internship undergone in R&D organization and reputed institution.
- An Evaluation committee formed by the HOD will review and the marks are awarded as follows: Internship Report (40%), Presentation (30%) and oral Examination (30%)

B. INPLANT TRAINING

- 2 to 4 weeks Training undergone in industries and also in R&D organization are considered as inplant training.
- An Evaluation committee formed by the HOD will review and the marks are awarded as follows: Inplant Training Report (40%), Presentation (40%) and Oral Examination (20%)

P: 60; TOTAL: 60 PERIODS

15EE01E SWITCHED MODE POWER CONVERSIONS L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: design the reactive elements for power electronic systems. (K5)
- CO2: discuss the concepts of switching converters. (K2)
- CO3: explain the operation of resonant converters. (K2)
- CO4: discuss the operation of transformerized switching converters. (K2)
- CO5: distinguish various types of UPS and filters. (K2)

UNIT I INTRODUCTION 9

Reactive elements – Design of Inductor, capacitor and transformer for Power electronics applications.

UNIT II BASIC SWITCHING CONVERTER TOPOLOGIES 9

Basic concepts of SMPS – DC-DC converters – Characteristics – Constituent elements – Operating principles.

UNIT III RESONANT CONVERTERS 9

Classification of resonant converters – Basic resonant circuit concepts – Load resonant converters – Resonant switches converters – Zero voltage switching.

UNIT IV TRANSFORMERIZED SWITCHING CONVERTERS 9

Forward converter – Push-pull converter – Half-bridge switching converter – Full – bridge switching converter – Flyback converter – Zero-Current-Switching Quasi-Resonant Half-Bridge converter

UNIT V POWER CONDITIONERS, UPS AND FILTERS 9

Power line disturbances – Power conditioners – Offline and Online UPS, Applications – Voltage filters, Series-parallel resonant filters, filter for PWM VSI, current filter, DC filters.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Simon S. Ang, "Power Switching Converter", Marcel Dekker Inc., Taylor and Francis, 3rd Edition, 2005.
2. Umanand L., Bhat S.R., "Design of magnetic components for switched Mode Power converters", Wiley Eastern Ltd., 2001.

REFERENCES

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: Converters, Applications and Design", 3rd Edition, John Wiley and Sons, 2003.
2. Philip T. Krein, "Elements of Power Electronics", Oxford University Press, 2004.
3. Rashid M.H., "Power Electronics: Circuits, Devices and Applications", 3rd Edition, Pearson Education, 2004.
4. Keng C. Wu, "Switch-Mode Power Converters: Design and Analysis", 1st Edition, Academic Press, 2005.
5. Ramanarayanan V., "Course Material On Switched Mode Power Conversion", IISc Bangalore, 2007.

15EE02E SPECIAL ELECTRICAL MACHINES L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: develop the knowledge in construction, principle of operation and performance of synchronous reluctance motors. (K5)
- CO2: explain the construction, various operating modes, control and performance of stepping motors. (K2)
- CO3: analyze the structure and operation, converters, and controllers of switched reluctance motors. (K4)
- CO4: review the construction, principle of operation, control and performance of permanent magnet brushless D.C. motors. (K2)
- CO5: illustrate the construction, principle of operation and control of permanent magnet synchronous motors. (K3)

UNIT I SYNCHRONOUS RELUCTANCE MOTORS 9
Constructional features – Types – Axial and Radial flux motors – Operating principles –Reluctance torque – Phasor diagram – Characteristics.

UNIT II STEPPING MOTORS 9
Constructional features – Principle of operation – Variable reluctance motor – Single and multi stack configurations – Permanent Magnet Stepper motor – Hybrid motor – Theory of torque predictions – Modes of excitations – Characteristics – Drive circuits – Closed loop control.

UNIT III SWITCHED RELUCTANCE MOTORS 9

Constructional features – Principle of operation – Inductance profile – Characteristics – Torque equation – Power Converters and their controllers – Methods of Rotor position sensing – Current control schemes – Sensorless operation – Closed loop control of SRM.

UNIT IV PERMANENT MAGNET BRUSHLESS DC MOTORS 9

Permanent Magnet materials – Magnetic Characteristics – Principle of operation – Types – Commutators : Mechanical and electronic commutators – Square wave permanent magnet brushless motor drives – Sensors – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature reaction MMF – Sine wave motor with practical windings – Phasor diagram – Torque / speed characteristics – Power controllers – Converters.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Miller T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
2. Venkataratnam K., "Special Electric Machines", Universities Press, 2009.

REFERENCES

1. Krishnan R., "Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application", CRC Press, New York, 2001.
2. Aearnley P.P., "Stepping Motors – A Guide to Motor Theory and Practice", Peter Perengrinus, London, 2002.
3. Kenjo T. and Nagamori S., "Permanent Magnet and Brushless DC Motors", Clarendon Press, London, 1988.
4. Gnanavadivel J., Karthikeyan J. and Albert Alexander S., "Special Electrical Machine", Anuradha publications, 3rd Edition, 2007.
5. Kenjo T., "Stepping Motors and Their Microprocessor Controls", Clarendon Press London, 2007.

TEXT BOOKS

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001
2. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 4th Edition,2005.

REFERENCES

1. S. Rao and Parulekar, “Energy Technology – Non Conventional, Renewable and Conventional”, New Delhi, Khanna Publishers, 2009.
2. Paul.C.Krause, O.Wasynczuk, “Analysis of Electrical Machinery and Drive Systems”, 3rd Edition, Wiley Publications 2013.
3. Ned Mohan, Tore M. Undeland and William P. Robbins, “Power Electronics: Converters, Applications and Design”, New Jersey, John Wiley and Sons, 2003.
4. S.N.Bhadra, D. Kastha, & S. Banerjee, “Wind Electrical Systems”, Oxford University Press, 2009
5. Rai. G.D, “Solar energy utilization”, Khanna publishes, 2010
6. Gray, L. Johnson, “Wind Energy System”, Prentice Hall Private Limited, 1995
7. B.H.Khan, “Non–conventional Energy sources”, Tata McGraw Hill Private Limited, NewDelhi.

15EE04E**CAD OF ELECTRICAL APPARATUS****L T P C****3 0 0 3****COURSE OUTCOMES**

Upon completion of this course, the students will be able to

- CO1: compare the conventional and field analysis based design. (K4)
- CO2: interpret the basic concept of finite element method. (K3)
- CO3: perceive the procedures of CAD packages. (K5)
- CO4: devise the design of rotating machines. (K5)
- CO5: analyze the design of transformers. (K4)

UNIT I**INTRODUCTION****9**

Outline of Electromagnetic Fields – Electromagnetic field equations – Laplace and Poisson’s Equations – Conventional Design Procedures – Limitations – Need for field analysis based design.

UNIT II**PHILOSOPHY OF FEM****9**

Mathematical models – Differential / Integral equations – Finite Difference method – Finite element method – 2D field problems – Charge simulation method.

- UNIT III CAD PACKAGES 9**
Elements of a CAD system – Preprocessing – Modeling – Meshing – governing equations – boundary conditions and material characteristics – Setting up solution – Post processing.
- UNIT IV DESIGN APPLICATIONS 9**
Voltage Stress in Insulators – Capacitance calculation – Design of bushings – Inductance calculation – Torque calculation in Switched Reluctance Motor.
- UNIT V DESIGN OF TRANSFORMERS 9**
Single phase transformer – Computation of the No load Inductances – Estimation of Iron Loses –and leakage inductances.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. S.J. Salon, “Finite Element Analysis of Electrical Machines”, Springer, Yes DEE publishers, Indian reprint, 2007.
2. K.J.Binns, P.J.Lawrenson and C.W.Trowbridge, “The Analytical and Numerical Solution of Electric and Magnetic Fields”, John Wiley and sons, 1992.

REFERENCES

1. Joao Pedro, A.Bastos and Nelson Sadowski, “Electromagnetic Modeling by Methods”, Marcell Dekker Inc., 2003.
2. S.R.H.Hoole, “Computer Aided Analysis and Design of Electromagnetic Devices”, Elsevier, NewYork, 1989.
3. Matthew N. O. Sadiku, “Principles of Electromagnetics”, (English) 4th Edition, Oxford University Press, New Delhi, 2010
4. Nathan Ida, Joao P A Bastos, “Electromagnetics and calculation of fields”, Springer Verlag, Second Edition, 1997.
5. S.S.Rao, “The Finite Element Method in Engineering”, Elsevier, 2011.

15EE05E SOLID STATE DRIVES

L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: discuss the concepts of multi quadrant dynamics of drives. (K2)
- CO2: analyze the fully controlled converter fed separately excited dc drives. (K4)
- CO3: design current and speed controllers for dc drives. (K5)
- CO4: explain the various speed control strategies of induction motor. (K2)
- CO5: apply different control techniques of synchronous motor. (K3)

UNIT I DRIVE CHARACTERISTICS 9
Equations governing motor load dynamics – steady state stability – Multi quadrant dynamics – Acceleration, deceleration, starting and stopping – load torque characteristics of various drives.

UNIT II CONVERTER / CHOPPER FED DC DRIVE 9
Steady state analysis of fully controlled converter fed separately excited DC drive – Continuous and discontinuous conduction – Time ratio and current limit control – four quadrant operation of chopper.

UNIT III DESIGN OF CONTROLLERS FOR DRIVES 9
Transfer function of converter fed DC drive – current and speed feedback – Armature voltage control and field weakening mode control, Design of current and speed controller – Converter selection and characteristics.

UNIT IV INDUCTION MOTOR DRIVES 9
Stator voltage, frequency, V/f control – field weakening mode – Static rotor resistance control– Slip power recovery scheme – voltage/current fed inverters – closed loop control.

UNIT V SYNCHRONOUS MOTOR DRIVES 9
V/f control and self-control of synchronous motor – Marginal angle control – power factor control – Permanent magnet synchronous motor.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Gopal K. Dubey, “Power Semi conductor controlled drives”, Prentice Hall Private Limited, 1989.
2. Bimal K. Bose., “Modern Power Electronics and AC Drives”, Prentive Hall / Pearson Education Private Limited, 2005.

REFERENCES

1. De N. K. and Sen P. K., "Electrical Drives", Prentice Hall Private Limited, 2006.
2. Murphy J.M.D. and Turnbull, "Thyristor control of AC Motor", Pergamon Press Oxford, 1990.
3. Krishnan R., "Electric Motor Drives: Modeling, Analysis, and Control", Prentice Hall Private Limited, 2001.
4. Dubey.G.K., "Fundamentals of Electrical drives", Narora publications, 2010.
5. Vedam Subramanyan, "Thyristor control of Electrical Drives", Tata McGraw Hill Private Limited, 1996.

15EE06E

ADVANCED SWITCHGEAR

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: explain the characteristics of arc in relation to circuit breaker. (K2)
- CO 2: explain the problems associated with circuit interruption by a circuit breaker. (K2)
- CO 3: describe and discriminate the different types of conventional circuit breaker. (K4)
- CO 4: analyze the recent advancements in circuit breaker. (K4)
- CO 5: explain the testing of circuit breaker. (K2)

UNIT I

THEORY OF CIRCUIT INTERRUPTION

9

Arc phenomena – Maintenance of the arc – Losses from plasma – Essential properties of arc – Arc interruption theories – High resistance Interruption – Current zero interruption theory.

UNIT II

CIRCUIT CONSTANTS IN RELATION TO CIRCUIT BREAKING

9

Introduction – Circuit breaker rating– Circuit constants and circuit conditions – Restriking voltage transient Characteristics of restriking voltage – Interaction between breaker and circuit – Current chopping – Duties of switchgear.

UNIT III

CONVENTIONAL CIRCUIT BREAKERS

9

Automatic switch – Air–break circuit breaker– Oil circuit breaker – Single and multi break construction – Air–blast circuit breaker– Performance of circuit breakers and system requirements – Modification of circuit breaker

duty by shunt resistors – Power factor correction by series resistance – Comparative merits of different types of conventional circuit breakers.

UNIT IV RECENT DEVELOPMENTS IN CIRCUIT BREAKERS 9

Modern trends – Vacuum circuit breakers – Sulphur hexafluoride (SF₆) circuit breakers– D.C. circuit breaker – High speed DC air break circuit breaker – HVDC circuit breaker – HVDC vacuum circuit breaker.

UNIT V TESTING OF CIRCUIT BREAKERS 9

Type tests and routine tests – short circuit testing– Equipments used in the station– Testing procedure – Direct testing – making capacity– Breaking capacity – Indirect testing –unit testing, synthetic testing.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. B Ravindranath and M Chander, “Power system Protection and Switchgear”, New Age International Publishers, 2011.
2. Rao Sunil.S, “Switchgear and protection”, Khanna Publishers, 1999.

REFERENCES

1. Badri ram and Viswakarma D N, “Power system protection and Switchgear”, Tata McGraw Hill Private Limited, New Delhi, 1995.
2. Wadhwa C.L, “Electrical Power Systems”, New Age international Publishers, 2006, 4th Edition, Reprint August 2007.
3. Ruben D. Garzon, “High Voltage Circuit Breakers: Design and Applications”, CRC Press.
4. Chunikhin A and Zhavoronkov M, “High Voltage Switchgear Analysis and Design”, Mir Publishers, Moscow, 1989.
5. Switchgear Manual, 12th Edition, ABB, 2012.
6. Power Engineering Guide, 7th Edition, Siemens Energy Sector, 2011.

**15EE07E SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: explain the fundamentals of solar cells. (K2)
- CO 2: recognize the various solar PV technologies and their up gradations along with their benefits. (K2)
- CO 3: design and analyze on–grid and off–grid PV applications. (K3)
- CO 4: realize cost benefit analysis of PV installations. (K2)

UNIT I ESSENTIAL BASICS OF SOLAR CELL 9

Solar cell – physics – Photovoltaics in Global Energy Scenario – Fundamentals of Semiconductors, Energy band, Charge carriers – Motion, PN Junction diode, Solar cells – Design characteristics, Solar radiation.

UNIT II COMMERCIAL AND DEVELOPING TECHNOLOGIES 9

Commercial technologies – Mono crystalline and Multi crystalline, Silicon – Wafer based Solar cell, Thin film solar cells – A-Si, Cd-Te and CIGS, Concentrated PV cells, Developing technologies – Organic cells, Dye sensitized cells.

UNIT III SOLAR PV FOR ON-GRID APPLICATIONS 9

Solar cells to solar array – On-Grid PV system – With and Without storage – Balance of system – DC-DC converters – Inverters – Net Metering – Design and analysis – Performance evaluation and monitoring – Field visit – Grid tied PV power plant.

UNIT IV SOLAR PV FOR OFF-GRID APPLICATIONS 9

Off-Grid stand alone PV system – System sizing – Module and Battery – Storage – Batteries for PV systems – Sun Tracking mechanism – Types of tracking – One-axis, Two-axis – Maximum power point tracking – Design and analysis – Performance evaluation and monitoring – Field visit – Off-grid PV system

UNIT V COST BENEFIT ANALYSIS FOR SOLAR PV INSTALLATIONS

9

Cost and manufacturability – Manufacturing economics – Scaling – Pricing – Trends in retail pricing – Energy economics – Grid tied power plant – Solar street lighting system

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Chetan Singh Solanki, “Solar Photovoltaics Fundamentals, Technologies and Applications”, 2nd Edition, Prentice Hall Limited.
2. James P. Dunlop, “Photovoltaic Systems”, Second Edition, American Technical Publishers

REFERENCES

1. Robert Foster, Majid Ghassemi and Alma Cota, “Solar Energy – Renewable Energy and the Environment”, CRC Press
2. www.pveducation.org

15EE08E ENERGY AUDITING AND MANAGEMENT L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: explain the concept of energy auditing. (K2)
- CO2: select energy efficient motor for various applications. (K4)
- CO3: identify the possibility of energy conservation in driven equipments. (K4)
- CO4: select suitable lighting schemes for various environment. (K4)
- CO5: describe the concept of Energy Management. (K6)

UNIT I ELECTRICAL ENERGY AND SAFETY AUDIT 9

Overview of Electricity Act – Energy conservation act – Electrical energy audit – Types – Tools – Tariff – Load factor improvement – Power factor correction – Power demand control and shifting – Electrical safety Auditing.

UNIT II ENERGY CONSERVATION IN ELECTRIC MOTORS 9

Motors efficiency – Motor selection – Factors affecting motor performance – Efficiency at low load – Rewound motors – Variable speed drives – Load reduction – High efficiency motors – Energy savings in transformers – Case studies.

UNIT III ELECTRICAL ENERGY CONSERVATION IN DRIVEN EQUIPMENTS 9

Input electrical energy requirements in pumps, fans and compressors – Load factor estimation in the equipment – Energy conservation potential – Electrical energy conservation in refrigeration and air conditioning systems.

UNIT IV ENERGY CONSERVATION IN INDUSTRIAL LIGHTING 9

Concept of lighting systems – Choice of lighting – Different lighting technologies – Energy saving – Control of lighting – Lighting standards and requirements – Light meter audit – Methods to reduce costs.

UNIT V ENERGY MANAGEMENT 9

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting – Energy manager, Qualities and functions, language, Questionnaire, Checklist of top level management.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. D. Yogi Goswami, Frank Kreith, "Energy Management and Conservation Handbook", CRC Press, 2008.
2. Marguerite A. H Ruffner, Yacov Y. Haimes, "Energy Auditing and Conservation: Methods, Measurements, Management, and Case Studies", Taylor and Francis, 1980.

REFERENCES

1. General Aspects of Energy management and Energy audit, Second Edition 2005, Bureau of Energy Efficiency, Ministry of Power, India.
2. Energy Efficiency in Electrical Utilities, Second Edition 2005, Bureau of Energy Efficiency, Ministry of Power, India.
3. Energy management handbook, John Wiley and Sons – Wayne C. Turner, 2006

15EE09E

POWER QUALITY

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: review the characterization of power quality in electric power system. (K2)
- CO2: categorize the causes of power quality problems. (K4)
- CO3: describe the estimation techniques and mitigation methods of voltage sag and interruptions. (K6)
- CO4: explain the concept of over voltages and harmonic controlling methods. (K2)
- CO5: outline the power quality monitoring and improvement techniques. (K3)

UNIT I INTRODUCTION

9

Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation – Harmonics Vs transients – Effect of harmonics – Harmonic distortion – Harmonic indices – Inter harmonics – Resonance – Harmonic distortion evaluation – Power acceptability curves – IEEE and IEC standards.

UNIT II SOURCES OF POWER QUALITY PROBLEMS

9

Single phase static and rotating AC/DC converters, Three phase static AC/DC converters, Battery chargers, Arc furnaces, Fluorescent lighting, pulse modulated devices, Adjustable speed drives.

UNIT III VOLTAGE SAG AND INTERRUPTIONS 9

Sources of Voltage Sag and Interruptions – Estimating voltage sag performance – Thevenin's equivalent source – Analysis and calculation of various fault condition – Voltage sag due to induction motor starting – Estimation of sag severity – Mitigation of voltage sag using active series compensators – Static transfer switches and fast transfer switches.

UNIT IV OVERVOLTAGES 9

Sources of overvoltage – Capacitor switching – Lightning – Ferro resonance – Mitigation of voltage swells – Surge arresters – Power conditioners – Devices for controlling harmonic distortion – Passive and active filters.

UNIT V POWER QUALITY MONITORING & IMPROVEMENT 9

Monitoring considerations – Monitoring and diagnostic techniques for various power quality problems– Power line disturbance analyzer – Quality measurement equipment – Harmonic spectrum analyzer – Flicker meters – Disturbance analyzer – Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Roger. C. Dugan, Mark. F. McGranaghram, Surya Santoso, H.WayneBeaty, "Electrical Power Systems Quality", Tata McGraw Hill Private Limited, 2012.
2. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", New York: Wiley, 1999.

REFERENCES

1. G.T. Heydt, "Electric Power Quality", 2nd Edition, West Lafayette, IN, Stars in Circle Publications, 2013.
2. M.H.J Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", New York: IEEE Press, 1999.
3. C. Sankaran, "Power Quality", CRC Press, 2009.
4. Alexander Kusko and Marc. T. Thompson, "Power Quality in Electrical Systems", Tata McGraw Hill Private Limited, 2007.
5. Angelo Baggini, "Handbook of Power Quality", John Wiley & Sons, 2008.

15EE10E

ENERGY STUDIES

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: recognize the basic of conventional and non conventional Energy sources. (K2)

CO2: describe the basic concepts of Energy generation and Conversion. (K6)

CO3: explain the various energy storage system. (K2)

CO4: discuss the present Energy scenario and its Environmental Impact. (K6)

CO5: analyze the various energy Policies and standards. (K4)

UNIT I ENERGY SOURCES

9

Energy classification – Energy sources – Principal sources of energy: conventional and non conventional sources – Bio–mass, fossil fuels, nuclear fuels, solar energy – Energy conversion –prospecting, extraction, resource assessment and their peculiar characteristics.

UNIT II ELECTRICAL ENERGY GENERATION

9

Production of electrical energy using thermal energy, chemical energy, electromagnetic energy and mechanical energy – Magneto hydrodynamic conversion – MHD plasmas – Analysis of MHD generators – MHD power applications – Batteries – Basic concepts – electrochemical principles and reactions – Selection and application of batteries – Fuel cells – general characteristics – Low power fuel cell systems – Fuel cell power plants.

UNIT III ENERGY STORAGE

9

Energy storage: requirements and methods – Storage of thermal energy – Storage of mechanical energy – Storage of electrical energy – Storage of chemical energy – Storage of nuclear energy.

UNIT IV ENERGY SCENARIO

9

Coal, Oil, Natural Gas, Nuclear power and Hydro – Utilization pattern in the past, present and future projections of consumption pattern – Sector–wise energy consumption – Environmental impact of fossil fuels – Energy scenario in India – Growth of energy sector and its planning in India.

UNIT V ENERGY POLICIES

9

National energy policy in the last plan periods, Energy use and Energy supply, Overview of renewable energy policy and the Five Year Plan programmes, Basic concept of Input–Output analysis, Concept of energy

multiplier and implication of energy multiplier for analysis of regional and national energy policy– Carbon Trading– Renewable Energy Certification – CDM.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Messerle, Hugo K., "Magneto hydrodynamic Electric Power Generation", J. Wiley, 1995.
2. Loulou. R, Shukla. P.R, and Kanudia. A, "Energy and Environment Policies for a sustainable Future", Allied Publishers Ltd, New Delhi, 1997.

REFERENCES

1. Homas Reddy, David Linden., " Handbook of Batteries, 4th Edition", Tata McGraw Hill Private Limited, 2010
2. Vielstich. W, Yokokawa. H, Gasteiger. H.A, "Handbook of fuel cells– part 1", Volume 5, John Wiley and Sons, 2009.
3. Bent Sorensen, "Renewable Energy", Elsevier, Academic Press, 2011.
4. Twidell, J.W. and Weir, A., "Renewable Energy Sources", 2nd Edition, Taylor & Francis, 2006.
5. IEEE Transactions on Power, Energy and Industry Applications.

15EE11E	ELECTROMAGNETIC INTERFERENCE AND ELECTROMAGNETIC COMPATIBILITY	L T P C 3 0 0 3
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COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: describe the sources of EMI and design for electromagnetic compatibility. (K2)
- CO2: discuss the methods of coupling and grounding. (K2)
- CO3: summarize the balancing, filtering and shielding methods. (K2)
- CO4: explain the digital logic noise and ground noise. (K2)
- CO5: list the standard and laboratory techniques for EMI/EMC. (K1)

UNIT I	INTRODUCTION	9
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Sources of EMI – Conducted and radiated interference – Characteristics – Designing for electromagnetic compatibility (EMC) – EMC regulation – Typical noise path – Use of network theory – Methods of eliminating interferences.

4. Prasad Kodali.W, "Engineering Electromagnetic Compatibility: Principles, Measurements, Technologies, and Computer Models", Wiley–Blackwell, 2nd Edition, 2001.
5. Henry W. Ott, "Electromagnetic Compatibility Engineering", Wiley–Blackwell, 2009.
6. Christos Christopoulos, "Principles and Techniques of Electromagnetic Compatibility", CRC Press, 2nd Edition, 2007.

15EE12E INSULATION TECHNOLOGY

**L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: describe the properties of insulating materials. (K2)
- CO2: explain the various breakdown mechanisms in gaseous dielectrics. (K2)
- CO3: analyze the various breakdown mechanisms in solid dielectrics. (K4)
- CO4: discuss the various breakdown mechanisms in liquid dielectrics. (K2)
- CO5: list out the applications of different insulating materials in electrical equipments. (K1)

UNIT I GENERAL PROPERTIES OF INSULATING MATERIALS 9

Requirements of insulating materials – Electrical properties – Molecular properties of dielectrics – Dependence of permittivity on temperature, pressure, humidity and voltage, permittivity of mixtures, practical importance of permittivity – Behavior of dielectric under alternating fields – Complex dielectric constants – Bipolar relaxation and dielectric loss – Dielectric strength.

UNIT II BREAKDOWN MECHANISMS IN GASEOUS DIELECTRICS 9

Behavior of gaseous dielectrics in electric fields – Gaseous discharges – Townsend's theory – Streamer theory – Electronegative gases and their influence on gaseous discharge – gaseous discharges in non–uniform fields – Breakdown in vacuum insulation.

UNIT III BREAKDOWN MECHANISMS IN SOLID DIELECTRICS 9

Intrinsic breakdown of solid dielectrics – Electromechanical breakdown – Streamer breakdown, thermal breakdown and partial discharges in solid dielectrics – Electrochemical breakdown – tracking and treeing – Breakdown in composite insulation.

UNIT IV BREAKDOWN MECHANISMS IN LIQUID DIELECTRICS 9

Liquids as insulators – Conduction and breakdown in pure and commercial liquids – Cryogenic insulation.

UNIT V APPLICATION OF INSULATING MATERIALS 9

Application of insulating materials in transformers, rotating machines, Insulators, Isolators/circuit breakers, cables, power capacitors and bushings.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Adrinaus, Dekker J., “Electrical Engineering Materials”, Prentice Hall Private Limited, New Delhi, 2001.
2. Alston L.L., “High Voltage Technology”, Oxford University Press, London, 1968 (B.S Publications, 1st Indian Edition 2006).

REFERENCES

1. Kuffel E., Zaengl W.S. and Kuffel J., “High Voltage Engineering Fundamentals”, Elsevier India Private Limited, 2005.
2. Dieter Kind and Hermann Karner, “High Voltage Insulation Technology”, (Translated from German by Narayana Rao Y., Friedr. Vieweg & Sohn, Braunschweig), 1985.
3. Naidu M.S. and Kamaraju V., “High Voltage Engineering”, Tata McGraw Hill Private Limited, New Delhi, 2009.
4. Ushakov V.Y., “Insulation of High Voltage Equipment”, Springer, ISBN.3–540–20729– 5,
5. Rod V. Latham, “High Voltage Vacuum Insulation: Basic Concepts and Technological Practice”, Academic Press, 1st Edition, 1995.

15EE13E FLEXIBLE AC TRANSMISSION

**L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: explain the fundamental idea about FACTS controllers. (K2)
- CO2: design of SVC voltage regulator using TCR–TSC logic. (K5)
- CO3: describe Transient stability model of TCSC. (K2)
- CO4: explain about basic principle of operation of STATCOM. (K2)
- CO5: explain controller interactions & its type. (K2)

UNIT I INTRODUCTION 9

Flexible AC transmission – uncompensated transmission line – reactive power control – series and shunt compensation. FACTS devices: Static Var Compensator (SVC) – Thyristor Controlled Series capacitor (TCSC) – Unified Power Flow controller (UPFC) – Interphase Power Flow Controller (IPC).

UNIT II STATIC VAR COMPENSATOR AND APPLICATIONS 9

Voltage control – advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Applications: enhancement of transient stability and power system damping – Steady state power transfer – Prevention of voltage instability.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR AND APPLICATIONS 9

Operation of TCSC – Modes – Modeling – Variable reactance model – Applications: improvement of system stability limit – Enhancement of system damping – Voltage collapse prevention.

UNIT IV EMERGING FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM) – Operating principle – V-I characteristics – UPFC – IPC: Principle and modes of operation – Applications: Modeling of UPFC, IPC for power flow and transient stability studies.

UNIT V COORDINATION OF FACTS CONTROLLERS 9

FACTS Controller interactions – SVC–SVC interaction – Coordination of multiple controllers using linear control techniques – Control coordination using Genetic algorithm.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Mohan Mathur, R., Rajiv. K. Varma, “Thyristor – Based Facts Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc., 2002.
2. Narani G. Hingorani and Laszlo Gyugyi, “Understanding FACTS concepts and Technology of flexible AC Transmission Systems”, IEEE power Engineering society Sponsor, IEEE press, 2001.

REFERENCES

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

2. Xiao–Ping Zhang, “Flexible AC Transmission Systems: Modelling and Control (Power Systems)”, Springer; 2nd Edition, 2012.
3. Yong–Hua Song, and Allan Johns, “Flexible AC Transmission Systems (FACTS)”, IET, 1999.
4. Narain G. Hingorani, Laszlo Gyugyi, “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems”, Wiley–IEEE Press, 1st Edition, 1999.
5. K.R.Padiyar, “FACTS Controllers in Power Transmission and distribution”, New age international Publishers 2007.

15EE14E EHV AC POWER TRANSMISSION

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: explain the role of EHVAC Transmission and Mechanical considerations. (K2)

CO2: calculate the line parameters for multiconductor lines. (K4)

CO3: estimate the voltage gradients of conductors. (K6)

CO4: discuss the concepts of corona and radio interference. (K2)

CO5: illustrate the effect of electrostatic field of EHV lines. (K3)

UNIT I INTRODUCTION 9

Role of EHVAC Transmission – Standard transmission voltages – Average values of line parameters – Power handling capacities and line losses – Mechanical considerations in line performance.

UNIT II CALCULATION OF LINE PARAMETERS 9

Properties of bundled conductors – Calculation of resistance, inductance and capacitance for multiconductor lines – Calculation of sequence inductances and capacitances – Line parameters for different modes of propagation.

UNIT III VOLTAGE GRADIENTS OF CONDUCTORS 9

Charge–potential relations for multi–conductor lines – Surface voltage gradient on conductors – Gradient factors and their use – Distribution of voltage gradient on sub conductors of bundle – Voltage gradients on conductors in the presence of ground wires on towers.

UNIT IV CORONA EFFECTS 9

I^2R loss and corona loss – Corona loss formulae – Audible noise generation and characteristics – Limits for audible noise – Day–Night

equivalent noise level – Corona pulse generation and properties – Limits for radio interference fields – Measurement of radio interference.

UNIT V ELECTROSTATIC FIELD OF EHV LINES 9

Electric shock and threshold currents – Calculation of electrostatic field of AC lines – Effect of high field on humans, animals, plants and vehicles – Electrostatic induction in un-energized circuit of a DC line – Induced voltages in insulated ground wires.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International Pvt. Ltd., 2nd Edition, 2013.
2. Power Engineer's Handbook, TNEB Engineers Association, Revised and Enlarged, 6th Edition, October 2002.

REFERENCES

1. Microtran Power System Analysis Corporation, "Microtran Reference Manual", Vancouver Canada. (Website: www.microtran.com)
2. R.K. Rajput, "A Text Book of Power System Engineering", Laxmi Publications, 2015.
3. Xiao-Ping Zhang, "Restructured Electric Power Systems", Wiley Publications, 2010.
4. Shobhit Gupta, and Deepak Gupta, "EHV AC/DC Transmission", genius publications, 2014.
5. A. Chakrabarti, D. P. Kothari and A. K. Mukhopadhyay, "Performance, Operation and Control of EHV Power Transmission System", A H Wheeler Publishing Co Ltd, 1999.

**15EE15E HIGH VOLTAGE DC TRANSMISSION L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: describe the DC power transmission technology. (K2)
- CO2: analyze HVDC converters. (K4)
- CO3: describe the various types, control and protection of MTDC systems. (K2)
- CO4: analyze harmonics and filters. (K4)
- CO5: discuss the simulation tools and Modeling of HVDC system. (K2)

UNIT I HVDC POWER TRANSMISSION TECHNOLOGY 9
Introduction – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system– Planning for HVDC transmission – Modern trends in DC transmission.

UNIT II ANALYSIS OF HVDC CONVERTERS 9
Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuit– Converter bridge characteristics – Characteristics of a twelve pulse converter –Detailed analysis of converters – Line Commutated Converter.

UNIT III MULTI TERMINAL DC SYSTEMS 9
Introduction – Potential applications of MTDC systems – Types of MTDC systems – Control and Protection of MTDC systems – Current margin method – Voltage limiting control – Decentralized current balancing – Two ACR method – Study of MTDC systems.

UNIT IV HARMONICS AND FILTERS 9
Introduction – Generation of harmonics – Characteristics and non characteristics harmonics – Design of AC filters – Single tuned filters – High pass filters – Protection of filters – Design of DC filters – Carrier frequency and Radio Interference noise.

UNIT V SIMULATION OF HVDC SYSTEMS 9
Introduction to system simulation – Philosophy and tools – HVDC system simulation – Modeling of HVDC systems for digital dynamic simulation – Transient simulation of DC and AC systems.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Padiyar.K.R, “HVDC Power Transmission Systems: Technology and system Interactions”, New Age International (P) Limited, and Publishers, 2010.
2. Edward Wilson Kimbark, “Direct Current Transmission”, Vol. I, Wiley interscience, New York, London, Sydney, 1971.

REFERENCES

1. Colin Adamson and Hingorani N G, “High Voltage Direct Current Power Transmission”, Garraway Limited, London, 1963.
2. Arrillaga. J., “High Voltage Direct Current Transmission”, Peter Pregrinus, London, 1983.
3. Erich Uhlmann, “Power Transmission by Direct Current”, BS Publications, 2004.

UNIT V LYAPUNOV STABILITY 9

Lyapunov stability definition – Lyapunov stability theorem – Lyapunov functions for non linear system – Krasovskii method – Variable gradient method – Direct method of Lyapunov and linear systems.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. I.J. Nagrath and M.Gopal, “Control Systems Engineering”, New Age International Publishers, 2010.
2. M. Gopal, “Digital Control and State variable method”, Tata McGraw Hill Private Limited, 4th Edition, 2012.

REFERENCES

1. K.Ogatta, “Modern Control Engineering”, Prentice Hall Private Limited, 2014.
2. Benjamin C. Kuo, “Automatic Control Systems”, Prentice Hall Private Limited, 2010.
3. Hasan Khalil, “Nonlinear systems and control”, Prentice Hall Private Limited, 2002.
4. M. Gopal, “Modern Control System Theory”, New Age International, 2006.
5. M. Gopal, “Control Systems Principles and Design”, Tata McGraw Hill Private Limited, 4th Edition, 2012.
6. J.E.Slotine &W.P.Li, “Applied non–linear control”, Prentice Hall Private Limited, USA, 2012.
7. George J. Thaler, “Automatic Control Systems”, Jaico Publishers, 1998.

**15EE17E LOGIC AND DISTRIBUTED CONTROL SYSTEM L T PC
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1 : describe the PLC components and basic programming concept. (K2)
- CO2 : illustrate the instruction used in PLC. (K3)
- CO3 : develop the program using PLC for industrial applications. (K3)
- CO4 : describe the functionality of SCADA (K2)
- CO5 : explain the basic concepts of DCS and its Interfacings. (K2)

UNIT I PROGRAMMABLE LOGIC CONTROLLER 9

Advantages of PLC over relay logic – Parts of PLC – Architecture – Principles of operation – PLC versus Computer – PLC Size and

Application – PLC Hardware components – Different programming concept – Programming timers and counters.

UNIT II INSTRUCTION IN PLC 9

Instructions in PLC – Program control instructions – Data manipulation instructions – math instructions – sequencer and shift register instructions – Programming concept using Instructions.

UNIT III APPLICATIONS OF PLC 9

PLC Installation Practices – Editing and Troubleshooting – Data acquisitions system – Application of PLC – Case study of bottle filling system, traffic light control system – Industrial Application: Cement industry – Paint Industry – Power Plant.

UNIT IV SUPERVISORY CONTROL AND DATA ACQUISITION 9

Introduction to SCADA – SCADA Functional requirements and Components – General features, Functions and Applications, Benefits – Configurations of SCADA, RTU (Remote Terminal Units) Connections – SCADA Communication requirements – Structure of a SCADA Communications Protocol.

UNIT V DISTRIBUTED CONTROL SYSTEM AND ITS INTERFACING 9

DCS –Evolution of Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities – Operator interfaces – Low level and high level operator interfaces – Operator displays – Engineering interfaces – Low level and high level engineering interfaces – General purpose computers in DCS.

L : 45; TOTAL : 45 PERIODS

TEXT BOOKS

1. Petruzella, "Programmable Logic Controller", Tata McGraw Hill Private Limited, 4th Edition, 2011.
2. Michael P. Lukas, "Distributed Control System", Van Nostrand Reinhold Co., Canada, 2001.

REFERENCES

1. T. Hughes, "Programmable Logic Controllers", ISA press, 2007.
2. Krishna Kant, "Computer based Industrial Control", Prentice Hall Private Limited, New Delhi, 2014.
3. <http://nptel.ac.in/courses/108106022>
4. M. Chidambaram, "Computer Control of Processes", Narosa Book Distributors Private Limited, 2002.

15EE18E ADVANCED CONTROL THEORY

**L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: construct discrete model of system. (K5)
- CO2: design digital compensator. (K5)
- CO3: solve optimal control problems. (K6)
- CO4: design robust controller for simple application. (K5)
- CO5: apply model reference adaptive control. (K3)

UNIT I SAMPLED DATA SYSTEM 9

Configuration of digital control scheme – Time domain models of discrete time systems – Transfer function models – Frequency response – Stability of sampled data system – Jury stability criterion – Sample and hold system – Sampled spectra and aliasing – Reconstruction of analog signal – Practical aspect of choice of sampling rate – Principle of discretisation – Impulse invariance – Step invariance – Bilinear transformation

UNIT II DESIGN OF DIGITAL CONTROL ALGORITHMS 9

Z plane specifications of control system design – Steady state accuracy – Transient accuracy – Nyquist stability criterion of Z plane – Disturbance rejection – Insensitivity and robustness – Digital compensator design using frequency response plot – Lead, Lag, Lag-Lead compensation – Z plane synthesis

UNIT III OPTIMAL CONTROL 9

Parameter optimization: Servomechanism – Optimal control problems: Transfer function and State variable approaches – State regulator problem – Infinite time regulator problem – Output regulator and Tracking problem – Parameter optimization : regulators.

UNIT IV ROBUST CONTROL 9

Robust control system and system sensitivity – Analysis of robustness – Systems with uncertain parameters – Design of robust control systems – PID controller – Design of robust PID controller – Design of robust internal model control system – Pseudo quantitative feedback system.

UNIT V ADAPTIVE CONTROL 9

Model reference adaptive control – MIT rule – MRAC using Lyapunov theory – First order systems – General higher order SISO systems – MRAC for a single link manipulator – Self tuning control.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. M.Gopal, "Digital Control & State Variable Methods", Tata McGraw Hill Private Limited, 4th Edition, 2012.
2. I.J. Nagrath and M.Gopal, "Control Systems Engineering", New Age International Publishers, 5th Edition 2012.
3. Richard C. Dorf, "Modern control systems", 12th Edition, Addison Wesley, 2014.

REFERENCES

1. K.Ogatta, "Discrete time control system", PHI, 2010.
2. B.C.Kuo, "Digital Control Systems", SRL Publication, 2003.
3. M. Gopal, "Control Systems Principles and Design", Tata McGraw Hill Private Limited, 4rd Edition, 2012.
4. M.Gopal, "Modern control system theory", New Age International Publishers, 2006.
5. Gene F.Franklin, J.David Powell and Abbasemami-Naeini, "Feedback Control of Dynamic Systems", 7th Edition, Pearson Education, 2015.

15EE19E SOFT COMPUTING FOR ELECTRICAL ENGINEERING

**L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: explain the components of fuzzy logic system. (K2)
- CO2: distinguish various structures of ANN. (K2)
- CO3: describe the basic concepts of genetic algorithms. (K2)
- CO4: apply ANN and FLC to various electrical applications. (K3)
- CO5: employ GA to power system optimization and control applications. (K3)

UNIT I FUZZY LOGIC SYSTEM 9

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning – Fuzzification, inferencing and defuzzification methods – Fuzzy knowledge and rule bases – Fuzzy logic modelling

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Basic concepts – Types of activation functions – McCulloch–Pitts neuron model – Adaline and Madaline, Applications – Architecture – Feed forward

and Feedback – Multilayer Perceptron– Hopfield network – Self organizing network.

UNIT III GENETIC ALGORITHM 9

Basic concepts – Functional evaluation and constraint handling – Representation – Cross over – Mutation – Selection schemes – Stopping criteria.

UNIT IV APPLICATIONS OF FLC AND ANN 9

Implementation of fuzzy logic controller for motor drives – Identification and control of linear and nonlinear dynamic systems using Neural Network – ANN application to short term load forecasting .

UNIT V APPLICATIONS OF GA 9

GA application to power system optimization problem – Economic dispatch, load scheduling and unit commitment problems – System Identification and PID controller tuning.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House,2006.
2. Kosko,B. "Neural Networks And Fuzzy Systems", Prentice Hall Private Limited, 2004.

REFERENCES

1. S.N.Sivanandam & S.N.Deepa, "Principles of Soft Computing", Wiley India Private Limited, 2013.
2. Klir G.J. & Folger T.A. "Fuzzy sets, uncertainty and Information", Prentice Hall Private Limited, 2010.
3. Zimmerman H.J. "Fuzzy set theory–and its Applications" Kluwer Academic Publishers, 2014.
4. Driankov, Hellendroon, "Introduction to Fuzzy Control", Narosa Publishers, 2nd Edition, 2011.
5. Samir Roy, "Introduction to Soft Computing: Neuro – Fuzzy and Genetic Algorithms", Pearson Education, 1st Edition, 2013.
6. Fakhreddine O. Karray, "Introduction to Soft Computing: Neuro – Fuzzy and Genetic Algorithms", Pearson Education, 1st Edition, 2009.
7. Devendra K. Chaturvedi, "Soft Computing: Techniques and its Applications in Electrical Engineering", Springer, 2008.

15EE20E**MEMS AND NEMS****L T P C**
3 0 0 3**COURSE OUTCOMES**

Upon completion of this course, the students will be able to

- CO1: outline the design concepts of MEMS. (K1)
- CO2: describe the processes in micromachining. (K2)
- CO3: summarize the various types of sensors and actuators. (K2)
- CO4: make use of MEMS concepts in various applications. (K3)
- CO5: discuss the processes of NEMS and its applications. (K2)

UNIT I INTRODUCTION TO MEMS 9

Microelectromechanical systems – Micro sensors – Micro actuators – Single and Poly crystalline silicon – Silicon Piezoresistor –Polymers – SU8 photoresists – Scaling laws in miniaturization

UNIT II MICROMACHINING 9

Micro systems fabrication process – Problems with Bulk Micromachining and Surface Micromachining – Wafer Bonding – LIGA process.

UNIT III SENSORS AND ACTUATORS 9

Mechanical: Beam and Cantilever – Capacitive effect – MEMS Gyroscopes – Micromachined thermocouple probe – Peltier effect Heat pumps – Thermal flow sensors and MEMS relay – Shape Memory Alloys.

UNIT IV RF MEMS and MOEMS 9

RF based communication system – MEMS inductors –Varactors – Tuners – Filter – Resonator – MEMS Switches – Phase shifter – Principle of MOEMS – Micro mirrors – Light detectors

UNIT V NEMS 9

Nano electro mechanical systems – fabrication and process techniques – integration of nano systems and devices – applications – Single Electron Transistor – Carbon Nano tube Devices.

L: 45; TOTAL: 45 PERIODS**TEXT BOOKS**

1. Tai Ran Hsu , “MEMS and Microsystems Design and Manufacture”, Tata Mcraw Hill Private Limited, 2007.
2. Nitaigour Premchand Mahalik, “MEMS” ,Tata McGraw Hill Private Limited, 2012.

UNIT IV DSP BASED POWER ELECTRONICS APPLICATIONS 9

DC– DC Buck – Boost converters – Continuous and Discontinuous Conduction Mode – Interfacing DSP to Buck – Boost Converter – Interrupt Service Routine – Regulation Code Sequences – Space Vector PWM Technique – Principle of constant V/f control of induction motor – DSP implementation.

UNIT V RECENT TRENDS IN DSP SYSTEM DESIGN 9

FPGA – Features and families – Complementary Programmable Logic Device – DSP versus FPGA – VHDL programming – VHDL based controller design – Applications of FPGA.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Mitra, Sanjit Kumar, "Digital Signal Processing: a Computer Based Approach", Tata McGraw Hill Private Limited, 2012.
2. Sen M Kuo, Woon .Seng. Gan, "Digital signal Processors– Architecture, implementation and applications", Pearson Education, 2005.

REFERENCES

1. Avtar Singh and S. Srinivasan, "Digital Signal Processing", Thomson Brooks, 2004.
2. Phil Lapsley, Bler, Sholam, E.A.Lee, "DSP Processor fundamentals", IEEE Press, 1999.
3. Charles.D. Roth, "Digital System Design using VHDL", 2008.
4. N. Mohan, T.M. Undeland, and W.P. Robbins, "Power Electronics: Circuits, Devices and Applications ", John Wiley & Sons, 2nd Edition, 1995.
5. Wolf Wayne, "FPGA Based System Design", Pearson Education, 2009.

**15EE22E MICROPROCESSORS, PC HARDWARE AND L T P C
INTERFACING 3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: illustrate the Hardware organization of PC. (K3)
- CO2: describe the Peripherals and drives interfaces. (K2)
- CO3: appraise the Peripherals with the PC. (K4)
- CO4: design a I/O system and port. (K5)

CO5: explain the register declaration and features of USB. (K2)

UNIT I HARDWARE ORGANIZATION OF PC 9

Hardware organization of IBM PC – Advanced microprocessors: Protected mode operation, Virtual memory, Multitasking – Special features of Pentium processors; Chipset chips – Memory organization and mapping.

UNIT II INTERFACING 9

System timer and RTC, System resources – Interrupts, DMA channels, I/O map. Peripherals: Drives – HDD, CD-ROM drive, IDE, SCSI interfaces. Video display systems – Video adapters, video standards, display controllers.

UNIT III PERIPHERALS 9

Peripherals: Keyboard and mouse, Printers, ROM BIOS services – Video, Keyboard, Disk, Printer, RTC, Serial I/O.

UNIT IV I/O SYSTEM 9

I/O Buses: 8-bit ISA, 16-bit ISA, EISA, PCI, buses – Pins and signals, Interfacing examples, PCMCIA and AGP

UNIT V PARALLEL AND SERIES PROGRAMMING 9

Parallel port – Register organization, pins and signals, handshaking and programming of SPP, EPP and ECP modes Serial port – Registers, Pins and signals, programming USB – Features.

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. N.Mathivanan, "Microprocessors, PC Hardware and Interfacing", PHI, 2003.
2. Bary B. Brey, "The INTEL Microprocessors 8086/8088, 80186/80188,80286, 80386, 80486, Pentium, and Pentium Pro processors", V Ed., PHI, 2002.

REFERENCES

1. B.Govindarajulu, "IBM PC and Clones: Hardware, and Maintenance", Tata McGraw Hill Private Limited, 2002.
2. S.J. Bigelow, "Troubleshooting, maintaining and repairing PCs", Tata McGraw Hill Private Limited, 2011.
3. Scott Muller, "Upgrading and repairing PCs", Prentice Hall Private Limited, 2015.

4. Douglas V. Hall, "Experiments in Microprocessors and interfacing Programming and Hardware" Douglas V. Hall, 2nd Edition, 2010.
5. Walter A. Triebel, "The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications", 4th Edition Aug. 2014.

15EE23E ADVANCED MICROPROCESSOR AND MICROCONTROLLER

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: explain the fundamental concepts of microprocessor architecture. (K2)
- CO2: develop knowledge about high performance Pentium CISC architectures. (K5)
- CO3: discuss about the ARM processors. (K2)
- CO4: describe the concept of PIC microcontroller. (K2)
- CO5: develop simple programming using arduino. (K5)

UNIT I INTRODUCTION 9

Generic Architecture – Instruction Set – Addressing modes – Memory hierarchy – register file – Cache – Virtual memory and paging – Segmentation – Pipelining – Instruction level parallelism – Reduced instruction set – RISC versus CISC.

UNIT II PENTIUM CISC ARCHITECTURE 9

CPU Architecture – Bus Operations – Pipelining – Branch prediction – Floating point unit– Operating Modes – Paging – Multitasking – Exception and Interrupts – Instruction set – Addressing modes.

UNIT III ARM RISC ARCHITECTURE 9

Organization of CPU – Bus architecture – Memory management unit – Instruction set – Thumb Instruction set – Addressing modes – Programming.

UNIT IV PIC MICROCONTROLLER 9

CPU Architecture – Instruction set – interrupts – Timers – I2C Interfacing – UART – A/D Converter – PWM and introduction to C-Compilers

UNIT V INTRODUCTION TO ARDUINO 9

Architecture – Instruction set – Registers and memory access – Digital I/O – timers, Debugging – Pulse width modulation (PWM) – Serial communication – Interrupts – Programming

L: 45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Daniel Tabak, "Advanced Microprocessors", Tata McGraw Hill Private Limited, 1995.
2. Steve Furber, "ARM System-On-Chip Architecture", Addison Wesley, 2001.
3. John .B.Peatman, "Design with PIC Microcontroller", Prentice Hall Private Limited, 2007.

REFERENCES

1. James L. Antonakos, "The Pentium Microprocessor", Pearson Education, 1997.
2. Gene .H.Miller." Micro Computer Engineering", Pearson Education, 2003.
3. James L.Antonakos, "An Introduction to the Intel family of Microprocessors", Pearson Education 1999.
4. Barry.B.Breg, "The Intel Microprocessors Architecture, Programming and Interfacing", 8th Edition, 2014.
5. Valvano, "Embedded Microcomputer Systems", Thomson Asia Private Limited, First Reprint, 2012.
6. Mike McRoberts, "Beginning arduino", Apress; 2013.

**15EE24E REAL TIME OPERATING SYSTEMS L T P C
3 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: recall the processes of general Operating systems. (K1)
- CO 2: describe the basics concepts of RTOS. (K2)
- CO 3: explain the Real time models and scheduling. (K2)
- CO 4: distinguish the various interprocess functions in RTOS. (K2)
- CO 5: demonstrate the applications of RTOS in various domains. (K3)

UNIT I REVIEW OF OPERATING SYSTEMS 9

Basic Principles – Structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Distributed Operating system – Distributed scheduling.

15EE25E AUTOMOTIVE ELECTRICAL AND ELECTRONICS L T P C
3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: describe the basics concepts of starting systems. (K2)
- CO 2: explain the aspects of charging systems. (K2)
- CO 3: distinguish the types of lighting system, batteries and accessories. (K2)
- CO 4: explain the various process in automotive electronics. (K2)
- CO 5: demonstrate the applications of sensors and activators. (K3)

UNIT I STARTING SYSTEM 9

Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.

UNIT II CHARGING SYSTEM 9

Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cutout. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments.

UNIT III LIGHTING SYSTEM, BATTERIES AND ACCESSORIES 9

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn: AC & DC horns, wind tone horn/air horns, electronic horn, reverse horn, Horn relay. Warning Buzzer. Windscreen wipers, windscreen washers, power windows, doors locks, Rear wind shield glass heating system. Rear view mirror adjusting, Day light regulating system, Central Locking system.

UNIT IV AUTOMOTIVE ELECTRONICS 9

Current trends in automotive electronic engine management system, electro-magnetic interference suppression, electromagnetic compatibility, ECU for Engine, electronic dashboard instruments, onboard diagnostic system (OBD), security and warning system. Electronic Fuel Injection and Ignition Systems: Introduction, feedback carburetor systems. Throttle body injection and multi-port or point fuel injection, fuel injection systems, Injection system controls. Advantages of electronic ignition systems:

Open Elective Course (OEC)
Group - I (Inter-disciplinary courses)

15ID01E	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: analyze various global trends and identify the scope of a new product (K4)
- CO2: perform requirement analysis and convert the requirements into design specification (K4)
- CO3: translate conceptual idea into detailed design (K6)
- CO4: create prototype to demonstrate the product (K6)
- CO5: perform sustenance engineering to improve the longevity of the product(K6)

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision: Types of various trends affecting product decision - Social Trends-Technical Trends- Economical Trends- Environmental Trends- Political/ Policy Trends- PESTLE Analysis.

Introduction to Product Development Methodologies and Management: Overview of Products and Services- Types of Product Development- Overview of Product Development methodologies - Product Life Cycle and PLM - Product Development Planning and Management .

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering: Types of Requirements- Requirement Engineering- Analysis -Traceability Matrix and Analysis- Requirement Management

System Design and Modeling: Introduction to System Modeling- Introduction to System Optimization- System Specification-Sub-System Design- Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques - Concept Screening and Evaluation - Concept Design - S/W Architecture - Hardware Schematics and simulation

Detailed Design: Component Design and Verification - High Level Design/Low Level Design of S/W Programs - S/W Testing-Hardware Schematic - Component design - Layout and Hardware Testing.

UNIT IV IMPLEMENTATION AND INTEGRATION 9

Prototyping: Types of Prototypes -Introduction to Rapid Prototyping and Rapid Manufacturing.

System Integration- Testing- Certification and Documentation: Introduction to Manufacturing/Purchase and Assembly of Systems- Integration of Mechanical, Embedded and S/W systems- Introduction to Product verification and validation processes - Product Testing standards, Certification and Documentation.

UNIT V SUSTENANCE ENGINEERING AND BUSINESS DYNAMICS 9

Sustenance - Maintenance and Repair - Enhancements

Product End of Life (EoL): Obsolescence Management - Configuration Management - EoL Disposal.

The Industry - Engineering Services Industry overview - Product development in Industry versus Academia

The IPD Essentials - Introduction to vertical specific product development processes - Product development Trade-offs - Intellectual Property Rights and Confidentiality- Security and configuration management

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", Tata McGraw-Hill Education, 4th Edition, 2009, ISBN-10-007-14679-9.
2. George E Dieter, Linda C Schmidt, "Engineering Design", McGraw-Hill International Edition,4th Edition, 2009, ISBN 978-007-127189-9

REFERENCES

1. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint 2004, Pearson Education, ISBN 9788177588217
2. Yousef Haik, Shahin T M M, "Engineering Design Process", Cengage Learning,2nd Edition Reprint, 2010, ISBN 0495668141
3. Clive L Dym, Patrick Little, "Engineering Design: A Project-based Introduction", John Wiley & Sons, 3rd Edition, 2009, ISBN 978-0-470-22596-7
4. Kevin Otto & Kristin Wood, "Product Design Techniques in Reverse Engineering and New Product Development", Pearson Education (LPE), 2001.
5. James R Evens, William M Lindsay "The Management and control of Quality" Pub:son south-western(www.swlearning.com), 6th edition.
6. AmitavaMitra, "Fundamentals of Quality control and improvement" Pearson Education Asia, 2nd Edition, 2002.

7. Montgomery D C, "Design and Analysis of experiments", John Wiley and Sons, 2003.
8. Phillip J Rose, "Taguchi techniques for quality engineering", McGraw Hill, 1996.
9. Reddy G B, "Intellectual Property Rights and the Law", Gogia Law Agency, 7th Edition Reprint, 2009.
10. Subbaram N R, "Demystifying Intellectual Property Rights", Lexisxis Butterworths Wadhwa, 1st Edition, 2009.

15ID02E

DISASTER MANAGEMENT

L T P C

3 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: classify the various types of disaster. (K2)
- CO2: interpret various natural and manmade disasters. (K2)
- CO3: choose a Hazard Assessment procedure. (K3)
- CO4: construct the protection measures against Disaster. (K3)
- CO5: apply Science and Technology in Disaster Management. (K3)

UNIT I INTRODUCTION TO DISASTER

8

Hazard, risk, vulnerability, disaster significance, nature, importance, dimensions and scope of disaster management - national disaster management frame work- financial arrangements- disaster- management cycle.

UNIT II SOURCES OF DISASTER

10

Natural disasters- significance, nature, types and effects - floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves, climatic change - global warming - sea level rise - ozone depletion. Manmade disasters- nuclear , chemical, biological, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents and sea accidents.

UNIT III DISASTER MITIGATION AND HAZARDS ASSESMENT 10

Factors affecting damage – types, social status, habitation pattern, physiology and climate - Factors affecting mitigation measures - prediction – preparation - communication - area and accessibility - population - physiology and climate - Vulnerability Assessment and seismic strengthening of buildings - Vulnerability Assessment of Buildings procedure - Hazard Assessment-Visual Inspection and Study of Available Documents

UNIT IV DISASTER MANAGEMENT 9

Disaster management - efforts to mitigate natural disasters at national and global levels - international strategy for disaster reduction- Rescue ,relief And Rehabilitation, Role Of National And International Agencies In Disaster Management-National Disaster Policy Of India (Salient Features).

UNIT V APPLICATIONS OF SCIENCE AND TECHNOLOGY AND CASE STUDIES 8

Applications of Science and Technology (RS, GIS, GPS) - Early Warning And Prediction Systems- Earthquake, cyclone, landslides, fire accidents, accidents- case studies

L: 45; TOTAL: 45 PERIODS

TEXTBOOKS

1. S.K.Singh, S.C. Kundu, Shobha Singh A ,”Disaster management”, William Publications, New Delhi, 1997.
2. Vinod K Sharma, “Disaster Management”, IIPA, New Delhi, 1995

REFERENCE

1. Annual Report, 2009-10,Ministry of Home Affairs, GOI

15ID03E	ENERGY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: explain the operation of Solar Thermal application and Solar Photovoltaic. (K2)
- CO2: explain the operation of wind energy systems. (K2)
- CO3: describe the concepts of various Bio-Energy Conversion techniques. (K2)
- CO4: illustrate the concepts of other conventional and nonconventional power plants. (K2)
- CO5: explain the concepts of hydrogen and fuel cell technology. (K2)

UNIT I INTRODUCTION TO SOLAR ENERGY 9

Sun - Earth Geometry, solar radiation, Solar Collectors - Application of solar thermal systems. Direct Electricity Conversion - Types of Solar cell - Solar Photovoltaic system and types.

UNIT II WIND ENERGY 9

Wind energy potential, Principle of wind energy conversion; Basic components, types and their constructional features; design considerations: wind data and site selection.

UNIT III BIO-ENERGY 9

Biomass: sources, characterization, principles of energy transfer technologies.
Biogas: Feedstock, types of Biogas plant- parameters affecting biogas production.

UNIT IV OTHER POWER PLANTS 9

Layout of Hydel - thermal - Nuclear - Gas turbine - Diesel - MHD- Geo thermal - OTEC -Tidal Power Plants.

UNIT V HYDROGEN AND FUEL CELLS 9

Energy carrier: Types - Hydrogen: generation, storage, transport and utilization - thermal energy storage: Principle and utilization - Fuel cells: Technologies, types and applications.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Soteris Kalogirou, "Solar Energy Engineering: Processes and Systems", Academic Press, 2014.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K, 3rd Edition, 2012.

REFERENCES

1. Mukund R Patel, "Wind and Solar Power Systems", CRC Press, 2nd Edition, 2006.
2. Hart A B and Womack, G J, "Fuel Cells: Theory & Applications", Prentice Hall, 1997.
3. El-Wakil M M, "Power Plant Technology", Tata McGraw-Hill, 2010.
4. Khandelwal K C and Mahdi S S, "Biogas Technology" - A Practical Handbook, Tata McGraw Hill, 1986.
5. Duffie J A and Beckman W A, "Solar Engineering of Thermal Processes", Wiley, 4th Edition, 2013.
6. Chetan Singh Solanki, "Solar Photovoltaics Fundamentals, Technologies and Applications", Prentice Hall of India, 3rd Edition, 2015.

Group - II (Trans disciplinary courses)

15TD01E

INDIAN BUSINESS LAWS

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: explain the elements of a valid contract.
- CO 2: discuss main provisions relating to Sale of Goods Act and Negotiable Instruments Act.
- CO 3: explain provisions relating to incorporation and functioning of company and partnership firm.
- CO 4: understand the fundamentals of Consumer Protection Act and Foreign Exchange Management Act.
- CO 5: understand the basic knowledge of Information Technology Act and RTI Act.

UNIT I THE INDIAN CONTRACT ACT, 1872

Definition of a Contract and its essentials - Formation of a valid Contract - Offer and Acceptance, Consideration - Capacity to Contract - Free consent - Legality of object - Discharge of a Contract by performance - Impossibility and Frustration - Breach, Damages for breach of a contract - Quasi contracts - Special Contracts - Contract of Indemnity and Guarantee - Contract of Bailment and Pledge - Contract of Agency.

UNIT II THE SALE OF GOODS ACT, 1930

Definition of a Contract of Sale - Conditions and Warranties - Passing of Property - Right of Unpaid Seller against the Goods - Remedies for Breach - The Negotiable Instrument Act, 1881
Definition and characteristics - Kinds of negotiable instruments - Promissory Note - Bill of Exchange and Cheques - Holder and Holder in due course - Negotiation, Presentment, Discharge from Liability - Noting and Protest - Presumption - Crossing of Cheques - Bouncing of Cheques.

UNIT III THE COMPANIES ACT, 1956

Nature and Definition of a Company - Registration and Incorporation - Memorandum of Association - Articles of Association - Prospectus - Kinds of Companies - Directors: Their powers and duties - Meetings - Winding up - The Indian Partnership Act, 1932 - Definition of Partnership and its essentials - Rights and Duties of Partners: Types of Partners - Minor as a partner - Doctrine of Implied Authority - Registration of Firms - Dissolution of firms - Limited Liability Partnership Act, 2000.

UNIT IV THE CONSUMER PROTECTION ACT, 1986

Aims and Objects of the Act - Redressal Machinery and Procedure for complaints under the Act - Remedies - Appeals - Enforcement of orders and Penalties - Foreign Exchange Management Act 2000 - Definition and Main Provisions.

UNIT V THE INFORMATION TECHNOLOGY ACT

Definition, Digital Signature - Electronic Governance – Attribution - Acknowledgment and Dispatch of Electronic Records - Sense Electronic Records and Sense Digital Signatures - Regulation of Certifying Authorities Digital Signature Certificates - Duties of Subscribers - Penalties and Offences - The Right to Information Act, 2005 - Right to know - Salient Features of the Act - Obligation of Public Authority - Designation of Public Information Officer - Request for obtaining information - Duties of a PIO - Exemption from Disclosure of Information - Partial Disclosure of Information - Information Commissions - Powers of Information Commissions - Appellate Authorities – Penalties - Jurisdiction of Courts.

TEXT BOOKS

1. Kuchhal M.C, “Business and Industrial Laws”, 3rd Edition, JBA Publishers, New Delhi, 2013.
2. Gulshan S.S, “Merchantile Law”, 3rd Edition, JBA Publishers, New Delhi, 2007.

REFERENCES

1. Mulla D.F, “The Sale of Goods Act and the Indian Partnership Act”, 10th Edition, LexisNexis Ltd., India, 2012.
2. Dabas J, “Negotiable Instruments Act”, 2nd Edition, JBA Publishers, New Delhi, 2013.
3. Avtar S, “The Principles of Mercantile Law”, 9th Edition, Eastern Book Company, India, 2011.

15TD02E

**LEADERSHIP AND PERSONALITY
DEVELOPMENT**

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: identify the various leadership skills.
- CO 2: understand group dynamics and factors influencing the team performance.
- CO 3: describe the personality dimensions based on personality theories.
- CO 4: explain personality determinants and personality types.
- CO 5: apply effective training program for personality development.

UNIT I INTRODUCTION

Leadership – Meaning, Concepts and Myths about Leadership, Components of Leadership- Leader, Followers and Situations - Leadership Skills – Basic Leadership Skills - Building Technical Competency - Advanced Leadership Skills - Team Building for Work Teams - Building High Performance Teams.

UNIT II TEAMS AND LEADERSHIP

Assessing Leadership & Measuring Its Effects - Group- Nature, Size, Roles, Norms, Cohesion, and Stages of Group Development - Teams and their Leadership – Effective Team Characteristics and Team Building - Ginnetts Team Effectiveness Leadership Model.

UNIT III PERSONALITY

Personality - Meaning, Concept, Personality Patterns, Symbols of Self, Moulding the Personality Pattern, Persistence & Change - Personality & Personal Effectiveness - Psychometric Theories – Cattel and Big Five - Psychodynamic Theories - Carl Jung and MBTI - Transactional Analysis - Johari – Window - Personal Effectiveness.

UNIT IV PERSONALITY DETERMINANTS

Personality Determinants – Heredity and Environment – Types of personality.

UNIT V PERSONALITY TRAINING

Concept, Role, Need, Importance and types of personality Training - Understanding Process of Learning - Developing an Integrated Approach of Learning in Training Programme - Training Needs Assessment.

TEXT BOOKS

1. Yukl G, "Leadership in Organisations", 8th Edition, Pearson Education Ltd., England, 2013.
2. Lall M, Sharma S, "Personal Growth Training & Development", Kindle Edition, USA, 2009.

REFERENCES

1. Janakiraman B, "Training and Development", Wiley Dream tech, Biztantra, 2005.
2. Pareek U, "Understanding Organizational Behaviour", 2nd Edition, Oxford University Press, USA, 2007.

15TD03E

**INTERNATIONAL BUSINESS
MANAGEMENT**

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: understand the global business environment.
- CO 2: explain the impact of economic, legal, cultural, geographical and political factors on international business.
- CO 3: discuss the issues and problems of Multinational Enterprises.
- CO 4: discuss the role of various international financial institutions.
- CO 5: discuss about important aspects of WTO and GATT agreement.

UNIT I INTERNATIONAL BUSINESS ENVIRONMENT

International Business Environment - Globalization - Forces, Meaning, Dimensions and Stages in Globalization - Trading Environment of International Trade - Tariff and Non-tariff Barriers - Trade Blocks.

UNIT II RISK ANALYSIS AND PRACTICES

Country Risk Analysis - Political, Social and Economic - Cultural and Ethical practices - Responsibilities of International Business - Economic crisis in foreign countries.

UNIT III MULTINATIONAL ENTERPRISES

Managing Multinational Enterprises - Problems and Potential - Multinational Service Organizations - Indian companies becoming multinationals - Potential, Need and Problems.

UNIT IV INTERNATIONAL FINANCIAL MANAGEMENT

Introduction to International Financial Management - Balance of Trade and Balance of Payment - International Monetary Fund, Asian Development Bank and World Bank - Financial Markets and Instruments - Introduction to Export and Import Finance - Methods of Payment in International Trade.

UNIT V INTERNATAIONAL AGREEMENT

General Agreement on Trade and Tariffs, (GATT) - World Trade Organization - Seattle and Doha Round of Talks - Dispute Settlement Mechanism under WTO - Problems of Patent Laws - International Convention on Competitiveness - Global Sourcing and its Impact on Indian Industry - Globalization and Internal Reform Process.

TEXT BOOKS

1. Bhalla V.K, Shivaramu S, "International Business Environment", 9th Edition, Anmol Publications Pvt. Ltd., Delhi, 2005.
2. Apte P.G, "International Financial Management", 5th Edition, Tata McGraw Hill, India, 2008.
3. Cherulinam F, "International Business", 5th Edition, Prentice Hall of India, New Delhi, 2010.

REFERENCES

1. Rao, Rangachari, "International Business", Himalaya Publishing House, New Delhi, 2010.
2. Hill C, "International Business", 10th Edition, Tata McGraw Hill Education, New Delhi, 2014.
3. Daniels J.D, "International Business Environment", 15th Edition, Prentice Hall of India, New Delhi, 2014.

15TD04E

BASICS OF MARKETING

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: describe the basic concepts of marketing.
- CO 2: discuss the significance of consumer behavior and market segmentation.
- CO 3: discuss brand, trade mark, after- sales service and product life cycle concepts.
- CO 4: formulate strategies for pricing and channels of distribution.
- CO 5: analyze and selection of best promotional technique.

UNIT I INTRODUCTION

Nature and Scope of Marketing - Importance of Marketing – Concepts: Traditional and Modern - Selling Vs. Marketing - Marketing Mix - Marketing Environment.

UNIT II CONSUMER BEHAVIOR AND MARKET SEGMENTATION

Nature, Scope and Significance of Consumer Behavior - Market Segmentation - Concept and Importance - Bases for Market Segmentation.

UNIT III PRODUCT PLANNING

Concept of Product - Consumer and Industrial Goods - Product Planning and Development - Packaging - Role and Functions - Brand Name and Trade Mark - After- Sales Service - Product Life Cycle Concept.

UNIT IV PRICING AND PHYSICAL DISTRIBUTION

Price - Importance of Price in the Marketing Mix - Factors Affecting Price of a Product/Service - Discounts and Rebates - Distribution Channels - Concept and Role - Types of Distribution Channels - Factors Affecting Choice of a Distribution Channel - Retailer and Wholesaler - Distributions Channels and Physical Distribution.

UNIT V PROMOTION

Definition - Methods of Promotion - Optimum Promotion Mix - Advertising Media - Their Relative Merits and Limitations - Characteristics of an Effective Advertisement - Personal Selling - Selling as a Career - Classification of a Successful Sales Person - Functions of Salesman.

TEXT BOOKS

1. Etzel M.J, Walker B.J, Stanton W.J, "Fundamentals of Marketing", 13th Edition, McGraw Hill, New York, 2004.
2. Tanner J, Raymond M, "Principles of Marketing", University of Minnesota Libraries Publishing, New York, 2015.

REFERENCES

1. Rajan Nair N, Varma M.M, "Marketing Management", 2nd Edition, S.Chand & Sons, New Delhi, 2005.
2. Ramaswamy V.S, Namakumari S, "Marketing Management", 3rd Edition, Macmillan India Limited, London, 2002.

15TD05E RETAILING AND DISTRIBUTION MANAGEMENT

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO 1: explain the concepts of retailing and distribution management.

CO 2: analyze and solve retailers' problems to make decisions in retail organizations.

CO 3: plan and formulate strategy for retail management process.

CO 4: discuss about various distribution technology and stores management.

CO 5: analyze the issues and challenges in Logistic Management

UNIT I INTRODUCTION

Meaning and Nature of Distribution and Retail Industry - Future of Retailing and Distribution in India - Distribution Channels – Concept, Role and Types - Factors Affecting Choice of Distribution Channel.

UNIT II TYPES OF RETAILING

Stores Classified by Owners - Stores Classified by Merchandising Categories - Wheel Of Retailing - Traditional Retail Formats Vs. Modern Retail Formats in India - Store and Non-Store Based Formats - Cash and Carry Business - Retailing Models – Franchiser Franchisee, Directly Owned - Wheel of Retailing and Retailing Life Cycle – Issues in Retailing.

UNIT III MANAGEMENT OF RETAILING OPERATIONS

Meaning - Functions of Retail Management - Strategic Retail Management Process - Retail Planning - Importance and Process - Developing Retailing Strategies.

UNIT IV TECHNOLOGY IN DISTRIBUTION

Bar-Coding – RFID – Electronic Payment Systems - Store Administration - Floor Space Management – Managing Store Inventories and Display Action Plans - Pricing Strategies and Location Strategies.

UNIT V LOGISTICS OF RETAIL MANAGEMENT

Components and Functions; Distribution Related Issues and Challenges - Gaining Competitive Advantage through Logistics Management.

TEXT BOOKS

1. Agrawal D. K., "Distribution & Logistics Management: A Strategic Marketing Approach", Macmillan Publishers India Limited, New Delhi, 2007.
2. Berman B, Evans J.R, "Retail Management – A Strategic approach", 12th Edition, Pearson Education Ltd., England, 2013.
3. Cox R, Brittan P, "Retailing an introduction, Financial Times Management", 5th Edition, Pearson Education Limited, England, 2004.

REFERENCES

1. Rushton A, Croucher P, Baker P, "The Handbook of Logistics & Distribution Management", Kogan Page Limited, London, 2006.
2. Coughlan A.T, Anderson E, Stern L.W, El-Ansary A.I, "Marketing Channels", 7th Edition, Prentice Hall, New Jersey, 2006.
3. Sinha P. K, Uniyal D.P, "Managing Retailing", Oxford University Press, India, 2007.

15TD06E

INTERNATIONAL ECONOMICS

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: discuss the impact of globalization.
- CO 2: identify and analyze different theoretical models of international economics in light of 'real world' situations.
- CO 3: examine the consequences of trade policies.
- CO 4: explain the importance of international financial markets.
- CO 5: discuss the important aspects of international banking.

UNIT I INTRODUCTION

Background of International Business Economics - Globalization and International Business – The Emergence of Global Institutions – Drivers of Globalizations - The Globalization Debate.

UNIT II THE INTERNATIONAL TRADE THEORY

The Law of Comparative Advantage – The Demand and Supply, Offer Curves - The Terms of Trade – Factor Endowments and the Heckscher – Ohlin Theory – Implications of Trade Theories - Economics of Scale - Imperfect Competition.

UNIT III INTERNATIONAL TRADE POLICY

Trade Restrictions - Tariffs, Non –Tariff Trade Barriers - Tariff Vs. Quota - The New Protectionism – Economic Integration - Custom Unions and Free Trade Areas - Major Regional Trade Agreements - Foreign Exchange Market – Types of Foreign Exchange Transactions – Reading Foreign Exchange Quotations – Forward and Futures Market – Foreign - Currency Options – Exchange Rate Determination – Arbitrage – Speculation and Exchange - Market Stability.

UNIT IV WORLD FINANCIAL ENVIRONMENT

Global Foreign Exchange Markets – Economic Theories of Exchange - Rate Determination - International Regime for FDI and MNC - Consequences of Economic Globalization.

UNIT V INTERNATIONAL BANKING

Reserves, Debt and Risk - Nature of International Reserves – Demand for International Reserves – Supply of International Reserves – Gold Exchange Standard – Special Drawing Rights – International Lending Risk – The Problem of International Debt – Financial Crisis and The International Monetary Fund – Eurocurrency Market.

TEXT BOOKS

1. Krugman P.R, Obstfeld M, “International Economics Theory and Policy”, 8th Edition, Prentice Hall, Boston, 2008.
2. Carbaugh R.J, “International Economics”, 15th Edition, South Western College publication, USA, 2014.

REFERENCES

1. Daniels J, Radebaugh L, Sullivan D, Salwan P, “International Business”, 12th Edition, Pearson Education, New Delhi, 2010.
2. Suranovic S, “International Economics: Theory and Policy”, Flat World Knowledge, USA, 2010.

15TD07E

INDIAN ECONOMY

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: discuss the current economic development in India
- CO 2: describe the key indicators of estimation of national income
- CO 3: explain elementary concepts of economic planning and development in India
- CO 4: discuss the concept of public finance and preparation of budget
- CO 5: discuss the influence of infrastructure growth on economic development

UNIT I ECONOMIC DEVELOPMENT

Meaning - Measurement of Economic Development - Characteristic of underdeveloped and developed economies - Causes for Indian economic underdevelopment - Major issues in development - Strategies for economic development Import substitution and Export oriented strategies - Determinants of economic development.

UNIT II NATIONAL INCOME

The National Income and its estimates in India - Limitations of National income estimation - Trends in National income of India: Growth and Structure - Inter-state variations in National income - Income distribution - Measurement of poverty in India.

UNIT III ECONOMIC PLANNING

Planning and economic development in India - Planning models in India (Elementary concepts) - Capital formation - Growth of Public and Private sector in India – Industrial policies an assessment - Capital formation and domestic saving.

UNIT IV INDIAN PUBLIC FINANCE

Budgetary policies of the central government - Composition and trends in public revenue and expenditure - Expenditure control and government consumption expenditure - concepts of Budgetary deficits and implications - state budget.

UNIT V INFRASTRUCTURE AND ECONOMIC DEVELOPMENT

Power and energy - Transport system in India's economic development - Communication system in India - Urban infrastructure - Science and technology - Private investment in infrastructure - Outlook and prospects.

TEXT BOOKS

1. Dutt R, Sundaram K.P.M, "Indian Economy", S.Chand and Co., New Delhi, 2006.
2. Agarwal A.N, Agarwal M.K, "Indian Economy: Problems of Development and Planning", 41st Edition, New Age International Ltd., New Delhi, 2016.

REFERENCES

1. Arvind P, "India: The Emerging Giant", Oxford University Press, USA, 2008.
2. Government of India, Economic Survey, (2010 -11 to 2014 -15).

15TD08E

RURAL ECONOMICS

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: discuss the role and importance of agriculture in economic development of India.
- CO 2: describe the impact of agricultural farming in rural employment, wage policy, technological change and green revolution.
- CO 3: analyze the relationship between rural and urban society.
- CO 4: recognize the formation and system of rural social institutions.
- CO 5: compare the social changes in the rural society after modernization and globalization.

UNIT I INTRODUCTION

Nature and Scope of Rural Economy - Importance of Agriculture in Economic Development of India - Nature of Land Problems - Evolution of Policy – Land Tenure System - Land Reform Measures.

UNIT II AGRICULTURE AND FARMING

Agricultural Holdings - Fragmentation and Sub-Division of Holdings, Cooperative Farming-Rural Labour Problems - Nature of Rural Unemployment - Employment and Wage Policy - Sources of Technological Change and Green Revolution.

UNIT III RURAL SOCIETY

Rural Society Structure and Change - Village and its Social Organization - Indian Village and its Types - Rural-Urban Continuum and Rural-Urban Relationships.

UNIT IV RURAL SOCIAL INSTITUTIONS

Rural Social Institutions - Family, Property, Caste, Class, Agrarian Structure - Indebtedness and Poverty - Jajmani System - Religion, Village, Panchayat Raj and Community Development Programmes – Problems.

UNIT V SOCIAL CHANGES

Social Change in Rural India-Impact of Westernization - Secularization, Urbanisation, Industrialisation, Migration, Transportation, Modernization of Indian Rural Society - Post Modernization and Globalization and Indian Villages.

TEXT BOOKS

1. Carver T.N, "The Principles of Rural Economics", Ginn and company, USA, 1911.
2. Desai A.R, "Rural Sociology in India", 5th Edition, Popular Prakashan Ltd., Mumbai, 2011.

REFERENCES

1. Dube S.C., "India's changing villages", Psychology Press, UK, 2003.
2. Datt R, Sundharam K.P.M, Datt G, Mahajan A, "Indian Economy", 72nd Edition, S.Chand & Co., New Delhi, 2016.
3. Chaudhari, C.M., "Rural Economics", Sublime Publication, Jaipur, 2009.

15TD09E

INTERNATIONAL TRADE

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: discuss the importance of international trade in developing countries.
- CO 2: describe the impact of Trade agreements in international Business environment.
- CO 3: explain the role of foreign exchange and their impact on trade and investment flows.
- CO 4: discuss the benefits of Multinational Corporation in Internal Trade
- CO 5: analyze the key role of globalisation in Indian economy.

UNIT I INTRODUCTION

International Marketing - Trends in International Trade - Reasons - Global Sourcing and Production Sharing - International Orientations - Internationalization Stages and Orientations - Growing Economic Power of Developing Countries – International Business Decision.

UNIT II INTERNATIONAL BUSINESS ENVIRONMENT

Trading Environment - Commodity Agreements – State Trading - Trading Blocks and Growing Intra-Regional Trade - Regional Groupings – SAARC, BRICS, ECM, ASEAN - Trade Liberalization - The Uruguay Round-Evaluation – UNCTAD – GATT – WTO.

UNIT III INTERNATIONAL FINANCIAL ENVIRONMENT

International Money and Capital Markets - Foreign Investment Flows – Pattern, Structure and Effects - Movements in Foreign Exchange and Interest Rates and their Impact on Trade and Investment Flows - Exchange Rate Mechanism and Arrangement.

UNIT IV MULTINATIONAL CORPORATIONS

Definition - Organizational Structures - Dominance of MNC's - Recent Trends - Code of Conduct - Multinationals in India - Issue in Investment, Technology

Transfer, Pricing and Regulations - International Collaborations and Strategic Alliances.

UNIT V INDIA IN THE GLOBAL SETTING

India an Emerging Market - India in the Global Trade - Liberalization and Integration with Global Economy - Factors Favouring and Resisting Globalization - Trade Policy and Regulation in India - Trade Strategies - Export-Import Policy - Regulation and Promotion of Foreign Trade in India.

TEXT BOOKS

1. Daniels J.D, Radebaugh L.H, Sullivan D.P, "International Business: Environment and Operations", 12th Edition, Prentice Hall, USA, 2009.
2. Ricky W.G, Michael W.P, "International Business: A Managerial Perspective", Prentice Hall, USA, 2009.

REFERENCES

1. Bhattacharya B, Varshney R.L, "International Marketing Management", 25th Revised Edition, S. Chand & Sons, New Delhi, 2015.
2. Verma M.L, "International Trade", Common wealth Publisher, New Delhi, 2010.

15TD10E

GLOBAL CHALLENGES AND ISSUES

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: understand the various global issues.
- CO 2: demonstrate a reasonable understanding of environmental debates and issues.
- CO 3: explain the developmental issues relating to food, health and energy.
- CO 4: demonstrate the economical issues in international trade.
- CO 5: describe the civilization issues relating to human rights and social justice.

UNIT I SECURITY ISSUES

Nuclear Issues - Global and South Asian Context - Small Weapons Proliferation and Internal Arms Race - Chemical and Biological Weapons – Terrorism - Causes, Consequences And Trends - Cyber Terrorism – Counter Terrorism.

UNIT II ENVIRONMENTAL ISSUES

Global Warming and Climate Change - Threats to Bio-Sphere and Space - Pollutions, De-Forestation, Solid, Chemical and Nuclear Wastes and their Management - Preserving the Green Cover and Wild Life.

UNIT III DEVELOPMENTAL ISSUES

Food Security - Poverty and Hunger - Energy Security - Supply and Demand - Traditional and Alternative Sources of Energy – ITER - Health Security – Health for all - Development Vs. Environment - Sustainable Development.

UNIT IV ECONOMIC ISSUES ON INTERNATIONAL TRADE

International Trade - GATT, WTO - Regional Associations - ECM, ASEAN, OPEC, BRICS - Financial Crisis - ASEAN, Mexico and Greece - Global Issues in Trade and Commerce.

UNIT V CIVILIZATION ISSUES

Human Rights - Issues Relating to Freedom of Speech and Expression - Right to Self Determination - Preservation of Cultures and Cultural Diversities - Rights of Women and Children - Dividends of Globalization and Social Justice – Good Governance.

TEXT BOOKS

1. Payne R, “Global Issues”, 4th Edition, Pearson Education Ltd., New York, 2013.
2. Owens P, Baylis J, Smith S, “The Globalization of World Politics”, 3rd Edition, Oxford University Press, USA, 2013.

REFERENCE

1. Chirco J.A, “Globalization: Prospects and Problems”, Sage Publications, New Delhi, 2013.

15TD11E

INDIAN CULTURE AND HERITAGE

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: describe Indian culture, civilization and its features.

CO2: demonstrate stone age, Indian races and their contribution in pre-historic culture.

CO3: explain historical development of Indian culture.

CO4: explain the significance, conditions and development of Vedic culture.

CO5: analyze the advent of Islam and European culture.

UNIT I INTRODUCTION

Introduction to Culture - Meaning and Scope - Culture and Civilization - General Characteristics Features of Indian Culture - Geographical Impact on Indian Culture.

UNIT II PRE-HISTORIC CULTURE

Dravidian Culture - Old Stone Age - New Stone Age - Metal Age - Indian Races and their Contribution to Indian Culture.

UNIT III HISTORICAL DEVELOPMENT OF INDIAN CULTURE

Indus Valley Culture - City Planning - Social and Religious Conditions - Vedic and Later Vedic Cultures - Dharmasastras and Caste Systems - Comparison of Indus and Vedic Culture - Importance of Indus Valley and Vedic Cultures.

UNIT IV CULTURE IN SANGAM AGE AND POST SANGAM AGE

Sangam Literature - Society - Political and Economical Conditions - Trade - Religion and Fine Arts.

UNIT V ADVENT OF ISLAM AND EUROPEAN CULTURE

Impact on Indian Culture and Heritage – Reform Movements - Brahma Samaj, Ariya Samaj, Self Respect Movement – Post Colonial Development.

TEXT BOOKS

1. Luniya B.N, "Evolution of Indian Culture", Lakshmi Narain Agarwal Publishers, Agra, 1986.
2. Jeyapalan N, "History of Indian culture", Atlantic publishers, New Delhi, 2001.
3. Sharma H.C, "Indian Culture and Heritage", Neha Publishers & Distributors, New Delhi, 2012.

REFERENCES

1. John G.A, "Dictionary of Indian Philosophy (Sanskrit-English)", University of Madras, Madras, 1998.
2. Misra R.S, "Studies in philosophy and Religion", Bharathiya Vidya Prakasans, Varanasi, 1991.
3. Misra S.K, "Culture and Rationality", Sage publications India Pvt. Ltd., New Delhi, 1988.
4. Suda J.P, "Religious in India", Sterling Publishers Pvt. Ltd., New Delhi, 1978.

15TD12E

INDIAN HISTORY

**L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: illustrate the basics of Indian cultural heritage.
- CO2: describe interaction between Ancient Indian cultural heritage and Islamic culture.
- CO3: demonstrate Innovation by rulers of medieval period in the area of Administration, and their contact with the Europeans.
- CO4: analyse modern Indian movements, Economic history and Impact of the British rule on India.
- CO5: demonstrate the concepts of Indian National Movement and the history of freedom struggle in India.

UNIT I ANCIENT INDIAN CULTURE

Ancient Indian Cultural Heritage - Social, Political, Legal and in the Area of Religion and Philosophy.

UNIT II LAW RELATING TO CULTURE

Law Givers and Dispute Resolution Systems in Ancient India (Administration of Justice in Ancient India - Pre-Islamic Period) - Law Relating to Culture - The Advent of Islam - Interaction between Ancient Indian Cultural Heritage and Islamic Culture - The Emergence of Synthetic Indian Culture.

UNIT III ADMINISTRATION IN ANCIENT INDIA

Innovation by Rulers of Medieval Period in the Area of General and Revenue Administration - District Administration - Court Systems - Indian Contact with the Europeans.

UNIT IV SOCIO-ECONOMIC HISTORY

Socio-Religious Reform Movements in Modern India and its Legal Culture - Economic History of India During British Period - Impact of the British Rule on India – Education.

UNIT V EUROPEAN CULTURE IMPACT

Impact of European Culture and Liberal Thought on India – The Indian National Movement - The History of Freedom Struggle in India upto 1947.

TEXT BOOKS

1. Sreenivasa M.H.V, "History of India Part I and II", JBA Publishers, New Delhi, 2015.
2. Agarwal R.C, Bhatnagar M, "Constitutional Development and National Movement of India", S. Chand Publishers, New Delhi, 2005.

REFERENCES

1. Altekar S, "State and Government in Ancient India", Motilal Banarsidass Publishers, New Delhi, 2002.
2. Majumdar R.C, "History and Culture of the Indian People", Vol. 2, The Age of Imperial Unity, Bharatiya Vidya Bhavan, New Delhi, 2001

**15TD13E SUSTAINABLE DEVELOPMENT AND PRACTICES L T P C
0 0 0 3**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO 1: recognize the sustainable development and the way to achieve the sustainable development.
- CO 2: outline the concept, factors governing the sustainability and their linkages.
- CO 3: explain the environmental impact assessment and environmental audit.

CO 4: describe the environmental planning and managing the resources.

CO 5: acquire the knowledge about the environmental problems and their solutions.

UNIT I SUSTAINABLE DEVELOPMENT

Need for Sustainability - Nine Ways to Achieve Sustainability - Economics as the Dismal Science - Population, Resources and Environment.

UNIT II CHALLENGES OF SUSTAINABLE DEVELOPMENT

Concept of Sustainability - Factors Governing Sustainable Development - Linkages among Sustainable Development, Determinants of Sustainable Development - Case Studies on Sustainable Development.

UNIT III ENVIRONMENT IMPACT ASSESSMENT AND AUDIT

Concepts-process-evaluation methodology-EIA and EMS integration-setting up of audit programme - typical audit process - carrying out the audit-benefits of environmental auditing-environmental audit programmes in India.

UNIT IV ENVIRONMENTAL PLANNING

Introduction - Perspective of Environmental Planning - land resource development planning - Planning and managing the natural resources - landscape ecological planning - information and decision of environmental planning - Land use policy in India.

UNIT V ENVIRONMENTAL EDUCATION

Knowledge about the environment - Knowledge about the environment and population growth - Knowledge about the solution and environmental problems - Environmental education (EE) – Strategies for EE – Models for future Environmental Education Systems.

TEXT BOOKS

1. Rogers P, Jalal K.F, Boyd J.A, "An Introduction to Sustainable Development", Earth scan Publications Ltd., UK, 2006.
2. Santra S.C," Environmental Science", 3rd Edition, New Central Book Agency (P) Ltd., London, 2013.

REFERENCES

1. Stavins R.N. "Economics of the Environment: Selected Readings", 5th Edition, W.W. Norton and Company, New York, 2005.
2. Sachs J.D, "The Age of Sustainable Development", Columbia University Press, New York, 2015.

15TD14E

WOMEN IN INDIAN SOCIETY

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: Demonstrate historical perspective about women in Indian society.
- CO2: Explain social problems of women.
- CO3: Understand the legislation for women protection in India.
- CO4: Demonstrate the involvement of women literacy, career and politics.
- CO5: Analyse the role of NGO's in women empowerment.

UNIT I INTRODUCTION

A Historical Perspective - Early Vedic, Colonial and Modern Periods - Position of Women in Contemporary India.

UNIT II SOCIAL ISSUES

Issues of Girl Child - Female Infanticide and Foeticide, Sex Ratio, Child Marriage, Dowry and Property Rights - Women's Health and Birth Control - Reproduction - Violence against Women - Domestic Violence - Female Headed Households - Women in the Unorganized Sector of Employment - Women's Work- Status and Problems - Problems of Dalit Women.

UNIT III PROTECTIVE LEGISLATION FOR WOMEN

Protective Legislation for Women in the Indian Constitution - Anti Dowry, SITA, PNDT, And Prevention Sexual Harassment At Workplace (Visaka Case) - Domestic Violence (Prevention) Act.

UNIT IV WOMEN AND EDUCATION

Formal and Non-Formal Literacy - Post Literacy - Vocational Training - Dual Career Modernization – Women and Politics - Political Status - Global Movements and Indian Movements.

UNIT V ROLE OF NGO'S IN WOMEN EMPOWERMENT

Gender Economy - All India Women's Conference (AIWC) – Women's India Association (WIA) - National Council of Women in India (NCWIE) - Indian Association of Women's Studies – Women Development Cells - Self Help Groups.

TEXT BOOKS

1. Majumdar M, "Social Status of Women in India", Wisdom Press, New Delhi, 2012.
2. Harish R, Harishankar V.B, "Re-Defining Feminisms", Rawat Publications, Jaipur, 2011.

REFERENCES

1. Rathod P.B, "An Introduction to Women's Studies", ABD Publishers, Jaipur, 2010.
2. Ray R, "Hand Book of Gender", Oxford University Press, New Delhi, 2012.

15TD15E

INDIAN CONSTITUTION

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: describe the basic understanding of the Indian Constitution.
- CO2: understand the structure and functions of parliament.
- CO3: demonstrate the organization and working of the Judiciary.
- CO4: understand the structure and functions of state legislature.
- CO5: understand the 73rd and 74th Constitutional Amendments.

UNIT I INDIAN CONSTITUTION

Salient Features - Preamble - Fundamental Rights – Directive Principles of State Policy - Fundamental Duties.

UNIT II PARLIAMENTARY SYSTEM

Powers and Functions of President and Prime Minister - Council of Ministers - The Legislature Structure and Functions of Lok Sabha and Rajya Sabha – Speaker.

UNIT III THE JUDICIARY

Organisation and Composition of Judiciary - Powers and Functions of the Supreme Court - Judicial Review – High Courts.

UNIT IV STATE GOVERNMENTS

Powers and Functions of Governor and Chief Minister – Council of Ministers - State Legislature.

UNIT V LOCAL GOVERNMENTS

73rd and 74th Constitutional Amendments – Federalism - Center – State Relations.

TEXT BOOKS

1. Basu D.D, "Introduction to Indian Constitution", Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, "Indian Government and Politics", Vikas Publishing House, New Delhi, 2010.

REFERENCES

1. Pylee M.V, "Introduction to the Constitution of India", Vikas Publishing House, NewDelhi, 2011.
2. Kashyap S, "Our Constitution", National Book Trust, New Delhi, 2010.

15TD16E

BIO MECHANICS IN SPORTS

L T P C
0 0 0 3

COURSE OUTCOMES

Upon completion of this course, the students will be able to

- CO1: discuss the basics of biomechanics in sports & movement technique accurately.
- CO2: discuss the basics of linear kinematics and its applications in the field of sports.
- CO3: demonstrate the linear kinematics in the field of sports.
- CO4: discuss the basics of angular kinematics and its applications in the field of sports.
- CO5: demonstrate the angular kinematics in the field of sports.

UNIT I INTRODUCTION

Meaning, Aim and Objectives, Importance of Biomechanics in Sports - Types of Motion Linear, Angular, Curvilinear and Circular Motion.

UNIT II LINEAR KINEMATICS

Speed, Velocity, Acceleration, Motion, Projectile Motion – Application of Linear Kinematics in The Field of Physical Education and Sports.

UNIT III ANGULAR KINEMATICS

Angular Speed - Angular Velocity - Angular Acceleration - Relationship between Linear and Angular Motion – Application of Angular Kinematics in the Field of Physical Education and Sports.

UNIT IV LINEAR KINETICS

Mass, Weight, Force, Pressure, Work, Power, Energy, Impulse, Momentum, Impact, Friction, Newton's Law of Motion - Law of Inertia and Types of Inertia.

UNIT V ANGULAR KINETICS

Levers, Equilibrium and Centre of Gravity – Friction and its Types, Centrifugal and Centripetal Force Bio Mechanical Principles Involved in Designing Sports Equipments.

TEXT BOOKS

1. Singh S.K, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2009.
2. McGinnis P.M, "Biomechanics of Sports and Exercise", 2nd Edition, Human Kinetics Publishers, USA, 2004.

REFERENCES

1. Saxena A, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2011.
2. Heyward V.H, Gibson A.L, "Advanced Fitness Assessment and Exercise Prescription", 7th Edition, Human Kinetics, USA, 2014.