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. – ELECTRONICS AND INSTRUMENTATION ENGINEERING
Accredited by NBA

B.E. – ELECTRONICS AND INSTRUMENTATION ENGINEERING

CURRICULUM AND SYLLABUS

VISION

Achieving excellence in Teaching–Learning, Research and Consultancy among Nationwide peer groups.

MISSION

The EIE department will achieve its vision by:

- Offering well–balanced curriculum to acquire professional competencies and transferable skills.
- Bringing innovations in Teaching-Learning process through effective content delivery and appropriate assessment methods.
- Catalyzing the research activities of both faculty members and students through more and more sponsored research projects.
- Rendering its consultancy services by providing instrumentation solutions to the nearby Industries.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Within a few years (3 to 5 years) of graduation, our graduates are expected to

1. be an engineer in Design, Manufacturing, Marketing, Operation and Maintenance with the technical and managerial skills in the fields of Measurement, Control, Robotics, and Automation Engineering Technology.

2. utilize modern and effective management skills for Performing Investigation, Analysis and Synthesis in the implementation of instrumentation and automatic control systems.

3. pursue higher studies at the institutes of repute in India and abroad and work in Educational Institutions, Research Organizations and Engineering Consultancy Companies and be successful entrepreneurs.

4. collaborate in multi disciplinary teams and be the leaders in their organization, their profession and in society.

PROGRAM OUTCOMES (POs)

1. Apply knowledge of Mathematics, Physics, Mechanics, Chemistry, Thermal Sciences, Earth Sciences, Biological Sciences, Engineering Fundamentals, Analog & Digital Electronics, Measurement & Instrumentation Principles and Control & Automation to the solution of complex engineering problems in Electronics and Instrumentation Engineering.
2. Identify, formulate, research literature and analyse complex Engineering problems in, Measurement & Instrumentation Systems, Control & Automation Systems and Computer Systems reaching substantiated conclusions using first principles of mathematics, Physics, Mechanics, Chemistry, Thermal Sciences, Earth Sciences, Biological Sciences and Engineering Sciences.
3. Design solutions for complex Electronics and Instrumentation Engineering problems, Design and Implement Control Systems, Instrumentation Systems, Modern Electronic Systems, Computer Systems, Design Instrumentation & Process Control Components and Design Processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations**.**
4. Conduct investigations of complex Electronics and Instrumentation Engineering problems in the areas of Instrumentation Devices and automatic control systems 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 modelling, to complex Electronics and Instrumentation engineering problems pertaining to Electronics systems, Measurements, Control, Robotics and Automation 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 in the fields of Electronics system, Measurements, Control, Robotics and Automation and solutions to complex Electronics and Instrumentation Engineering problems.
7. Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex Electronics and Instrumentation Engineering Problems in societal and environmental contexts.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary 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 **EIE programme** is designed with total number of credits ***171 (128*** 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.

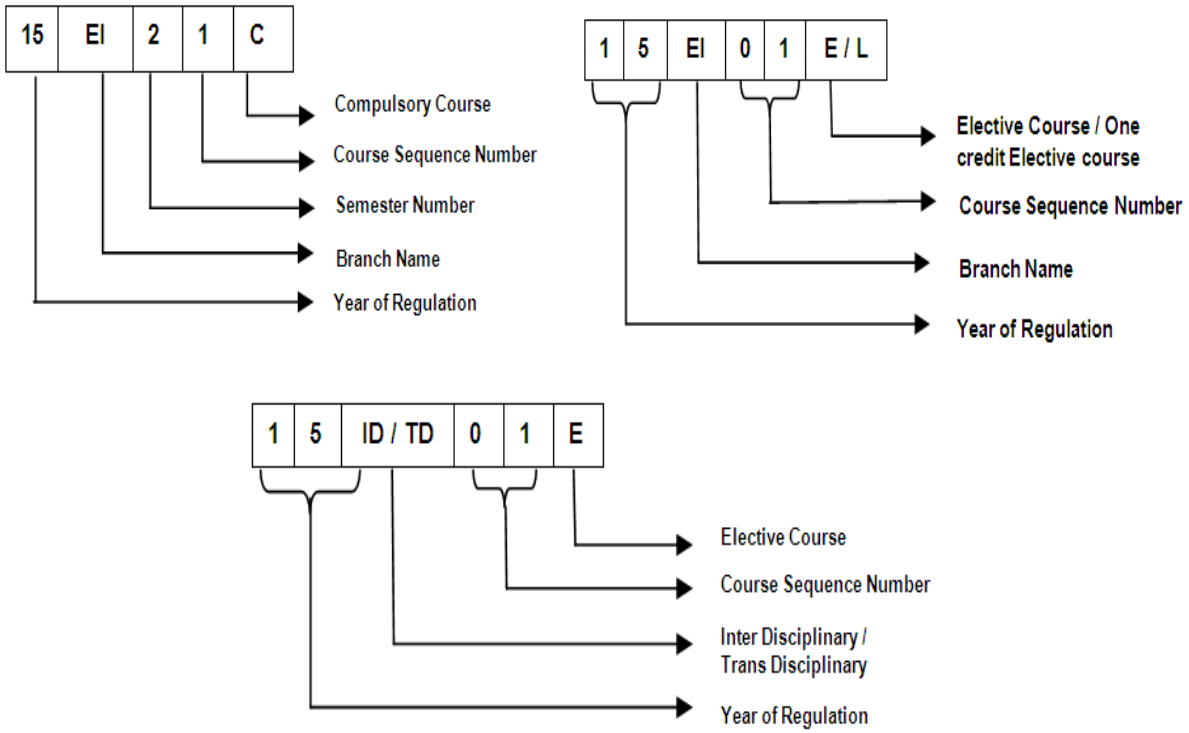
5. **Mandatory courses (MAC)** include the courses recommended by the regulatory bodies such as AICTE, UGC etc as given below:
   a. Technical English / Professional English
   b. Professional Ethics and Human Values
   c. Environmental Science and Engineering
   d. Communication Skills Laboratory
6. 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. – ELECTRONICS AND INSTRUMENTATION 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	15EI21C	Professional English*	3	0	0	3	B
2.	SFC	15EI22C	Calculus, Probability and Statistics@	3	2	0	4	B
3.	SFC	15EI23C	Materials Science and Technology	3	0	0	3	B
4.	SFC	15EI24C	Electric Circuits Analysis	3	2	0	4	C
5.	CFC	15EI25C	C Programming for Engineers*	3	0	0	3	B
6.	MAC	15EI26C	Environmental Science and Engineering*	3	0	0	3	A
PRACTICAL								
7.	SFC	15EI27C	Physics and Environmental Chemistry Laboratory	0	0	2	1	-
8.	CFC	15EI28C	C Programming Laboratory*	0	0	2	1	-
9.	SFC	15EI29C	Electric Circuit Analysis 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, *X*EC - *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

SEMESTER – III

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	SFC	15EI31C	Fourier Series and Transforms	3	2	0	4	B
2.	PCC	15EI32C	Signals and Networks	3	0	0	3	B
3.	PCC	15EI33C	Electronic Devices and Circuits	3	2	0	4	B
4.	PCC	15EI34C	Sensors and Transducers	3	0	0	3	D
5.	PCC	15EI35C	Electrical Measurements and Electronic Instrumentation	3	0	0	3	C
6.	MAC	15EI36C	Professional Ethics and Human Values*	3	0	0	3	A
PRACTICAL								
7.	PCC	15EI37C	Transducers and Measurements Laboratory	0	0	2	1	-
8.	PCC	15EI38C	Electronic Devices and Circuits Laboratory	0	0	2	1	-
9.	MAC	15EI39C	Communication Skills Laboratory*	0	0	2	1	-
TOTAL				**18**	**4**	**6**	**23**	

SEMESTER – IV

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	SFC	15EI41C	Complex Analysis and Numerical Methods	3	2	0	4	B
2.	PCC	15EI42C	Control Systems	3	2	0	4	B
3.	SFC	15EI43C	Electrical Machines	3	0	0	3	B
4.	PCC	15EI44C	Industrial Instrumentation - I	3	0	0	3	E
5.	SFC	15EI45C	Digital Circuits and Systems	3	0	0	3	B
6.	SFC	15EI46C	Fundamentals of Thermodynamics and Fluid Mechanics	3	0	0	3	B
PRACTICAL								
7.	PCC	15EI47C	Control Systems Laboratory	0	0	2	1	-
8.	SFC	15EI48C	Digital Circuits and Systems Laboratory	0	0	2	1	-
9.	SFC	15EI49C	Electrical Machines Laboratory	0	0	2	1	-
			TOTAL	**18**	**4**	**6**	**23**	

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SEMESTER – V

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	PCC	15EI51C	Industrial Instrumentation - II	3	0	0	3	D
2.	PCC	15EI52C	Microprocessor, Microcontroller and Applications	3	2	0	4	E
3.	PCC	15EI53C	Linear Integrated Circuits	3	0	0	3	B
4.	PCC	15EI54C	Process Control	3	2	0	4	B
5.	XEC		Elective – I	3	0	0	3	
PRACTICAL								
6.	PCC	15EI55C	Industrial Instrumentation Laboratory	0	0	2	1	-
7.	PCC	15EI56C	Microprocessor and Microcontroller Laboratory	0	0	2	1	-
8.	PCC	15EI57C	Linear Integrated Circuits Laboratory	0	0	2	1	-
9.	PCC	15EI58C	Process Control Laboratory	0	0	2	1	-
			TOTAL	**15**	**4**	**8**	**21**	

SEMESTER – VI

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	PCC	15EI61C	Logic and Distributed Control System@	3	0	0	3	B
2.	PCC	15EI62C	Testing and Calibration of Instruments	3	0	0	3	C
3.	PCC	15EI63C	Biomedical Instrumentation	3	0	0	3	B
4.	PCC	15EI64C	Robotics and Automation	3	0	0	3	B
5.	XEC		Elective - II	3	0	0	3	
6.	XEC		Elective - III	3	0	0	3	
PRACTICAL								
7.	PCC	15EI65C	Virtual Instrumentation Laboratory	0	0	2	1	-
8.	PCC	15EI66C	Industrial Automation Laboratory	0	0	2	1	-
9.	MAC	15EI67C	Product Development Laboratory	0	0	4	2	-
10.	PCC	15EI68C	Comprehension	0	0	2	1	-
			TOTAL	**18**	**0**	**10**	**23**	

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OEC – Open Elective Course) *****Common to all B.E. / B.Tech., Programmes, @Common to EEE and EIE

SEMESTER – VII

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	MAC	15EI71C	Project Management and Finance*****	3	0	0	3	B
2.	PCC	15EI72C	IOT and its Applications	3	0	0	3	B
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								
7.	PCC	15EI73C	Mini Project	0	0	8	4	-
8.	PCC	15EI74C	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	15EI81C	Project Work	0	0	20	10	-
3.	PCC	15EI82C	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, *X*EC - *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

PROGRAMME ELECTIVE COURSES (PEC)

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Analog and Digital Electronics Domain								
1.	PEC	15EI01E	Mechatronics	3	0	0	3	C
2.	PEC	15EI02E	MEMS and Nano Technology	3	0	0	3	B
3.	PEC	15EI03E	Digital Image Processing	3	0	0	3	B
4.	PEC	15EI04E	Embedded Systems	3	0	0	3	C
5.	PEC	15EI05E	VLSI Design	3	0	0	3	B
6.	PEC	15EI06E	Medical Informatics	3	0	0	3	B
7.	PEC	15EI07E	Digital Signal Processing and Analysis	3	0	0	3	E
Measurement and Instrumentation Domain								
8.	PEC	15EI13E	Power Plant Instrumentation	3	0	0	3	B
9.	PEC	15EI14E	Instrumentation in Petrochemical Industries	3	0	0	3	C
10.	PEC	15EI15E	Aeronautical Instrumentation	3	0	0	3	B
11.	PEC	15EI16E	Non – Destructive Testing	3	0	0	3	D
12.	PEC	15EI17E	Sensor Networks	3	0	0	3	B
13.	PEC	15EI18E	Fiber Optics and Laser Instruments	3	0	0	3	B
Control and Automation Domain								
14.	PEC	15EI24E	Industrial Drives and Control	3	0	0	3	B
15.	PEC	15EI25E	System Identification and Adaptive Control	3	0	0	3	B
16.	PEC	15EI26E	Intelligent Controllers	3	0	0	3	B
17.	PEC	15EI27E	Process Control Components	3	0	0	3	B
18.	PEC	15EI28E	Building Automation	3	0	0	3	B
19.	PEC	15EI29E	Computer Control of Process	3	0	0	3	B
20.	PEC	15EI30E	Nonlinear Control	3	0	0	3	B
21.	PEC	15EI31E	Industrial Chemical Process	3	0	0	3	B
22.	PEC	15EI32E	Automotive Instrumentation and Control	3	0	0	3	B

ONE CREDIT ELECTIVE COURSES (PEC)

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
1.	PEC	15EI01L	PLC Programming	0	0	2	1	-
2.	PEC	15EI02L	Programming in ARDUINO	0	0	2	1	-
3.	PEC	15EI03L	Control system using Graphical Programming	0	0	2	1	-
4.	PEC	15EI04L	DCS Fundamentals & Industrial communication protocols*	1	0	0	1	G

5.	PEC	15EI05L	Embedded system design using ARM microcontroller	0	0	2	1	-
6.	PEC	15EI06L	Hands on Training using FPGA	0	0	2	1	-
7.	PEC	15EI07L	Graphical Programming for Electronic Circuits	0	0	2	1	-
8.	PEC	15EI08L	Soft Computing Techniques using Fuzzy and Neural Network	0	0	2	1	-
9.	PEC	15EI09L	Instrumentation Detail Engineering*	1	0	0	1	G
10.	PEC	15EI10L	Virtual Graphical Programming for beginners	0	0	2	1	G
11.	PEC	15EI11L	Field Instruments for Process control*	1	0	0	1	G
12.	PEC	15EI12L	Instrumentation in Cement Industries*	1	0	0	1	G
13.	PEC	15EI13L	Clinical Laboratory Instrumentation*	1	0	0	1	G
14.	PEC	15EI14L	Digital Signal Processing using MATLAB	0	0	2	1	-
15.	PEC	15EI15L	Design of PID Controllers using MATLAB	0	0	2	1	-
16.	PEC	15EI16L	Co-simulation in LabVIEW	0	0	2	1	-
17.	PEC	15EI17L	Python Programming for IOT	0	0	2	1	-
18.	PEC	15EI18L	PCB Design	0	0	2	1	-

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 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

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. (K2, S4)

CO4: coordinate and communicate in a wide range of situation. (K3, S4)

CO5: integrate and apply the acquired skills in real life situation. (K2, 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, Globerena.

15SH12C MATHEMATICAL FOUNDATIONS FOR ENGINEERS L T P C
(Common to all B.E. / B.Tech. Degree Programmes) 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.

15SH13C ENGINEERING PHYSICS 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: summarize the properties and structures of solids. (K2)

CO 2: define the principles of acoustics and ultrasonics and apply the ultrasonic methods for industrial and medical field. (K2)

CO 3: choose the appropriate Laser technique for industrial and medical applications.(K3)

CO 4: describe the different types, fabrication, losses of optical fibers and their applications in communication and instrumentation. (K2)

CO 5: explain the physical properties of photons & electrons and their applications in different electron microscopes. (K3)

UNIT I PROPERTIES OF MATTER AND CRYSTAL PHYSICS 9

Hooke's law - Types of moduli of elasticity - Determination of Rigidity modulus and Young's modulus - I shaped Girders.

Miller indices – d spacing - Characteristics of SC, BCC, FCC and HCP structures.

UNIT II ACOUSTICS AND ULTRASONICS 9

Acoustics: Weber-Fechner law - Sabine's formula - Absorption Coefficient and its determination - factors affecting acoustics of buildings and their remedies.

Ultrasonics: Production - magnetostriction generator - piezoelectric generator, Properties - Cavitations - Velocity measurement - acoustic grating, Industrial applications - Medical application - Sonograms.

UNIT III LASER SYSTEM AND APPLICATIONS 9

Einstein's A and B coefficients – Types and working of Lasers - CO_2 Laser, Nd-YAG Laser, Semiconductor Laser (Homojunction), Determination of wavelength of Laser and Particle size - Industrial applications - Medical applications-Holography.

UNIT IV FIBER OPTICS AND ITS APPLICATIONS 9

Numerical aperture and Acceptance angle - Types of optical fibers - Double crucible technique – Splicing - Loss in optical fiber - Fiber optical communication system - Applications - Fiber optic sensors - Endoscope.

UNIT V QUANTUM PHYSICS 9

Photo electric effect - Matter Waves - Davisson and Germer experiment - Heisenberg's Uncertainty principle - Schrodinger's wave equation - particle in one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics", 10th Edition, John Wiley & Sons Inc.USA, 2014.
2. Arthur Beiser, "Concepts of Modern Physics", 6th Edition, McGraw Hill Publications Private Limited, 2008.

REFERENCES

1. Richard P.Feynmann, Robert B Leighton and Mathew Sands, "Feynmann's Lectures on Physics", 4th Edition, Addison Wesley Publication USA, 2010.
2. Yoav Peleg, Reuven Pnini, Elvahu Zaarur, Eugene Hecht, "Schaum's Outline of Quantum Mechanics", 2nd Edition, McGraw Hill Companions Limited, USA, 2010.
3. William T.Silfvast, "Laser Fundamentals", 2nd Edition, Cambridge University Press, NewYork, 2008.

15SH14C ENGINEERING CHEMISTRY 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: identify suitable water treatment techniques for industrial and domestic purpose.(K3)
CO 2: explain the type of corrosion and corrosion control methods. (K3)
CO 3: select the polymer for specific application. (K2)
CO 4: explain the preparation, properties and applications of nano materials. (K2)
CO 5: outline the principle and instrumentation of various analytical techniques. (K2)

UNIT I WATER TREATMENT 9

Types of water - hardness - estimation of hardness of water – disadvantages of using hard water in boiler – oils and silica in water; water 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
4. Skoog D.A., James H. F. and Crouch S.R., “Instrumental Analysis”, Cengage Learning India Private Limited, New Delhi, 2011
5. Mc Cash E.M. and Banwell C.N., “Fundamentals of molecular spectroscopy”, 5th Edition, McGraw Hill Education (India) Private Limited, 2013.

15SH15C INTRODUCTION TO ENGINEERING L T P C

(Common to all B.E./B.Tech. Degree Programmes) 2 0 0 2

COURSE OUTCOMES

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

CO 1: recognize the history of engineering through various engineering wonders in past and identify the engineering profession. (K2)

CO 2: recognize and analyse various engineering career paths and preparing for an engineering career. (K3)

CO 3: understand the profile of engineers in various fields. (K3)

CO 4: understand the OBE concepts and its components. (K2)

CO 5: understand learning components and creativity. (K3)

UNIT I HISTORY OF ENGINEERING AND INTRODUCTION TO ENGINEERING PROFESSION 7

History of Engineering: Definition of Engineering, The Beginnings of Engineering, Overview of ancient Engineering, Traveling through the Ages, A case study of two historic Engineers – Lionardo da Vincy, Gutenberg.

Introduction to Engineering Profession: Engineering work is all around you - Engineering as a profession and common traits of Good Engineers – History of Engineering Disciplines – Functions of Engineering.

UNIT II CAREER PATHS OF ENGINEER AND PREPARING FOR AN ENGINEERING CAREER 8

Career Paths for Engineers: The corporate ladder, The independent entrepreneur, Employment Opportunities in Government, The military, Engineering and social service abroad, The Engineering Professor, Graduate work outside of engineering, A mix of two or more of the first six options.

Preparing for an Engineering Career: Making the Transition from High School to College - Budgeting Your Time - Daily Studying and Preparation - Getting Involved with an Engineering Organization - Your Graduation Plan - Other Considerations.

UNIT III PROFILES OF ENGINEERS 4

Initial Career Profiles of Civil, Mechanical, Electrical, Electronics, Instrumentation, Communication, Information Technology, Computer Engineering Graduates.

UNIT IV OVERVIEW OF OBE AND CBCS 4

Graduate attributes of Washington Accord – Programme Specific Criteria (PSC) – Programme Educational Objectives (PEOs) – Programme Outcomes (POs) – Course Outcomes (COs) – CBCS : Course categories - Scheme of instruction, Assessment and Evaluation.

UNIT V LEARNING AND CREATIVE THOUGHT 7

Introduction: The successful engineering student - the engineering curriculum - curriculum planning and management - adapting to the college classroom.

The learning process: the nature of learning - information processing and memory - determinants of efficient learning - practical suggestions for learning.

Differences in the way people think: The four-quadrant model of thinking - hindrances to problem solving.

On Creativity: What is creativity? - the nature of creativity - characteristics of creative people - the creative process - overcoming obstacles to creative thinking.

L: 30 TOTAL: 30 PERIODS

REFERENCES

1. Paul H. Wright, "Introduction to Engineering", School of Civil and Environmental Engineering, 3rd Edition, John Wiley & Sons, Inc, 2002.
2. Saeed Moaveni, "Engineering Fundamentals an Introduction to Engineering", 4th Edition, Cengage Learning, USA, 2011.
3. William C. Oakes, Les L. Leone and Craig J. Gunn, "Engineering Your Future – A Comprehensive Introduction to Engineering", Oxford University Press, USA, 2010.
4. Philip Kosky, George Wise, Robert Balmer and William Keat, "Exploring Engineering An Introduction to Engineering and Design", Academic Press, Elsevier, USA, 2010.

WEB RESOURCES

www.ieagreements.org/IEA-Grad-Attr-Prof-Competencies.pdf

15SH16C	**ENGINEERING GRAPHICS**	**L T P C**
	(Common to all B.E./B.Tech. Degree Programmes)	**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)
CO 3: 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

(Common to all B.E./B.Tech. Degree Programmes) **L T P C**

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. Jeyapoovan 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. Kannaiah 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.

15EI21C **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. (K2, A2)

CO 2: write effectively in any Professional context. (K3, A2)

CO 3: acquire the skills related to Group discussion. (K3, A2)

CO 4: communicate and respond in different social and professional contexts. (K3, A3)

CO 5: recall the acquired skills in solving competitive exam. (K2, S3)

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.

15EI22C CALCULUS, PROBABILITY AND STATISTICS **L T P C**

(Common to EEE and EIE) **3 2 0 4**

COURSE OUTCOMES

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

CO 1: compute and change variables in double and triple integrals.(K3)

CO 2: analyze the concepts related to vector calculus and apply them in engineering field. (K3)

CO 3: use the concepts of multivariate random variables. (K2)

CO 4: calculate the various measures of dispersion. (K3)

CO 5: explain and successfully apply all aspects of appropriate testing techniques. (K3)

UNIT I MULTIPLE INTEGRALS 15

Double integration – Cartesian and polar coordinates - Change of order of integration - Change of variables - Cartesian to polar coordinates- Area as double integral- Triple integration - Cartesian and polar coordinates – Change of Variables- Cartesian to spherical and cylindrical coordinates.

UNIT II VECTOR CALCULUS 15

Gradient, Divergence and Curl – Directional derivatives – Irrotational and solenoidal vector fields- Vector integration – Line, Surface and Volume Integrals - Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT III PROBABILITY 15

Discrete and continuous random variables – Moments - Moment generating function and their properties- Normal Distribution - Joint distributions - Marginal and conditional distributions - Covariance - Correlation and Regression.

UNIT IV STATISTICS 15

Mean, median, mode and standard deviation – Moments – Skewness – Kurtosis - Correlation of single and bivariate frequency distributions – Regression lines.

UNIT V TESTING OF HYPOTHESIS 15

Sampling distributions - Tests for single mean, Proportion, Difference of means (for large samples) – Tests for single variance and equality of variances – t-test, F-test and Chi-square test for goodness of fit – Independence of attributes.

L: 45 T: 30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Grewal.B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
2. Ronald E.Walpole, Raymond H.Myers, Sharon L.Myers, 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.

15EI23C MATERIALS SCIENCE AND TECHNOLOGY 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 electrical properties of conducting and semiconducting materials.(K2)
CO 2: summarize the physics underlying the magnetic and superconducting behaviour of materials. (K2)
CO 3: predict the mechanism by which the electric field interacts with dielectric material and their applications. (K2)
CO 4: define the mechanical behavior of engineering materials. (K2)
CO 5: describe the properties of advanced materials properties which are used in engineering applications and devices. (K2)

UNIT I CONDUCTING MATERIALS AND SEMICONDUCTORS 9

Conductors:

Band theory of solids - Classical free electron theory of metal - Electrical and thermal conductivity – Wiedemann Franz law, Quantum free electron theory - Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

Semiconductors:

Types of Semiconductors - Intrinsic and Extrinsic Semiconductors – Definition - Hall effect.

UNIT II MAGNETIC MATERIALS AND SUPERCONDUCTORS 9

Magnetic materials:

Types and Properties of magnetic materials - Domain theory of ferromagnetic materials – Ferrites – structure and applications.

Superconductors:

BCS Theory, Properties - Meissner effect – Isotopic effect, Type I and Type II superconductors Applications of superconductors – Cryotron, SQUID, Magnetic levitation.

UNIT III DIELECTRIC MATERIALS 9

Types of dielectric materials - polar and non-polar dielectrics - Types of Polarization – electronic, ionic, orientation and space charge polarization - frequency and temperature dependence of polarization, internal field - Clausius – Mosotti relation - dielectric loss and dielectric breakdown - Applications of dielectric materials - Ceramic materials - properties and applications.

UNIT IV MECHANICAL BEHAVIOR OF ENGINEERING MATERIALS 9

Elastic behavior of materials - plastic deformation in single and polycrystalline crystal – mechanism of slip, critical resolved shear stress ductile and brittle failure – Griffith's theory of brittle fracture.

UNIT V ADVANCED ENGINEERING MATERIALS 9

Shape memory alloys (SMA) - Nano materials - Solar cell – Biomaterials – Preparation, Properties and Applications

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Charles Kittel, "Introduction to Solid State Physics", 7th Edition, John Wiley and Sons, Singapore, 2007.
2. William D.Callister,Jr, "Materials Science and Engineering An introduction", 7th Edition, John Wiley and Sons, 2006.

REFERENCES

1. Wole Soboyejo, "Mechanical Properties of Engineered Materials", Marcel Dekker Inc, 2003
2. Charles P. Poole and Frank J.Ownen, "Introduction to Nanotechnology', John Wiley and Sons India, 2003
3. Ali Omar.M, 'Elementary Solid State Physics", 6th Edition, Pearson Education Inc., 2009.
4. Silver F and Dillion C, "Biocompatibility: Interactions of Biological and Implantable Materials", VCH Publishers, New York, 1989.
5. Bhat S.V, Sujata V. Bhat, Biomaterials, Springer Netherlands, 2002.

15EI24C ELECTRIC CIRCUIT ANALYSIS L T P C
3 2 0 4

COURSE OUTCOMES

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

CO 1: explain basic concepts of electric potential, current, power and electric network topology including nodes, branches and loops. (K2)
CO 2: explain the relationship between voltage and current in resistors, capacitors and inductors. (K2)
CO 3: simplify and analyze the electric circuits using network theorems. (K3)
CO 4: apply mesh and nodal technique to analyze the circuit (K3)
CO 5: analyze the dynamic behavior of the first and second order AC and DC circuits. (K3)

UNIT I ELECTRIC CIRCUIT ELEMENTS AND ITS INTERCONNECTION 15

Electrical parameters in DC and AC circuits – Kirchhoff's laws –series and parallel circuits - voltage and current division - source transformation – Network reduction – star/delta conversion.

UNIT II TRANSIENT RESPONSE OF ELECTRIC CIRCUITS 15

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

UNIT III NETWORK ANALYSIS AND THEOREMS FOR DC AND AC CIRCUITS 15

Mesh and nodal analysis for DC and AC circuits - Thevenin's and Norton's Theorem – Superposition Theorem – Maximum Power Transfer Theorem – Reciprocity Theorem and their applications.

UNIT IV RESONANCE AND COUPLED CIRCUITS 15

Frequency response of series and parallel resonance circuits – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT V INTRODUCTION TO TWO-PORT NETWORK FUNCTIONS 15

Two-port Network – impedance, admittance Transmission and hybrid parameters of two-port network- Inter relationship of different parameters – Interconnection of two-port networks – T and π representation and Lattice network.

L: 45 T: 30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Richard C.Dorf, James A.Svoboda, "Introduction to Electric Circuits", 8th Edition, Wiley India, New Delhi, 2010.
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, 2011.
3. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", 6th Edition, Tata McGraw Hill publishers, New Delhi, 2006.

REFERENCES

1. John Bird, "Electrical Circuit Theory and Technology", 4th Edition, Newnes Publication, 2010.
2. Paranjothi SR, "Electric Circuits Analysis", New Age International Limited, New Delhi, 1996.
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, 1999.
5. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", 2nd Edition, McGraw Hill, 2003.

15EI25C 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.

15EI26C 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

15EI27C PHYSICS AND ENVIRONMENTAL CHEMISTRY LABORATORY L T P C
0 0 2 1

PART A – PHYSICS LABORATORY

COURSE OUTCOMES

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

CO 1: demonstrate the optical properties of waves. (K2, S3)
CO 2: analyze the characteristics of semiconducting materials and devices. (K3,S3)
CO 3: quantify the acceleration due to gravity (g). (K2, S3)
CO 4: analyze the thermal properties of materials. (K3, S3)

LIST OF EXPERIMENTS

a. (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.
b. Determination of Band Gap of a semiconductor material.
c. Determination of Radius of curvature of a Plano convex lens using Newton's rings Method.
d. Determination of wavelength of mercury spectrum using spectrometer & grating
e. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
f. Determination of g using compound pendulum
g. Determination of Hall Coefficient.
h. Specific heat capacity of liquid – Newton's law of cooling.
i. Characteristics of LED
j. Study of V-I characteristics of a solar cell.

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 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 Environmental 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.

15EI28C	**C PROGRAMMING LABORATORY**	**L T P C**
	(Common to all B.E. / B.Tech. Degree Programmes)	**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 + 1/2at2, 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

15EI29C ELECTRIC CIRCUIT ANALYSIS LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO 1: demonstrate the basic concepts of electric circuits. (K2, S3)
CO 2: examine the electric circuits using mesh and nodal analysis. (K2, S3)
CO 3: analyze electric circuits using network theorems. (K3, S3)
CO 4: compute the frequency response of resonant and tuned circuits. (K2, S3)
CO 5: analyze electric circuits using simulation software. (K3, S3)

LIST OF EXPERIMENTS

1. Verification of Ohm's law and Kirchoff's law.
2. Transient response of RL and RC circuits for DC input.
3. Verification of mesh and nodal analysis.
4. Verification of Thevenin's and Norton's theorem.
5. Verification of Superposition theorem.
6. Verification of Maximum Power Transfer theorem.
7. Verification of Reciprocity theorem.
8. Measurement of self inductance of a coil.
9. Frequency response of series and parallel resonance circuits.
10. Frequency response of single tuned coupled circuits.
11. Study of two-port network.
12. Verification of network theorems and response of the given circuits using simulation software.

P: 30 TOTAL: 30 PERIODS

15EI31C FOURIER SERIES AND TRANSFORMS L T P C
3 2 0 4

COURSE OUTCOMES

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

CO1 : perform Fourier series analysis of the functions. (K2)
CO2 : compute the Fourier transforms of various functions. (K2)
CO3 : apply Laplace Transform techniques to solve ordinary differential equations.(K3)
CO4 : understand the concepts of wavelet transform. (K2)
CO5 : solve difference equations using Z-Transforms. (K3)

UNIT I FOURIER SERIES 15

Dirichlet's conditions – General Fourier series – Half range series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT II FOURIER TRANSFORMS 15

Fourier Integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity – Application of fourier transform – discrete time system analysis.

UNIT III LAPLACE TRANSFORMS 15

Definition of Laplace transform and its inverse – Transforms of elementary functions – Properties (excluding proofs) – Transforms of periodic functions – Initial and Final value theorems – Convolution theorem (excluding proof) - Solutions of linear ordinary differential equations of second order with constant coefficients – Application of Laplace transform – continuous time system analysis.

UNIT IV WAVELETS AND WAVELET TRANSFORMS 15

Introduction – Continuous Wavelet Transforms – Discrete Wavelet Transforms – Ortho normal Wavelets.

UNIT V Z – TRANSFORMS 15

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Formation of difference equations – Solutions of difference equations using Z-transform – Application of Z-transform – discrete time system analysis.

L : 45 T:30 TOTAL:75 PERIODS

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.
3. Lokenath Debnath and Dambaru Bhatta "Integral transforms and their applications", 2nd Edition, Chapman & Hall /CRC Taylor and Francis Group, 2010.

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 Publishing Company, New Delhi, 2007.
3. Jain.R.K. and Iyengar.S.R.K., "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Private Limited, 2007.

15EI32C SIGNALS AND NETWORKS L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: represent the mathematical descriptions of continuous and discrete time signals and systems (K2)

CO2: analyze the spectral characteristics of periodic and aperiodic signals using Fourier analysis for LTIS (K3)

CO3: determine the response of linear systems using Laplace and Fourier Transform. (K3)

CO4: analyze one port and two port networks using network functions (K3)

CO5: synthesize RL,LC, RC networks (K4)

UNIT I INTRODUCTION TO SIGNALS AND SYSTEMS 9

Continuous and discrete time signals: Classification of Signals – Periodic, aperiodic even – odd – energy and power signals – Deterministic and random signals – complex exponential and sinusoidal signals –periodicity –unit impulse – unit step – Transformation of independent variable of signals: time scaling, time shifting. System properties: Linearity, Causality, time invariance and stability.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series analysis, Spectrum of C.T. signals, Fourier Transform and Laplace Transform in Signal Analysis**.**

UNIT III LINEAR TIME INVARIANT – CONTINUOUS TIME SYSTEMS 9

Differential equation, Block diagram representation, Impulse response, Convolution integral, frequency response, Fourier and Laplace transforms in analysis, State variable equations and matrix representation of systems

UNIT IV NETWORK FUNCTIONS 9

Network function for one-port and two-port, calculation of network function for ladder and general networks, poles and zeros with restrictions for driving point functions and transform functions, two-port parameters-Z,Y,ABCD, H-parameters, stability by Routh - Harwitz criterion.

UNIT V NETWORK SYNTHESIS 9

Identification of network synthesis, Brune's positive and real function (PRF), properties of PRF, testing of driving point functions, even and odd function, one terminal pair network driving point synthesis with LC elements, RC elements, Foster and Cauer form.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Franklin FaKun. Kuo, "Network Analysis & Synthesis", 2nd Edition, Wiley India Pvt Ltd, 2010.
2. G.Proakis & D.G.Manolakis Digital Signal Processing Principles, Algorithms and applications, 4th Edition, Pearson India, 2007.

REFERENCES

1. Mac.E Van Valkenburg, "Network Analysis", 3rd Edition, Phi Learning, 2014.
2. A.NagoorKani, "Signals and Systems", 1st Edition, Mcgraw Hill Education, 2007.
3. P.Ramesh Babu & R.Anandanatarajan, "Signals and Systems", 2nd Edition, Scitech Publications, 2006.
4. Mac.E Van Valkenburg, "Network Synthesiss", 1st Edition, New Age International Publishers Ltd, 1984.

15EI33C ELECTRONIC DEVICES AND CIRCUITS L T P C
3 2 0 4

COURSE OUTCOMES

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

CO1 : describe two and three terminal semiconductor devices and their characteristics. (K2)
CO2 : use BJT amplifiers in relevant circuits. (K3)
CO3 : use FET amplifiers in relevant circuits. (K3)
CO4 : classify the power amplifiers and feedback amplifiers. (K3)
CO5 : describe the oscillators and pulse circuits. (K2)

UNIT I DIODES 15

PN diode : Biasing the diode – VI characteristics of diode – Junction diode switching time.
Diode applications: HWR – FWR– power supply filters –clipper circuits.
Special purpose diodes: Zener diodes, Schottky diode, Tunnel Diode

UNIT II BJTs 15

Bipolar Junction Transistors : Transistor structure – basic operation –Transistor characteristics and parameters –transistor as an amplifier – transistor as a switch – transistor biasing – DC load line - AC load line
BJT amplifiers: CE, CC and CB amplifiers–Analysis of single stage transistor amplifier using parameters voltage gain, current gain, input impedance and output impedance – Multistage RC coupled Amplifiers –Transformer coupled amplifier

UNIT III FETs 15

Field-Effect Transistors: JFET characteristics and parameters –MOSFET - D-MOSFET, E-MOSFET - MOSFET characteristics and parameters, Fin FET
FET amplifiers: JFET/Depletion MOSFET small signal model

UNIT IV POWER AMPLIFIERS AND FEEDBACK AMPLIFIERS 15

Power amplifiers: Classification of Power amplifiers- Class A, B, AB and C Power amplifiers -Design of power output, efficiency and cross-over distortion

Feedback amplifiers: Voltage / current, series / shunt feedback amplifiers.

UNIT V OSCILLATORS AND PULSE CIRCUITS 15

Sinusoidal signal generators: Oscillator – Condition for oscillation – Phase shift-Wein Bridge.

Square wave generators: Multivibrators – Schmitt triggers

L : 45 T : 30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Millman and Halkias, "Electronic Devices and Circuits", Tata McGraw–Hill, 2010.
2. Floyd, T.L, "Electronic Devices" 6th Edition, Pearson Education, 2013.

REFERENCES

1. Boylsted and Nashelsky, "Electronic Devices and Circuit Theory", Prentice Hall of India, 6th Edition, 2010.
2. Millman, J., Prakash Rao.,M.S. and Taub,H., "Pulse Digital and Switching Wave Forms", McGraw-Hill,2007.
3. Streetman, B. and Sanjay,B., "Solid State Electronic Devices", Prentice Hall of India, 5th Edition, 2009.
4. Paul R.Gray, Paul J.Hurst, Stephen H.Lewis and Robert G.Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley, 5th Edition, 2009.

15EI34C SENSORS AND TRANSDUCERS L T P C

3 0 0 3

COURSE OUTCOMES

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

CO1 : outline the basic need of measurement systems. (K2)
CO2 : interpret the static and dynamic characteristics of transducers. (K2)
CO3 : explain the various types of Resistive transducers. (K2)
CO4 : describe the features of Capacitive and Inductive Transducers. (K2)
CO5 : illustrate the various applications of transducers using modern sensors. (K2)

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Generalized measurement system - Units and standards – Static calibration – Classification of errors - Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics – Accuracy, precision, resolution, threshold, sensitivity, linearity, repeatability, reproducibility, loading effect, drift, static error, span and range, hysteresis, dead time and dead zone - Dynamic characteristics – Mathematical model of transducers – Zero, I and II order transducers - Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer - Strain gauge – types - Resistance temperature detector (RTD) – Thermistor – Characteristics and Laws of Thermocouple- Hot-wire anemometer - constant current and constant temperature operation - Resistive humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Induction potentiometer – Variable reluctance transducer – Eddy current transducer – Principle of operation, construction details, characteristics and applications of LVDT – Capacitive transducer and types - Differential arrangement – Variation of dielectric constant for measurement of liquid level - Frequency response of Capacitive transducers - Dynamic microphone.

UNIT V MODERN TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto resistor - Digital displacement transducer– Fiber optic sensor - Introduction to SQUID sensor, Touch screen sensor, Photovoltaic cell, MEMS and Carbon Nano tubes.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Ernest O.Doebelin, “Measurement systems”, 6th Edition, Tata McGraw Hill Education Private Ltd, New Delhi, 2012.
2. A.K. Sawhney, “A course in Electrical & Electronic Measurement and Instrumentation”, Dhanpat Rai and Company Private Limited, Reprint: 2014.

REFERENCES

1. D. Patranabis, “Sensors and Transducers”, 2nd Edition, Prentice Hall of India, 2010.
2. John P.Bentley, “Principles of Measurement Systems”, 4th Edition, Pearson Education, 2004.
3. Neubert H.K.P., “Instrument Transducers – An Introduction to their Performance and Design”, Oxford University Press, Cambridge, 2003.
4. Murthy, D.V.S., “Transducers and Instrumentation”, 2nd Edition, Prentice Hall of India Private Limited, New Delhi, 2010.
5. S.Renganathan, “Transducer Engineering”, Allied Publishers, 2005.

15EI35C ELECTRICAL MEASUREMENTS AND ELECTRONIC INSTRUMENTATION

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1 : explain the principle of operation of different types of electrical Instruments. (K2)

CO2 : explain the various measurement techniques of Power, Energy and Power factor. (K2)

CO3 : illustrate the working principle of Potentiometers and Instrument transformers. (K2)

CO4 : determine the unknown resistance, inductance and capacitance in different facets of measurement. (K3)
CO5 : explain the operation of various electronic measuring instruments. (K2)

UNIT I MEASUREMENT OF VOLTAGE AND CURRENT 9

Classification of electrical instruments - Deflecting, controlling and damping torques - D'Arsonval Galvanometer: Principle and operation – Different types of electrical measuring instruments: Principle, construction and operation of Moving coil, Moving iron, Electro dynamometer, Induction and Rectifier types, Errors and compensation – Extension of range of voltmeter and ammeter.

UNIT II MEASUREMENT OF POWER, ENERGY AND POWER FACTOR 9

Electrodynamometer type wattmeter: Theory & its errors, Methods of correction – LPF wattmeter – Phantom loading – Principle and operation of single phase Induction type energy meter, single phase electrodynamometer type power factor meter.

UNIT III POTENTIOMETERS AND INSTRUMENT TRANSFORMERS 9

DC potentiometer: Basic circuit, standardization, Laboratory type (Crompton's) – AC potentiometers: Drysdale (polar) type, Gall-Tinsley (coordinate) type – Applications of DC and AC potentiometers – Leeds Northrup self balancing potentiometer – Instrument Transformers: C.T and P.T – construction, theory, operation and characteristics.

UNIT IV MEASUREMENT OF R,L,C 9

Resistance Measurement - DC Bridges: Wheatstone bridge, Kelvin double bridge, Localization of cable faults using Murray and Varley loop methods – AC Bridges: Inductance Measurement - Maxwell's bridge, Hay's bridge, Anderson bridge – Capacitance Measurement: Schering bridge – Measurement of Q factor - Western digital ac bridge Sources of errors in bridge circuits.

UNIT V ELECTRONIC MEASUREMENTS 9

Digital Multimeter – Digital frequency meter – Programmable decade frequency synthesizer – Basic swept receiver spectrum analyzer – Digital Storage Oscilloscope.

L : 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. A.K. Sawhney, "A Course in Electrical & Electronic Measurements and Instrumentation", Dhanpath Rai and Company Private Limited, Reprint: 2014.
2. J.B.Gupta, "A Course in Electronic and Electrical Measurements and Instrumentation", S.K. Kataria and Sons, Delhi, 2003.

REFERENCES

1. E.W. Golding & F.C.Widdis, "Electrical Measurements and Measuring Instruments", A.H.Wheeler and Company, 2011.
2. H.S.Kalsi, "Electronic Instrumentation", Tata McGraw Hill Education Private Ltd, Third edition, 2010.
3. Martin U. Reissland, "Electrical Measurement – Fundamental Concepts and Applications", New Age International Private Limited, 2001.

15EI36C	PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	C
	(Common to all Programmes)	3	0	0	3

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

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 issued - 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”, McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S and Senthil Kumar VS, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCES

1. Charles D and Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, 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.

15EI37C TRANSDUCERS AND MEASUREMENTS LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1 : demonstrate and analyze the principle of operation of various transducers in the measurement of physical quantities. (S3, K2)

CO2 : perform the measurement of unknown resistance, capacitance and inductance and also criticize the output. (S2, K2)

CO3 : demonstrate the various steps involved in the calibration of electrical instruments. (S3, K2)

LIST OF EXPERIMENTS

1. Characteristics of a potentiometric transducer.
2. Characteristics of Strain gauge.
3. Characteristics of LVDT.
4. Characteristics of Hall effect transducer.
5. Characteristics of LDR.
6. Characteristics of RTD, thermistor and thermocouple.
7. Measurement of resistance using Wheatstone bridge.
8. Measurement of resistance using Kelvin’s double bridge.
9. Measurement of capacitance using Schering Bridge.
10. Measurement of inductance using Anderson Bridge.
11. Calibration of Single-phase induction type Energy meter.
12. Calibration of Single-phase wattmeter
13. Calibration of Series and Shunt type ohmmeters.
14. Calibration of Ammeter and Voltmeter.

P:30 TOTAL: 30 PERIODS

15EI38C ELECTRONIC DEVICES AND CIRCUITS LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1 : construct the circuits with two terminal and three terminal semi-conductor devices and demonstrate their characteristics. (S3, K3)

CO2 : construct, test and implement the amplifiers and oscillators using BJT and FET.(S3, K3)

CO3 : demonstrate the characteristics of devices and its applications using modern virtual instrumentation kit. (S3, K3)

LIST OF EXPERIMENTS

1. Characteristics of Semiconductor diode and Zener diode.
2. Characteristics of Transistor in Common Emitter, Common Collector, and Common Base Configuration
3. Characteristics of FET
4. Photodiode, photo transistor Characteristics and study of light activated relay circuit
5. Single phase half wave and full wave rectifiers with inductive and capacitive filters using virtual instrumentation suite
6. Amplifier design using BJT (simulation)
7. Differential amplifier using FET
8. Realization of Passive filters
9. Design of sinusoidal wave generator using BJT
10. Study of simulation experiments (Multivibrator)

P:30 TOTAL: 30 PERIODS

15EI39C COMMUNICATION SKILLS LABORATORY L T P C
(Common to all B.E. / B.Tech., Programmes) **0 0 2 1**

COURSE OUTCOMES

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

CO 1: interpret any passage after listening and interact at different situations fluently (K2,S3)

CO2: excel appropriately in competitive and professional contexts. (K3, S3)

CO3: acquire the sub-skills required for paper presentations and group discussions which will help them to excel in their workplace. (K3,S3)

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”, PHI Learning Private Limited, Delhi, 2009

15EI41C COMPLEX ANALYSIS AND NUMERICAL METHODS L T P C
3 2 0 4

COURSE OUTCOMES

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

CO1 : grasp the concepts of analytic functions. (K3)
CO2 : evaluate complex integration over contour .(K3)
CO3 : use numerical techniques to solve algebraic equations.(K3)
CO4: interpolate the given data and evaluate numerical integration. (K3)
CO5 : solve differential equations using numerical methods. (K3)

UNIT I ANALYTIC FUNCTIONS 15

Functions of a complex variable – Analytic functions – Necessary and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic functions – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w= z+c, cz, 1/z, and bilinear transformation.

UNIT II COMPLEX INTEGRATION 15

Cauchy’s integral theorem and Cauchy’s integral formula (excluding proofs) – Taylor’s and Laurent’s expansions – Singular points – Residues – Residue theorem (excluding proof) – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour(excluding poles on boundaries).

UNIT III SOLUTION OF ALGEBRAIC EQUATIONS 15

Solving non-linear algebraic equations – Newton - Raphson method; Solution of linear system - Direct methods - Gauss Elimination method – Gauss Jordan method; Iterative methods – Gauss-Jacobi and Gauss-Seidel methods.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 15

Lagrange's and Newton's divided difference interpolation formulas – Newton's forward and backward difference interpolation formulae – Approximation of derivatives using interpolation polynomials- Numerical integration using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS 15

Taylor's series method – Fourth order Runge – Kutta method; Solution of one dimensional wave equation – One dimensional and two dimensional heat equations.

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", Khanna Publishers, New Delhi, 6th Edition,2004.

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 Publishing Company,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.

15EI42C CONTROL SYSTEMS L T P C

3 2 0 4

COURSE OUTCOMES

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

CO1 : develop mathematical model for electro mechanical system. (K3)
CO2: analyze time and frequency response of electro mechanical system. (K3)
CO3: analyze the stability of linear control systems. (K2)
CO4: design compensator for linear systems. (K2)
CO5: analyze continuos time system using state space approach. (K2)

UNIT I MODELING OF ELECTRICAL AND MECHANICAL SYSTEM 15

Mathematical modeling of electrical, mechanical and electro mechanical system - Electrical analogy of mechanical system – Block diagram reduction technique - Signal flow graph representation.

UNIT II TIME AND FREQUENCY RESPONSE ANALYSIS 15

Standard test signals – Time response of First order and second order system -steady state error calculation for a system – approximate modeling of first and second order system using time response data- frequency response analysis –frequency domain specifications.

UNIT III STABILITY ANALYSIS 15

Concept of stability – Routh Hurwitz criterion of stability – Root Locus- Stability analysis using frequency response: Bodeplot – Polarplot – Nyquist stability criterion.

UNIT IV COMPENSATOR DESIGN 15

Lag, Lead, Lag-Lead compensator design using Bode Plot – Realization of compensator using operational amplifier- Introduction to P, PI and PID controller

UNIT V STATE SPACE ANALYSIS OF CONTROL SYSTEM 15

Introduction to state variable representation of continuous time system **-** Conversion of state variable form to transfer function - State space representation using physical, phase and canonical variables – Solution of state equation – Concepts of controllability and observability.

L : 45 T: 30 TOTAL: 75 PERIODS

TEXT BOOKS

1. I.J.Nagrath and M.Gopal, “Control Systems Engineering”, New Age International Publishers, 2007.
2. K.Ogata, “Modern Control Engineering”, PHI, 4th Edition New Delhi, 2005.

REFERENCES

1. M.Gopal, “Control Systems, Principles and Design”, Tata McGraw Hill, New Delhi,2005
2. Benjamin C.Kuo, “Automatic Control Systems”, Pearson Education, New Delhi, 2009.
3. Richard.C.Dorf & Robert.H.Bishop, “Modern Control Systems”, Addidon–Wesley, 2011.
4. Norman S.Nise, “Control systems Engineering”, John Wiley& sons (Asia), Pvt. Ltd., 4th Edition, 2008.

15EI43C ELECTRICAL MACHINES L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1 : explain the principle of operation of a DC Machine (K2)
CO2 : compare the different types of transformer and derive its EMF equation (K3)
CO3 : explain the principle of operation of synchronous machine with its starting methods (K2)
CO4 : derive the equivalent circuit of an Induction motor (K2)
CO5 : analyze the different types of single phase machines (K2)

UNIT I D.C MACHINES 9

Construction of D.C. Machines – Principle of operation of D.C generator - EMF equation – Armature reaction - Principle of operation of D.C Motor - Torque equation - Types of D.C. Motors – Starters - Speed control of D.C Motors.

UNIT II TRANSFORMERS 9

Principle of operation of ideal transformer - EMF equation - Construction details of shell and core type transformers - OC and SC tests - Equivalent circuit - Regulation and efficiency of a transformer - Three-phase transformer connections.

UNIT III SYNCHRONOUS MACHINES 9

Principle of operation of alternator - Construction details - salient and non-salient pole alternators - Equation of induced EMF - Regulation: EMF and MMF methods - Synchronous motor - Starting methods - V curves and inverted V curves.

UNIT IV INDUCTION MACHINES 9

Three phase Induction motor - Construction and principle of operation, Classification of induction motor, Torque equation - Equivalent Circuit- Starting methods - Speed control of induction motors.

UNIT V SPECIAL MACHINES 9

Types of single phase motor – Double revolving field theory – Capacitor start capacitor run motors – Shaded pole motor – Repulsion type motor – Universal motor –Stepper motor- Switched reluctance motor – Permanent magnet Brushless D.C motor.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Nagrath, I.J., and Kothari, D.P., “Electrical Machines”, Tata McGraw - Hill, 3rd Edition, 2004.
2. Fitzgerald A.E, Kingsley C., Umans, S. and Umans S.D., “Electric Machinery”, McGraw- Hill, Singapore, 2000.

REFERENCES

1. Theraja, B.L., “A Text book of Electrical Technology”, Vol.II, S. Chand and Company, New Delhi, 2007.
2. Del Toro, V., “Electrical Engineering Fundamentals”, Prentice Hall of India, New Delhi, 1995.
3. Cotton, H., “Advanced Electrical Technology”, Sir Isaac Pitman and Sons Limited, London, 1999.
4. Bhattacharya, S.K., “Electrical Machines”, Tata McGraw Hill Publishing company ltd, 2nd Edition, 2007.
5. Mehta, V.K. and Rohit Mehta, “Principles of Power System”, S. Chand and Company Ltd, 2nd Edition, 2006.

15EI44C INDUSTRIAL INSTRUMENTATION - I L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1 : illustrate the working principles of instrument involved in speed, torque and force measurement. (K2)

CO2 : explain the working of instruments used for acceleration, vibration and density measurement. (K2)

CO3 : explain the working of pressure measuring instrument. (K2)

CO4 : explain the definitions and standards related to temperature measurement. (K2)

CO5 : select appropriate temperature sensors. (K3)

UNIT I MEASUREMENT OF FORCE, TORQUE AND SPEED 9

Electric balance - Different types of load cells - Hydraulic, Pneumatic, strain gauge - Magnetoelastic and Piezoelectric load cells, Different methods of torque measurement; Strain gauge, Relative angular twist, Speed measurement-Capacitive tacho, Dragcup type tacho-D.C and A.C tacho generators, Stroboscope.

UNIT II MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY 9

Accelerometers - LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers - Mechanical type vibration instruments, Seismic instruments as accelerometer, Vibration sensor, Calibration of vibration pickups, Units of density and specific gravity, Baume scale and API scale, Pressure type densitometers - Float type densitometers, Ultrasonic densitometer, gas densitometer

UNIT III PRESSURE MEASUREMENT 9

Units of pressure, Manometers, different types, Elastic type pressure gauges, Bourdon tube, bellows and diaphragms, Electrical methods - Elastic elements with LVDT and strain gauges, Capacitive type pressure gauge, Piezo resistive pressure sensor, Resonator pressure sensor, Measurement of vacuum-McLeod gauge, Thermal conductivity gauge, lonization gauges, Cold cathode type and hot cathode type, calibration of pressure gauges, Dead weight tester.

UNIT IV TEMPERATURE MEASUREMENT 9

Definitions and standards - Primary and secondary fixed points - Calibration of thermometers, Different types of filled in system thermometers - Sources of errors in filled in systems and their compensation, Bimetallic thermometers, RTD - characteristics and signal conditioning-3 lead and 4 lead RTDs - Thermistors.

UNIT V THERMOCOUPLE AND RADIATION PYROMETER 9

Thermocouples - Laws of thermocouple, Fabrication of industrial thermocouples, Signal conditioning for thermocouple, isothermal block reference junctions, Commercial circuits for cold junction compensation, Response of thermocouple, Special techniques for measuring high temperature using thermocouple, Radiation fundamentals, Radiation methods of temperature measurement, Total radiation pyrometers, Optical pyrometers, Two colour radiation pyrometers - Fiber optic sensor for temperature measurement.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS

1. D.Patranabis, “Principles of Industrial Instrumentation”, Tata McGraw-Hill Publishing Company, New Delhi, 2010.
2. A.K.Sawhney, “A course in Electrical and Electronic Measurement and Instrumentation” Dhanpat Rai and Sons, New Delhi, 2014.

REFERENCES

1. Ernest O.Doebelin, ‘Measurement systems’, 6th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2012.
2. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi 2002.
3. Donald P Eckman, Industrial Instrumentation, CBS Publishers & Distributors, Delhi, 2004
4. James W. Dailly, William F. Riley, Kenneth G. Mc.Connel, “Instruments for Engineering Measurements”, Wiley Edition.

15EI45C DIGITAL CIRCUITS AND SYSTEMS L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1 : simplify the boolean expression using various reduction techniques.(K2)
CO2 : analyse and design combinational circuits.(K3)
CO3 : analyse and design synchronous sequential circuits.(K3)
CO4 : analyse and design asynchronous sequential circuits.(K3)
CO5 : design and implement digital logic using memories. (K2)

UNIT I BOOLEAN ALGEBRA AND LOGIC GATES 9

Binary Codes – Boolean Algebra and Theorems – Boolean Functions – Simplification of Boolean Functions using Karnaugh Map and Tabulation Methods – Logic Gates – NAND and NOR Implementations.

UNIT II COMBINATIONAL LOGIC 9

Combinational Circuits – Analysis and Design Procedures – Circuits for Arithmetic Operations - Binary Adder – subtractor, Decimal adder- Code Conversion – Decoders and Encoders – Multiplexers and Demultiplexers – Introduction to HDL – HDL Models of Combinational circuits.

UNIT III SYNCHRONOUS SEQUENTIAL LOGIC 9

Sequential Circuits – Latches and Flip Flops – Analysis and Design Procedures – State Reduction and State Assignment – Shift Registers – Counters.

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC 9

Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards.

UNIT V MEMORY AND PROGRAMMABLE LOGIC DEVICES 9

Memories: RAM – SRAM, DRAM and ROM –– Programmable Logic Array - Programmable Array Logic, Introduction to FPGA.

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

1. Morris Mano M. and Michael D. Ciletti, "Digital Design", 4th Edition, Pearson Education, 2008.
2. Charles H. Roth Jr, "Fundamentals of Logic Design", 5th Edition – Jaico Publishing House, Mumbai, 2003.

REFERENCES

1. John F. Wakerly, "Digital Design Principles and Practices", 4th Edition, Pearson Education, 2007.
2. Donald D. Givone, "Digital Principles and Design", Tata Mcgraw Hill, 2003.
3. Kharate G. K., "Digital Electronics", Oxford University Press, 2010.

15EI46C	FUNDAMENTALS OF THERMODYNAMICS AND FLUID MECHANICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Describe the thermodynamic systems and apply law of thermodynamics to analyze the systems. (K2)
CO2: Explain the significance of Steam properties in Power plants and basic thermodynamics behind refrigerators and heat pump. (K2)
CO3: Explain the fundamentals of fluid properties and fluid flows.(K2)
CO4: Investigate the principles of dimensional analysis and similitude to simple problems and use dimensionless parameters.(K3)
CO5: Apply principles of fluid mechanics to the operation, design, and selection of hydraulics turbines and pumps. (K3)

UNIT I LAWS OF THERMODYNAMICS AND BASIC IC ENGINE CYCLES 9

Systems zeroth law, first law of thermodynamics -concept of internal energy and enthalpy applications to closed and open systems -second law of thermodynamics –concept of entropy –clausius inequality and principles of increase in irreversible processes. Basic IC engine and gas turbine cycles- single and multistage reciprocating compressors.

UNIT II THERMODYNAMICS OF REFRIGERATORS AND PUMPS 9

Properties of steam –Ranking cycle—Boilers and its accessories–Basic thermodynamics of refrigerators and heat pumps-Basics of Heat transfer

UNIT III BASIC CONCEPT OF FLUID MECHANICS & FLOW OF FLUIDS 9

Introduction – classification – types of fluids – properties –laws of pressure – atmospheric, gauge, absolute pressure, pressure measurement – manometers – mechanical gauges. Types of fluid flow velocity –rate equation of continuity-energy of a liquid in motion –head of a liquid – Bernoulli's theorem –orifice and mouthpiece.

UNIT IV DIMENSIONAL AND MODEL ANALYSIS 9

Introduction – dimensions – dimensional analyses –Rayleigh's and Buckingham's method-similitude - dimensionless numbers and their significance –similarity laws – model studies.

UNIT V PUMPS AND TURBINES 9

Introduction – types of pumps – reciprocating pump – construction details–co-efficient of discharge – slip – power required – centrifugal pump –classification – working principle– specific speed – turbines – classification – working principle

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Yunus A. Cengel and Michael A. Boles, "Thermodynamics – An Engineering Approach", 7th Edition, Tata McGraw-Hill Education, 2011.
2. Streeter, Victor L Wylie, Benjamin E, "Fluid Mechanics", 7th Edition, McGraw-Hill

REFERENCES

1. P.K. Nag, "Engineering Thermodynamics", 5th Edition, the McGraw-Hill Companies, 2013.
2. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5th Edition), Laxmi publications (P) Ltd, New Delhi, 2013.
3. Ramamritham S, "Fluid Mechanics, Hydraulics and Fluid Machines", Dhanpat Rai & Sons, Delhi, 2004.
4. http://nptel.ac.in/video.php?subjectId=112105123
5. http://nptel.ac.in/courses/112105171/1

15EI47C CONTROL SYSTEMS LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: analyze time and frequency response for the system using simulation software (S2, K3)

CO2 : design the compensator using simulation software (S2, K3)

CO3 : develop the compensator using op-amp (S2, K3)

LIST OF EXPERIMENTS

1. Study the basics of control system
2. Determine the overall transfer function of a system from the individual blocks using software and verify theoretically.
3. Study the time response of first and second order system.
4. Modeling of first and second order system using time response data.
5. Determine the steady state response for the closed loop system
6. Determine the transfer function of dc servo Motor.
7. Determine the transfer function of armature controlled dc motor.
8. Stability analysis of linear system
9. Design the lag-lead compensator for the given system
10. Realize the compensator using operational amplifier.

11. Test the controllability and observability for the given system.
12. Solve the state equation for the system using simulation software

P: 30 TOTAL: 30 PERIODS

15EI48C DIGITAL CIRCUITS AND SYSTEMS LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1 : design and construct the combinational and sequential circuits using logic gates.(S3, K3)

CO2 : design and simulate the combinational and sequential circuits using HDL. (S3, K3)

CO3 : record the experimental data, analyze the results, and prepare a formal laboratory report. (S3, K3)

LIST OF EXPERIMENTS

1. Verification of Boolean theorems using digital logic gates
2. Design and implementation of combinational circuits using basic gates for arbitrary functions, code converters (Excess-3 to BCD and Binary to Gray code converter and vice-versa), etc.
3. Design and implementation of binary adder / subtractor using IC's.
4. Design and implementation of parity generator / checker using basic gates.
5. Design and implementation of magnitude comparator
6. Design and implementation of multiplexers/ Demultiplexers
7. Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.
8. Design and implementation of 4-bit synchronous Counters using FF IC's
9. Simulation of combinational circuits using Hardware Description Language (VHDL/Verilog HDL software required)
10. Simulation of sequential circuits using HDL (VHDL/ Verilog HDL software required)

P:30 TOTAL: 30 PERIODS

15EI49C ELECTRICAL MACHINES LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1 : demonstrate the performance of DC generators under load/no load conditions. (S3, K3)

CO2 : demonstrate performance characteristics of DC motors and AC motors. (S3, K3)

CO3 : demonstrate the performance of the transformer with various test condition. (S3, K3)

CO4 : compute and conduct the regulation of Three Phase Alternator using EMF and MMF methods. (S2, K2)

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of separately excited D.C. generator
2. Open circuit and load characteristics of self excited D.C. generator
3. Load test on D.C. shunt motor
4. Swinburne's test
5. Speed control of D.C. shunt motor
6. Load test on single phase transformer
7. Open circuit and short circuit test on single phase transformer
8. Regulation of three phase alternator by EMF and MMF methods
9. Load test on three phase induction motor
10. No load and blocked rotor tests on three phase induction motor

P:30 TOTAL: 30 PERIODS

15EI51C INDUSTRIAL INSTRUMENTATION - II L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1 : explain the theory, operation and installation of variable head type flow meters.(K2)

CO2 : illustrate the working principle of quantity, area and mass flow meters. (K2)

CO3 : describe the construction and principle of operation of electrical type flow meters. (K2)

CO4 : explain the working principle of various liquid level measuring instruments.(K2)

CO5 : discuss the different measurement procedures of viscosity, humidity and moisture. (K3)

UNIT I VARIABLE HEAD TYPE FLOW METERS 9

Variable head type flow meters: Orifice plate, Venturi tube, Flow nozzle and Dall tube – Installation of head flow meters – Conditioning Orifice Plates- Pitot tube.

UNIT II QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS 9

Positive displacement flow meters: Nutating disc, Reciprocating piston, Oval gear and Helix type flow meters – Inferential meter – Turbine flow meter – Area flow meter: Rotameter – Theory and installation – Mass flow meters: Thermal and Coriolis – Temperature/pressure compensation in mass flow meters - Calibration of flow meters: Dynamic weighing methods.

UNIT III ELECTRICAL TYPE FLOW METER 9

Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Open channel flow measurement – Solid flow rate measurement.

UNIT IV LEVEL MEASUREMENT 9

Level measurement: Float, Displacer type and Bubbler system – Electrical level gauge:- Resistance and Capacitance – Nuclear radiation - Ultrasonic level transmitters - Guided Wave Radar Level Transmitters – vibration and microwave level switches- – Boiler drum level measurement. Leading manufacturers of flow and level instruments with specifications. (Non-descriptive).

UNIT V MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE 9

Viscosity: Say bolt viscometer and Rotameter type viscometer – Consistency meters – Dry and wet bulb psychrometers – Hot wire electrode type hygrometer, Dew cell -Electrolysis type hygrometer – Commercial type dew point meter – Moisture measurement: Different methods of moisture measurements- Moisture measurement in Instrument air supply.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Doeblin E.O., “Measurement Systems Application and Design”, International Student Edition, 6th Edition, McGraw-Hill Book Company, 2012.
2. Patranabis D., “Principles of Industrial Instrumentation”, 3rd Edition, Tata McGraw-Hill Company Limited, 2011.

REFERENCES

1. Liptak B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005.
2. Jain R.K., “Mechanical and Industrial Measurements”, Khanna Publishers, Delhi, 1999.
3. Eckman D.P., “Industrial Instrumentation”, Wiley Eastern Limited, 1990.
4. Lessons in Industrial Instrumentation: www.ibiblio.org/ kuphaldt/ socratic/ sinst/ book/ liii.pdf
5. Industrial Flow measurement: http://eprints.hud.ac.uk/5098/1/macrabtreefinalthesis.

15EI52C MICROPROCESSOR, MICROCONTROLLER AND APPLICATIONS L T P C
3 2 0 4

COURSE OUTCOMES

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

CO1: explain the fundamental features and operation of Microprocessor (K2)
CO2: explain the various peripheral interfacing of Microprocessor. (K2)
CO3: develop an embedded C Programs for Port configuration, Timers, Interrupt in PIC microcontroller to the given applications. (K3)
CO4 : develop an embedded C programs for interfacing of Keypad, LCD, ADC and serial communication with 18F microcontroller.(K3)
CO 5 : develop an embedded C programs for data acquisition and control application using 18F microcontroller.(K3)

UNIT I INTRODUCTION TO MICROPROSESSOR AND MICROCONTROLLER 15

8085 (8-bit) Microprocessor architecture, addressing modes and overview of instruction set -detail of Micro-computer system& Microcontroller architecture, comparison,

advantages and applications of Harvard & Von Neumann architecture, RISC & CISC comparison. Introduction – embedded system & Role of microcontroller in embedded System.

UNIT II PIC MICROCONTROLLER ARCHITECTURE 15

PIC 18F architecture, registers, memory Organization and types, stack, oscillator options, BOD, power down modes and configuration bit settings. Brief summary of Peripheral support and overview of instruction set, MPLAB IDE & C18 Compiler.

UNIT III INTERNAL PERIPHERAL PROGRAMMING 15

Port structure, interrupt structure & timers of PIC18F. Interface the switches, LED, LCD, Keypad, use of timers with interrupts, PWM generation.

UNIT IV COMMUNICATION AND INTERFACE PROGRAMMING 15

MSSP structure: UART, SPI, I2C and ADC. Interface the Comparator output, RTC with I2C and EEPROM with SPI.

UNIT V CASE STUDIES WITH PIC* 15

Design the DAS, frequency counter with display on LCD, Digital Multi meter, and DC Motor control using PWM using PIC microcontroller.

*Should cover necessary signal conditioning of input stage, hardware interfacing with PIC Microcontroller, algorithm or flowchart and programming.

L: 45 T:30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Mazidi.M.A., “PIC Microcontroller & Embedded System”, 3rd Edition, Pearson 2008.
2. Rafiquzzaman. M, “Microcontroller Theory and Applications with the PIC18F”, 1st Edition, John Wiley & Sons, Inc. 2011.

REFERENCES

1. Ramesh Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th Edition, Penram International Publishing (India) Pvt Ltd, 2014.
2. Rajkamal, “Embedded system- Architecture, Programming, Design, Tata McGraw Hill, 2011.
3. Shibu.K.V., “Introduction of Embedded Systems” Tata McGraw Hill, 2009.
4. 18F xxx reference manual- www.microchip.com

15EI53C LINEAR INTEGRATED 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 given ideal and practical operational amplifier circuit (K2)

CO2: develop signal conditioning circuit using OP-AMP (K2)

CO3: design oscillatory and wave shaping circuit using OP-AMP (K3)

CO4: design timer and voltage regulator circuit (K3)

CO5: illustrate the internal functional blocks of the given IC. (K3)

UNIT I BASICS OF OPERATIONAL AMPLIFIER 9

Introduction to operational amplifiers – Basic differential amplifier - dual input balanced output and unbalanced output - Internal block schematic of operational amplifiers - operational amplifier parameters - ideal operational amplifier Open loop gain – input and output impedance – frequency response, frequency compensation. Slew rate, Input bias current – offset - drift - compensating networks ,CMRR, SVRR, finite gain bandwidth and its effect in operational amplifiers circuit performance verification.

UNIT II REALISATION OF OPERATIONAL AMPLIFIER 9

Open loop and closed loop configurations: Feedback configurations - Voltage series feedback and voltage shunt feedback verification. Instrumentation amplifier . operational amplifier applications - Summing , Difference , filters, V/I and I/V converters.

UNIT III APPLICATION OF OPERATIONAL AMPLIFIER 9

Integrator and differentiator ,multivibrators, waveform generators, clippers, clampers. Comparators: zero crossing, regenerative (Schmitt trigger) comparators, Peak detector circuit. Precision rectifiers. Sample and hold circuit- ADC- successive approximation, flash, integrating. DAC- weighted, R-2R; ADC-DAC-performance specifications.

UNIT IV TIMER, PLL AND ITS APPLICATIONS 9

555 Timer circuit – Functional block, characteristics & applications; 566-voltage controlled oscillator circuit; 565-phase lock loop circuit functioning and applications, Analog multiplier ICs.

UNIT V VOLTAGE REGULATOR AND APPLICATION ICs 9

IC voltage regulators - LM317, 723 regulators(design), switching regulator, MA 7840, LM 380 power amplifier, ICL 8038 function generator IC, isolation amplifiers, opto coupler, opto electronic ICs.

L : 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Ramakant A.Gayakward, “Op-amps and Linear Integrated Circuits”, 4th Edition, Pearson Education, 2003.
2. D.Roy Choudhary, Sheil B.Jani, “Linear Integrated Circuits”, 2nd Edition, New Age, 2004.

REFERENCES

1. Jacob Millman, 3.. C.Halkias, “Integrated Electronics - Analog and Digital circuits system”, Tata McGraw Hill, 2003.
2. Robert F.Coughlin, Fredrick F.Driscoll, “Op-amp and Linear ICs”, Pearson Education, 4th Edition, 2002.
3. David A.Bell, “Op-amp & Linear ICs”, Prentice Hall of India, 2nd Edition, 2006.
4. Sergio Franco, “Design with operational Amplifiers & Analog ICs”, Tata McGraw Hill.1998.

15EI54C PROCESS CONTROL L T P C
3 2 0 4

COURSE OUTCOMES

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

CO1: model the real time process with different order.(K3)
CO2: explain the performance of various controllers. (K2)
CO3:determine the controller parameter.(K2)
CO4:describe the suitable control scheme for real time process. (K2)
CO5: explain the operation of final control element.(K2)

UNIT I INTRODUCTION TO PROCESS CONTROL 15

Need for process control – Process with dead time, Process with inverse response – Continuous and Batch process – Degree of freedom – Self regulating and non self regulating processes - Servo and Regulator operation - Mathematical model of first order liquid level and thermal processes – Higher order process – Interacting and non-interacting systems – P and ID symbols.

UNIT II PERFORMANCE OF CONTROLLERS 15

Control System parameter - Basic control action – Characteristics of Discontinuous controller modes – Two position mode – Multi position mode – Floating controller mode - Characteristics of continuous controller - Proportional, Integral and Derivative control modes – Composite control modes – PI, PD and PID control modes.

UNIT III ANALOG CONTROLLER AND TUNING 15

Electronic controllers to realize various control actions – Pneumatic Controllers – Performance criteria – IAE, ISE, ITAE and ¼ decay ratio – Selection of controllers – Tuning of controllers – Ziegler-Nichol's method and Cohen Coon method.

UNIT IV CONTROL SYSTEMS WITH MULTIPLE LOOPS 15

Cascade control – Feed forward control – Ratio control – Selective control systems – Split range control – Adaptive and inferential control - Case study of control schemes of binary distillation column.

UNIT V FINAL CONTROL ELEMENT 15

Final control operation – Signal conversion - I/P converter – Pneumatic and electric actuators – Classification of control valves – Valve positioner – Control valves characteristics – Control valve sizing – Cavitations and flashing – Selection of control valves.

L: 45 T:30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Curtis.D.Johnson, "Process Control Instrumentation Technology", Pearson Education, 7th Edition, New Delhi, 2009.
2. G.Stephanopoulis, "Chemical Process Control", Prentice Hall of India, New Delhi, 2005.

REFERENCES

1. Donald P. Eckman, “Automatic Process Control”, Wiley Eastern Ltd., New Delhi, 2006.
2. Peter Harriott, “Process Control”, Tata McGraw Hill, New Delhi, 2007.
3. http://nptel.ac.in/courses/103101003
4. http://elearning.vtu.ac.in/06IT64.html

15EI55C INDUSTRIAL INSTRUMENTATION LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: perform the flow rate measurement using the differential pressure flow meters. (S2, K2)

CO2 : calibrate the variable area flow meter, pressure gauges and thermocouple. (S3, K2)

CO3 : operate analytical instruments for the measurement of pH, Conductivity and absorptivity of a solution. (S2, K2)

CO4 : perform measurements of Industrial parameters like Viscosity, Level, Torque and humidity. (S2, K2)

LIST OF EXPERIMENTS

1. Determination of Discharge coefficient of Orifice plate and Venturi meter.
2. Measurement of flow rate using Pitot tube.
3. Measurement of pH and conductivity of a solution.
4. UV-Visible Spectrophotometer.
5. Level Measurement using Differential pressure Transmitter.
6. Pressure gauge calibration using Dead Weight Tester.
7. Calibration of Rotameter.
8. Calibration of Thermocouple.
9. Measurement of vacuum pressure.
10. Determination of Viscosity using Saybolt / Redwood viscometer.
11. Measurement of humidity and moisture

P: 30 TOTAL: 30 PERIODS

15EI56C MICROPROCESSOR AND MICROCONTROLLER LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: develop an assembly language program for interfacing the peripherals and to perform the given task using 8085. (S2, K3)

CO2 : develop an embedded c program for Port onfiguration,timers,LCD,Keypad.ADC and control applications using PIC Microcontroller(S3, K3)

LIST OF EXPERIMENTS

1. Write and execute the assembly language program in 8-bit microprocessor
2. Write a program for interfacing button, LED, relay & buzzer as follows
   - when button 1 is pressed buzzer is turned ON and LED's start chase from left to right
   - when button 2 is pressed buzzer is turned OFF and LED start chase from right to left
3. Display message on LCD without using any standard library function.
4. Interfacing 4X4 keypad and displaying key pressed on LCD (or) on HyperTerminal.
5. Generate square wave using timer with interrupt
6. Interfacing serial port with PC both side communication.
7. Interfacing RTC chip using I^2C and display date and time using simulator
8. Interface analog voltage 0-5V to internal ADC and display value on LCD
9. Generation of PWM signal for DC Motor control.

P:30 TOTAL: 30 PERIODS

15EI57C LINEAR INTEGRATED CIRCUITS LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: demonstrate the characteristics of operational amplifier devices. (S3, K3)

CO2 : construct, test and implement the filters, power supply and oscillators using operational amplifier. (S3, K3)

CO3 : demonstrate the characteristics of multiplier and PLL. (S3, K3)

LIST OF EXPERIMENTS

1. Inverting, Non inverting and differential amplifiers.
2. Integrator and Differentiator.
3. Instrumentation amplifier
4. Active low-pass, High-pass and band-pass filters.
5. Digital to Analog converter and Analog to Digital converter (any one method).
6. Astable & Monostable multivibrators and Schmitt Trigger using op-amp.
7. Phase shift and Wien bridge oscillators using op-amp.
8. Astable and monostable multivibrators using NE555 Timer.
9. PLL characteristics and its use as Frequency Multiplier.
10. DC power supply using LM317 and LM723.

P: 30 TOTAL: 30 PERIODS

15EI58C **PROCESS CONTROL LABORATORY** **L T P C**
0 0 2 1

COURSE OUTCOMES

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

CO1 : record the dynamic behavior of process. (S2, K2)
CO2 : demonstrate the various components of process loop. (S3, K2)
CO3 : interpret the closed loop response of real time process. (S2, K2)
CO4 : construct the controller using tuning parameter. (S2, K4)

LIST OF EXPERIMENTS

1. Dynamics of first and second order systems
2. Simulation of different order processes with and without transportation lag
3. Characteristics of various transmitters
4. Realization of on/off controller with neutral zone using operational amplifier
5. Realization of PID controller using operational amplifier
6. Characteristics of control valve with and without positioner
7. Closed loop response of flow control loop
8. Closed loop response of level control loop
9. Closed loop response of temperature control loop
10. Closed loop response of pressure control loop
11. Tuning of controllers
12. Study of complex control system (ratio / cascade / feed forward)

P: 30 TOTAL: 30 PERIODS

15EI61C **LOGIC AND DISTRIBUTED CONTROL SYSTEM** **L T P C**
(Common to EIE and EEE) **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: explain the instructions used in PLC. (K2)
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 INSTRUCTIONS 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 acquisition system - Application of PLC - Case study of bottle filling system, traffic light control system – Industrial Applications: 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”, McGraw Hill, 3rdEdition, 2009.
2. Michael P. Lukas, “Distributed Control System”, Van Nostrand Reinhold Co., Canada, 2007.

REFERENCES

1. T. Hughes, “Programmable Logic Controllers”, ISA press, 2007.
2. Krishna Kant, “Computer based Industrial Control”, Prentice Hall, New Delhi, 2005.
3. http://nptel.ac.in/courses/108106022
4. M. Chidambaram, “Computer Control of Processes”, Narosa Book Distributors Pvt. Ltd., 2009.

15EI62C TESTING AND CALIBRATION OF INSTRUMENTS L T P C

3 0 0 3

COURSE OUTCOMES

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

CO1 : explain key terms related to testing and calibration.(K2)
CO2 : illustrate the test measurement instrumentation system.(K2)
CO3 : explain the testing procedures for industrial instruments.(K2)
CO4 : summarize the procedures related to calibration requirements. (K2)
CO5 : explain the calibration services of different laboratories.(K2)

UNIT I INTRODUCTION TO TESTING AND CALIBRATION 9

The Signal Flow of Electronic Instruments, The Instrument Block Diagram, Measurement Systems, Types of instrument, Traceability, Calibration Types, Calibration Requirements, Calibration Methodology, Instrument Specifications and Calibration Tests, Calibration Standard Requirements.

UNIT II TEST MEASUREMENT INSTRUMENTATION 9

Test Measurement Instrumentation, Process Instrumentation, Test Objective-Requirements and limitations, Test Data - Format and Analysis

UNIT III TESTING OF INSTRUMENTS 9

Voltage-Voltmeter, Current - Ammeter and Resistance - Ohmmeter, Temperature - Thermocouple, Pressure - Primary pressure sensing elements-Diaphragm, Bourdon tube

UNIT IV CALIBRATION REQUIREMENTS 9

Calibration procedure, calibration procedure content, calibration datasheet, Instrument Specification Forms, Project Specifications, Manufacturer's Specifications, Calibration Intervals, Safety Considerations, Calibration Status Labels

UNIT V CALIBRATION STANDARDS 9

National Measurement Standard Laboratories, Commercial Calibration Services, standards in different National Laboratories and Bureaus, calibration management and maintenance.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Mike Cable, "Calibration - A technician's guide", ISA, 2005.
2. Vaisala Oyj, "Calibration Book", Calibration book project team, 2006.

REFERENCES

1. Clyde F.Coombs Jr, "Electronic Instrument Handbook", 3rd Edition, 2008.
2. M/s. Beamex OYED, Fram in Vaasa, Finland, 2nd Edition, 2012.

15EI63C BIOMEDICAL INSTRUMENTATION L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: explain the organs of Nervous, cardio vascular and respiratory system of human body and sensors for biomedical applications. (K2)

CO2: distinguish the principles of electro physiological measurement systems of different physiological parameters. (K2)

CO3 : explain the working of non-electrical physiological measurement. (K2)

CO4 : illustrate the principles of imaging and telemetry systems. (K2)

CO5 : explain the working of rehabilitation and assisting devices. (K2)

UNIT I PHYSIOLOGY AND TRANSDUCERS 9

Cell and its structure – Resting and Action Potential – Propagation of action potential – Nervous system : Nerve cell – synapse – CNS- PNS-Electro physiology of heart and lungs- Mechanism of Hearing, Sound Conduction System – Anatomy of Eye – Introduction to biosensor and types.

UNIT II ELECTRO-PHYSIOLOGICAL MEASUREMENT 9

General block diagram of Biomedical Instrumentation system – Electrodes: Micro, needle and surface electrodes – Isolation amplifier- ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms. Electrical safety in medical environment: shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT III NON-ELECTRICAL PARAMETER MEASUREMENT 9

Measurement of blood pressure –blood flow- Cardiac output – Heart rate – phonocardiography – Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – measurement of partial pressure of CO_2 and O_2 in blood - Introduction to ESR, GSR measurements.

UNIT IV MEDICAL IMAGING AND TELEMETRY 9

Radiographic and fluoroscopic techniques – Instrumentation in Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Introduction to PET and SPECT – Introduction to telemedicine and Body Area Network

UNIT V REHABILITATION AND LIFE ASSISTIVE DEVICES 9

Rehabilitation: Definition, Introduction to Concept of Rehabilitation, Types of rehabilitation: Sensory and Motor rehabilitation. Types and working of Pacemakers – Defibrillators – Diathermy – Heart Lung machine.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. R.S.Khandpur, “Hand Book of Bio-Medical Instrumentation”, Tata McGraw Hill Publishing Company Limited, 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, “Bio-Medical Instrumentation and Measurements”, Pearson Education, 2nd Edition, PHI 2002.

REFERENCES

1. Robinson C.J., “Rehabilitation Engineering” (CRC Press) 1995.
2. Ballabio E., “Rehabilitation Technology” (IOS Press) 1993.
3. M.Arumugam, “Bio-Medical Instrumentation”, Anuradha Agencies, 2006.
4. L.A. Geddes and L.E.Baker, “Principles of Applied Bio-Medical Instrumentation”, John Wiley & Sons, 2008.
5. J.Webster, “Medical Instrumentation Application and Design”, 4th Edition, Wiley, 2009.
6. Mehmet R.Yuce, Jamil Y.Khan, “Wireless Body Area Network – Technology, Implementation and Applications”, Pan Stanford Publishing Pvt. Ltd., 2011.

15EI64C **ROBOTICS AND AUTOMATION** **L T P C**
3 0 0 3

COURSE OUTCOMES

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

CO1:explain the parts and configurations of a robot. (K2)
CO2 : discuss the different types of sensor and drive systems. (K2)
CO3 : summarize the types of robot end effector and its dynamics . (K2)
CO4 : explain manipulator kinematics and programming languages. (K2)
CO5 : describe the function of robot and automation in industrial activities. (K2)

UNIT I INTRODUCTION 9

Robot- Definition – Asimov's laws of robotics - co-ordinate systems, work envelope, types and classification – specifications – pitch, yaw, roll, joint notations, speed of motion, pay load, resolution, repeatability and accuracy – Robot parts and their functions – need for robots.

UNIT II SENSORS AND DRIVES 9

Principles and applications: Types of sensor - tactile sensors - proximity and distance sensors.- position, velocity, and acceleration sensors - force and torque sensors - photoelectric sensors - Sensor data processing - Machine vision system – Robot drive systems: Pneumatic drives-Hydraulic drives – mechanical drives – electrical drives.

UINT III MANIPULATOR AND GRIPPERS 9

Manipulator Dynamic – Euler's and Lagrangian formulation - force control - Types of end effectors: Mechanical gripper and gripper mechanism - end effector interfaces - design consideration of gripper.

UINT IV MANIPULATOR KINEMATICS 9

Manipulator Kinematics – link description, link connection, affixing frames to links, manipulator kinematics, Examples: Kinematics of one industrial robot - Introduction to inverse manipulator kinematics - Robot programming languages.

UNIT V INDUSTRIAL APPLICATIONS 9

Material Transfer - Material handling, loading and unloading - Processing – spot, continuous arc welding and spray painting - Assembly and Inspection – robot in healthcare.

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

1. Mikell P Groover, "Industrial Robotics - Technology, Programming and Applications", McGraw Hill, 2008.
2. J. J. Craig, "Introduction to Robotics, Mechanics and Control", Pearson Prentice Hall, 3rd edition, 2005.

REFERENCES

1. R. J. Schilling, "Fundamentals of Robotics Analysis and Control", Prentice Hall, 2007.
2. Saeed B. Niku, "Introduction to Robotics Analysis, Systems, Applications", Prentice Hall of India / Pearson Education, Asia, 2nd Edition 2010.

15EI65C VIRTUAL INSTRUMENTATION LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1 : build simple experiments on icons/controls available in virtual instrumentation software. (S3, K3)

CO2 : develop experiments on Data Acquisition using virtual instrumentation software. (S3,K3)

CO3 : construct fundamentals of Electronic Circuits and Devices using virtual instrumentation suite. (S4, K3)

CO4 : develop simple experiments on Control System using Control Design and Simulation. (S3, K3)

LIST OF EXPERIMENTS

1. Creating Virtual Instrumentation for simple applications.
2. Programming exercises for loops and charts.
3. Programming exercises for clusters and graphs.
4. Programming exercises on case, sequence structures and file Input / Output.
5. Data acquisition through Virtual Instrumentation
6. Exercise on fundamental electronic circuits using circuit simulation software and virtual instrumentation suite.
7. Exercise on Thevenin's equivalent circuit, Transient response of First and Second order circuits using circuit simulation software.
8. Programming exercise for fundamentals of control system using Control Design and Simulation module
9. Programming exercises on Time Domain and Frequency Domain response of First and Second Order System.
10. Design of PID Controller using Control Design and Simulation.

P:30 TOTAL: 30 PERIODS

15EI66C INDUSTRIAL AUTOMATION LABORATORY L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1 : design an on/off controller (S3, K3)

CO2 : construct a ladder program for real time process (S3, K4)

CO3 : create the functional diagram for various process in DCS (S2, K2)

LIST OF EXPERIMENTS

1. Design of Electronic on/off controller with relay concept and ELVIS
2. Microprocessor based temperature control system
3. Batch process control using Programmable Logic Controller
4. Level Process using Programmable Logic Controller

5. Reaction vessel control using Programmable Logic Controller
6. Automation of Traffic Light Control using Programmable Logic Controller
7. Automation of Bottle filling system using Programmable Logic Controller
8. Computer controlled closed loop response of Temperature process
9. Computer controlled closed loop response of Pressure process
10. Implementation of Controller for Temperature and Pressure process in Distributed Control System
11. Simulation of logical control scheme for the Cement Plant and Beverage Plant using Distributed Control system
12. Implementation of any control loop using SCADA system

P :30 TOTAL : 30 PERIODS

15EI67C 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

15EI68C COMPREHENSION

L	T	P	C
0	0	2	1

COURSE OUTCOMES

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

CO1: apply the knowledge acquired during the academic programme to real – life problems.(K3)

Two periods per week shall be allotted in the time table for the activity and this period shall be utilized by the student to receive guidance from the members of faculty on solving

real-life problems, practice solving these problems and on group discussions, seminar presentations, library reading as assigned by the faculty member in-charge. The continuous assessment and end semester evaluation may be carried out as specified in the guidelines to be issued from time to time, for which.

1. Two written tests of objective type question from the courses up to 6th semester may be conducted.
2. Seminars on latest topics may be conducted
3. Oral Exams on G.K, Technical knowledge, reasoning, may be conducted
4. Group discussions may be conducted

P: 30 TOTAL: 30 PERIODS

15EI71C	PROJECT MANAGEMENT AND FINANCE **(Common to all Programmes)**	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 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 MAXIMIZING PARTICIPATION 9

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 CONTROL OF PROJECTS 9

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

REFERENCES

1. Gido, "Effective project management", 3rd Edition, Cengage Learning, 2008.
2. Gray and Larson, "Project Management: The Managerial Process", 3rd Edition, TMH, 2010.
3. Choudhury S, "Project Management", 1st Edition, Tata Mc Graw Hill Publishing Co., 2007.

15EI72C IOT 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 benefits and architecture of IoT.(K2)
CO2 : explain the various hardware components of IoTand Interfacing devices.(K2)
CO3 : Interpret different communication devices and IoT Protocols(K3)
CO4 : interface the sensor and actuator in ARDUINO board. (K4)
CO5 : realize the applications of IoT (K2)

UNIT I INTRODUCTION 9

Definition of IoT :IoT key features, advantages and disadvantages,IoT- A Survey, Trends in the Adoption of the IoT, The Internet of things today, the internet of things tomorrow, The importance of IoT in Society : Societal benefits of IoT , Risk, Privacy and Security, IoT Architecture, Industrial IoT, Internet of Everything

UNIT II IOT-HARDWARE AND INTERFACE DEVICES 9

Major components of IoT devices, IoT devices VS Computers, smart wearable devices, standard devices, Interface devices to IoT-RFID, Zigbee, WIFI, GSM, Mobile Internet, Bluetooth and Ethernet.

UNIT III COMMUNICATION DEVICES AND PROTOCOLS 9

Communication Devices: UART,USART,SPI,I2 and, USB -IoT Protocols: MQTT, CoAP, AMQP, Websocket, Node, and CAN Protocol-Industrial automation using IoT.

UNIT IV INTERFACING WITH ARDUINO 9

ARDUINO environment – ARDUINO programming – Debugging, ARDUINO – Basic circuits & wiring to build a circuit – Interfacing Sensors and Actuators.

UNIT V IOT APPLICATIONS 9

Home automation, Smart Buildings and infrastructure, Smart Cities, Environment, Energy, Agriculture, Smart Mobility and Transport, Smart Health, Industry, Food and water Tracking and Security.

L:45; TOTAL:45 PERIODS

REFERENCES

1. Internet of Things – From Research and Innovation to market deployment byOvidiuVermesan& Peter Fries – River Publisher 2014 edition.
2. Building Internet of Things with the Arduino (Volume 1) by Charalampos Doukas, CreateSpace Independent Publishing Platform, 2012.
3. Internet of Things (A Hands-on-Approach) by *ArshdeepBahga and Vijay Madisetti,* Orient Blackswan Private Limited - New Delhi; First edition (2015).
4. An Introduction to Programming the Internet of Things (IOT) Specialization-Course era-https://www.coursera.org/specializations/iot.
5. http://web.cs.wpi.edu/~rek/IoT/Fall2015.html
6. www.tutorialspoint.com

15EI73C MINI PROJECT L T P C
0 0 8 4

COURSE OUTCOMES

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

CO1: select a project and able to work in a team leading to development of hardware / software product. (K4)

CO2 : Prepare a technical report and present the ideas with clarity. (K3)

- 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 review the activities and the marks are awarded as follows:
- Report (40%), Presentation (30%) and oral Examination (30%)

P: 120 TOTAL: 120 PERIODS

15EI74C 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)

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

15EI81C 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. (K4)

CO2 : Prepare a good technical report and present the ideas with clarity. (K3

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

15EI82C 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 : explain the concepts and working principle of various industrial elements. (K2)
CO2 : explain the problem related to industries. (K2)

INTERNSHIP (1 to 4 Credits)

- Internship undergone in R&D organization, reputed institution.

INPLANT TRAINING (2 to 4 Credits)

- Training undergone in industries and also in R&D organization are considered as inplant training.

Duration : 2 to 4 weeks
Assessment : Inplant Training Report (40%)
Students Presentation (40%)
Oral Examination (20%)

P: 60 TOTAL: 60 PERIODS

15EI01E MECHATRONICS L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1 : illustrate the concepts of mechatronics elements.(K2)
CO2 : explain the different actuation systems in mechatronics.(K2)
CO3 : Identify the controllers for mechatronics application.(K2)
CO4 : develop program using programmable logic Controllers.(K2)
CO5 : describe the applications of mechatronics system.(K2)

UNIT I INTRODUCTION TO MECHATRONICS ELEMENTS 9

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity: Motion, Force, Pressure, Liquid, Light Sensors – Selection of Sensors.

UNIT II DRIVES AND MECHANISMS OF AUTOMATED SYSTEM 9

Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – Stepper Motors-switching circuits for stepper motor – AC and DC Servo motors

UNIT III SYSTEM MODELS AND CONTROLLERS 9

Building blocks of Electrical and Thermal Systems, Rotational – Translational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.

UNIT IV PROGRAMMING LOGIC CONTROLLERS 9

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics– Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC.

UNIT V APPLICATION OF MECHATRONICS SYSTEM 9

Stages in designing Mechatronics systems – Traditional and Mechatronic Design – Possible Design Solutions. Case studies of Mechatronics systems – Pick and place Robot – Autonomous mobile robot – Wireless surveillance balloon – Engine Management sustem – Automatic Car park barrier.

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

1. K.P. Ramachandran, Wiley, “Mechatronics”, Integrated Mechanical Electronics System, India Pvt. Ltd. New Delhi, 2014
2. Bolton, “Mechatronics - A Multidisciplinary approach”, 4th Edition, Prentice Hall, 2009.

REFERENCES

1. Rajput. R.K, “A textbook of mechatronics”, S. Chand & Co, 2007.
2. Michael B. Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 2000.
3. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, “Mechatronics”, Chapman an d Hall, 1993.
4. Dan Necsulesu, “Mechatronics”, Pearson Education Asia, 2002 (Indian Reprint).
5. Lawrence J. Kamm, “Understanding Electro – Mechanical Engineering”, An Introduction to Mechatronics, Prentice Hall of India Pvt., Ltd., 2000
6. Nitaigour Premchand Mahadik, “Mechatronics”, Tata McGraw-Hill publishing Company Ltd, 2003

15EI02E MEMS AND NANOTECHNOLOGY L T P C

3 0 0 3

COURSE OUTCOMES

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

CO1 : illustrate the various concepts of micro system. (K2)

CO2 : explain the working of different sensors and its actuation. (K2)

CO3 : compare the different micro devices. (K2)

CO4 : classify the nano Structures and its properties. (K3)

CO5: explain the different characterization techniques of nano materials. (K2)

UNIT I MEMS: MICRO-FABRICATION, MATERIALS AND ELECTROMECHANICAL CONCEPTS 9

Definition – historical development – properties, design and fabrication micro-system, microelectronics, working principle, applications and advantages of micro system- Conductivity of semiconductors-Crystal planes and orientation-stress and strain flexural beam bending analysis-torsional deflections-Intrinsic stress - resonant frequency and quality factor.

UNIT II SENSORS AND ACTUATORS 9

Principle, material, design and fabrication of parallel plate capacitors as electrostatic, PZT sensors and actuators-Principle, material, design and fabrication of thermocouples, thermal resistor sensors.

UNIT III MICRO DEVICES 9

Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measurands - displacement sensors, pressure sensor, flow sensors, Accelerometer, chemical and bio sensor - sensitivity, reliability and response of micro-sensor - micro actuators – applications.

UNIT IV SCIENCE AND SYNTHESIS OF NANO MATERIALS 9

Classification of nano structures – effect the nanometer length scale - effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. Fabrication methods – Top down process – bottom up process.

UNIT V CHARACTERIZATION OF NANO MATERIALS 9

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, diffraction techniques, Mechanical, Magnetic and thermal properties – Nano positioning systems-Applications of nano sensors in medical and industries

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2012.
2. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003.
3. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003.

REFERENCES

1. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. Mark Madou , Fundamentals of Microfabrication, CRC Press, New York, 1997.
3. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN : 8493-9138-5
4. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc., 2013, ISBN: 978-93-82291-39-8.

15EI03E **DIGITAL IMAGE PROCESSING** **L T P C**
3 0 0 3

COURSE OUTCOMES

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

CO1: describe the image fundamentals and mathematical transforms necessary for image processing. (K2)
CO2 : explain the image enhancement techniques. (K2)
CO3 : describe image restoration procedures. (K2)
CO4 : explain the image compression procedures. (K2)
CO5 : explain the image segmentation and representation techniques. (K2)

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Elements of digital image processing systems, Vidicon and Digital Camera working principles, elements of visual perception, brightness, contrast, hue, saturation, mach band effect, color image fundamentals – RGB, HIS models, Image sampling, Quantization.

UNIT II IMAGE ENHANCEMENT 9

Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contraharmonic mean filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration - degradation model, Unconstrained restoration - Lagrange multiplier and Constrained restoration, Inverse filtering - removal of blur caused by uniform linear motion, Wiener filtering, Geometric transformations – spatial transformations.

UNIT IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation - Region growing – Region splitting and Merging – Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding Vector Quantization, Transform coding, JPEG standard, MPEG.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Rafael C.Gonzalez, Richard E.Woods, “Digital Image Processing”, 2nd Edition, Pearson, 2004.
2. Anil K.Jain, “Fundamentals of Digital Image Processing”, 2nd Edition, Pearson, 2002.

REFERENCES

1. Kenneth R.Castleman, “Digital Image Processing”, Pearson, 2006.
2. Rafael C.Gonzalez, Richard E.Woods, Steven Eddins, “Digital Image Processing using MAT LAB”, Pearson Education, Inc 2004.
3. William K.Pratt, “Digital Image Processing”, John Wiley, New York, 2002.
4. Milan Sonka et al, “Image Processing, Analysis and Machine Vision”, Brookes/Cole, Vikas Pubishing House, 2nd Edition, 1999.

15EI04E **EMBEDDED SYSTEMS** **L T P C**
3 0 0 3

COURSE OUTCOMES

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

CO1 : illustrate the basic concept of embedded systems.(K2)
CO2 : explain the embedded system development. (K2)
CO3 : apply the suitable embedded protocol for different applications.(K3)
CO4 : distinguish real time tasks and scheduling concepts. (K3)
CO5 : describe ARM processor. (K2)

UNIT I INTRODUCTION TO EMBEDDED SYSTEM 9

Model of an Embedded System-Microprocessor Vs Microcontroller - Figures of Merit for an Embedded System-Classification of Microcontroller unit: 4/8/16/32Bits-Current Trends-The Hardware Point of View: Microcontroller unit - 8-bit Microcontroller unit - Memory for Embedded System-Low Power Design - Pullup and Pull down resistors-Applications of embedded system: Mobile phone, ABS, MRI, Modern Wheel Chair

UNIT II EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

UNIT III EMBEDDED NETWORKING 9

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

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS - Real time Tasks - Real time systems-Types of Real time Tasks-Real time Operating Systems - Real time Scheduling Algorithms - Rate Monotonic Algorithm - The Earliest Deadline First Algorithm - Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking - Inter process Communication -priority inversion- priority inheritance- comparison of Real time Operating systems: Vx Works, PSOS, RT Linux.

UNIT V ARM PROCESSOR 9

Block diagram-features of the LPC 214X family – peripherals - ARM9 -ARM Cortex M3.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Rajkamal, 'Embedded System-Architecture, Programming, Design', McGraw Hill, 2013.
2. Peckol, "Embedded system Design", John Wiley & Sons, 2010.
3. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013.

REFERENCES

1. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill, 2009.
2. Elicia White," Making Embedded Systems", O' Reilly Series,SPD, 2011.

3. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.
4. Han-Way Huang, ”Embedded system Design using C8051”, Cengage Learning, 2009.
5. Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.

15EI05E **VLSI DESIGN** **L T P C**

(Common to EEE and EIE) **3 0 0 3**

COURSE OUTCOMES

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

CO1 : illustrate the basic concepts in MOS and VLSI Technology. (K2)
CO2 : explain the design process of MOS Technology. (K2)
CO3 : develop subsystem and layout in VLSI circuits. (K3)
CO4 : discuss the concepts of Arithmetic building Blocks. (K2)
CO5 : model the digital system using Verilog HDL. (K3)

UNIT I MOS TECHNOLOGY 9

Introduction to IC Technology- MOS and VLSI Technology - MOS transistors: Enhancement and Depletion mode transistor actions - Fabrication of NMOS, CMOS and BiCMOS transistors - Thermal aspects of processing - BiCMOS Technology - Production of E beam Masks-MOS electrical properties: IDS Vs VDS relationships, Threshold voltage-Trans conductance Vs Output conductance and Pull up to pull down ratio determination-BiCMOS Inverters-Latch up in CMOS circuits

UNIT II DESIGN PROCESSES AND SCALING EFFECTS 9

MOS and BiCMOS circuit design: Stick diagrams- Lambda based design rules-Layout diagrams - Scaling models - Scaling factors for device parameters - Limitations of scaling-Limits due to sub threshold currents-Limits on logic levels and supply voltage due to noise

UNIT III SUBSYSTEM DESIGN AND LAYOUT 9

Switch logic-GATE logic: Two input nMOS, CMOS and BiCMOS, NAND, AND, NOR gates -Combinational logic: Parity generator- Multiplexers-Clocked sequential circuits: Two phase clocking-Charge storage-Register elements and Shift register-System considerations: Bus lines arrangements-Pre-charged bus concepts-Power dissipation and Power distribution buses.

UNIT IV ARITHMETIC BUILDING BLOCKS 9

Data path circuits, Architecture for ripple carry adders, carry look ahead adders, high speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff.

UNIT V SPECIFICATION USING VERILOG HDL 9

Design Methodologies – Modules – Instances – Test bench – Operators – Number Specification – Identifiers and Keywords – Data Types – Modules and Ports – Gate-Level Modeling - Dataflow Modeling – Behavioral Modeling- Gate level/Dataflow description of decoder, equality detector, comparator, priority encoder, half adder, full adder, Ripple

carry adder, Behavioral modeling of D flip-flop, T flip-flop, Asynchronous counter, shift register

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. D.A.Pucknell, K.Eshraghian, "Basic VLSI Design", 3rd Edition, Prentice Hall of India, New Delhi, 2008.
2. Weste and Harris, "CMOS VLSI DESIGN: A Circuit and Systems Perspective", 3rd Edition, Pearson Education, 2007. (4th Reprint)
3. Samir Palnitkar, "Verilog HDL, A Guide to Digital Design and Synthesis" 2nd Edition, Pearson Education, 2005.

REFERENCES

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", PHI, 2nd Edition, 2003
2. Wayne Wolf, "Modern VLSI design", Pearson Education, 3rd Edition, 2007.
3. Uyemura J.P, "Introduction to VLSI circuits and systems", Wiley, 2002.
4. Ciletti, "Advanced Digital Design with the Verilog HDL", Prentice Hall of India, 2010

15EI06E MEDICAL INFORMATICS L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1 : classify various informatics system in medical field. (K3)
CO2 : explain different components of computerized Patient Record. (K2)
CO3 : explain the applications of computer in medical field. (K2)
CO4 : discuss the different computer assisted medical decision making system. (K2)
CO5 : explain the advance system in medical informatics. (K2)

UNIT I MEDICAL INFORMATICS 9

Introduction - Structure of Medical Informatics –Internet and Medicine - Security issues Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, e-health services, Health Informatics – Medical Informatics, Bioinformatics

UNIT II COMPUTERISED PATIENT RECORD 9

Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology - Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT III APPLICATIONS OF COMPUTERS IN MEDICAL FIELD 9

Automated clinical laboratories-Automated methods in hematology, Chromosome analysis by computer, Automated scanning for Cervical Cancer, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, Computer for Critically Ill / differently abled, Healthcare Information system.

UNIT IV COMPUTERISED MEDICAL DECISION-MAKING 9

Neuro computers and Artificial Neural Networks application, Expert system – General model of CMD, Computer –assisted decision support system-production rule system cognitive model, semester networks, decisions analysis in clinical medicine-computers in the care of critically patients-computer assisted surgery-designing.

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery computer aids for the differently abled, computer assisted instrumentation in Medical Informatics - Computer assisted patient education and health - Medical education and health care information.

L: 45 TOTAL: 45 PERIODS

TEXTBOOKS

1. Lele.R.D., Computers in medicine progress in medical informatics, Tata McGraw-Hill Publishing computers Ltd, New Delhi, 2005.
2. Mohan Bansal, Medical informatics, Tata McGraw-Hill, New Delhi, 2003.

REFERENCE

1. Dinesh Bhatia, Medical Informatics, PHI Learning Private Limited, Delhi, 2015.

15EI07E DIGITAL SIGNAL PROCESSING AND ANALYSIS L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: represent the signlas in transform-domain (Fourier and Z-transforms) (K2)
CO2: compute the discrete fourier transform of a system using FFT (K2)
CO3: design different types of digital filters (K2)
CO4: explain the application of digital signal processing. (K2)

UNIT I SIGNALS AND SYSTEMS 9

Basic elements of DSP – concepts of frequency in Analog and Digital Signals–sampling theorem –Discrete – time signals, systems – Analysis of discrete time LTI systems–Z transform – Convolution (linear and circular) – Correlation.

UNIT II FREQUENCY TRANSFORMATIONS 9

Introduction to DFT – Properties of DFT – Filtering methods based on DFT– FFT Algorithms Decimation–in–time Algorithms, Decimation–in–frequency Algorithms – Use of FFT in Linear Filtering.

UNIT III IIR FILTER DESIGN 9

Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (HPF,BPF, BRF) filter design using frequency translation

UNIT IV FIR FILTER DESIGN 9

Structures of FIR – Linear phase FIR filter – Filter design using windowing techniques, Frequency sampling techniques – Finite word length effects in digital Filters

UNIT V APPLICATIONS 9

Multirate signal processing – Speech compression – Adaptive filter – Musical sound processing – Image enhancement, Case study of TMS320C67xx.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, algorithms and applications" 4th Edition, Pearson Prentice Hall, 2007.
2. Salivahanan.S., Gnanpriya.C., " Digital Signal processing", McGraw Hill, 2011.

REFERENCES

1. Ifaeachor E.C,, Jervis B. W., " Digital Signal processing : Practical approach", Pearson publication, 2001.
2. Dr. Shaila Apte, "Digital Signal Processing" Wiley India Publication, 2nd Edition, 2013.
3. Navas.K.A., Jayadevan.R., " Lab Primer through MATLAB", PHI, 2014
4. Li Tan, Jean Jiang, "Digital Signal Processing: Fundamentals and applications" Academic press, 2013.

15EI13E POWER PLANT INSTRUMENTATION L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: explain concepts of Power Generation techniques. (K2)
CO2: outline different measurement and instrumentation principles used in power plant. (K2)
CO3: illustrate different concepts of Boiler control techniques. (K2)
CO4: explain various mechanism used in control of turbine. (K2)
CO5: illustrate the techniques of Instrumentation in Nuclear Power plant. (K2)

UNIT I INTRODUCTION TO POWER GENERATION 9

Power generation - types - importance of instrumentation in power plants - types and basic building block of all types of power plants - details of boiler processes - sub critical and supercritical boilers

UNIT II MEASUREMENTS & INSTRUMENTATION IN POWER PLANT 9

Watt Transducers - Measurement of water flow, air flow, steam flow – drum level measurement – steam pressure and temperature measurement- turbine speed and vibration measurement – flue gas analyser - dust monitor-dissolved oxygen analyser – chromatography.

UNIT III BOILER CONTROLS 9

Combustion Control-air/fuel ratio control - furnace draft control - drum level control - Main steam temperature control - Burners for liquid and solid fuels – burner management – Overview of control Valves-pneumatic-motorised

UNIT IV TURBINE CONTROL 9

Pressure Reducing Desuper heater (PRDS) control– turbine governing system – speed and load control–turbine lube oil system-Monitoring voltage and frequency –Operation of several units in parallel- Synchronization

UNIT V NUCLEAR POWER PLANT 9

Nuclear power plant instrumentation - P&I diagram - radiations detection instruments - process sensors - Spectrum Analyzer - nuclear reactor control systems and allied instrumentation.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Sam Dukelow. G "The control of Boilers", Instrument Society of America, 1991.
2. K.Krishnaswamy, M.Ponnibala, "Power Plant Instrumentation" 1st Edition, PHI Learning Pvt. Ltd., 2011.

REFERENCES

1. Anthony Lawrence Kohaz, "Boiler Operation Guide", 4th Edition, McGraw Hill, New Delhi, 1997.
2. Jain. R.K, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 1995.

15EI14E INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES L T P C

3 0 0 3

COURSE OUTCOMES

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

CO1: explain the exploration, recovery in petroleum industry. (K2)
CO2: discuss the various separation processes. (K2)
CO3: explain the procedures for obtaining various petroleum derivatives. (K2)
CO4: describe the working of modern measuring instruments for various parameters in petroleum refinery. (K2)
CO5: illustrate the control loops employed in petroleum industry. (K2)

UNIT I PETROLEUM PROCESSING 9

Petrochemical industry – Growth in India – Seismic and Electrical Petroleum exploration methods – Primary, Secondary and Enhancement Recovery techniques –Vertical, Horizontal and Double barrel type Separators – Processing of wet gases: Physical absorption and Chemical absorption – P&ID of a Petroleum Refinery.

UNIT II OPERATIONS IN PETROLEUM INDUSTRY 9

Thermal cracking – Catalytic cracking – Catalytic reforming – Polymerization – Alkylation – Isomerization – Production of ethylene, acetylene and propylene from petroleum.

UNIT III CHEMICALS FROM PETROLEUM PRODUCTS 9

Methane derivatives – Acetylene derivatives – Ethylene derivatives – Propylene derivatives

UNIT IV MEASUREMENTS IN PETROCHEMICAL INDUSTRY 9

Density: Gow-Mac Densitometer, Electromagnetic Suspension Densitometer - Viscosity: Capillary Extrusion Viscometer, Automatic Efflux Cup Viscometer - Estimation of Air, Water pollution and Solid wastes. Selection and maintenance of measuring instruments – Intrinsic safety of Instruments.

UNIT V CONTROL LOOPS IN PETROCHEMICAL INDUSTRY 9

Control loops: catalytic crackers, pyrolysis, polyethylene, vinyl chloride and PVC production units – pollution control practices in petrochemical sector.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Dr. Ram Prasad, “Petroleum Refining Technology”, Khanna Publisher, 1st Edition, 2000.
2. A.L. Waddams, “Chemicals from Petroleum”, Gulf Publishing Company, Book Division; 4th Edition, 1980.

REFERENCES

1. J.G. Balchan. and K.I. Mumme, “Process Control Structures and Applications”, Van Nostrand Reinhold Company, New York, 1988.
2. Austin G.T. Shreeves, “Chemical Process Industries”, McGraw Hill International Student Edition, Singapore, 1985.
3. B.G Liptak, “Instrumentation in Process Industries”, Chilton Book Company, 1994.
4. Pollution Control Technologies - Volume 3, ISBN: 978-1-84826-118-1 (eBook), ISBN: 978- 1-84826-568-4 (Print volume)

15EI15E AERONAUTICAL INSTRUMENTATION L T P C

3 0 0 3

COURSE OUTCOMES

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

CO1: discuss the principles and operation different aircraft systems. (K2)
CO2: explain the different airplane control systems. (K2)
CO3: describe the principles and operation of Engine systems. (K2)
CO4: explain the principle and operation of aircraft auxiliary systems. (K2)
CO5: explain the working of instruments used in aircraft system. (K2)

UNIT I AIRCRAFT SYSTEMS 9

Hydraulic systems - Study of typical workable system - components - Pneumatic systems - Advantages - Working principles - Typical Air pressure system – Brake system - Typical Pneumatic power system - Components, Landing Gear systems – Classification.

UNIT II AIRPLANE CONTROL SYSTEMS 9

Conventional Systems - fully powered flight controls - Power actuated systems – Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology.

UNIT III ENGINE SYSTEMS 9

Fuel systems for Piston and jet engines - Components of multi engines.Lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.

UNIT IV AUXILIARY SYSTEM 9

Basic Air cycle systems - Vapour Cycle systems, Evaporative vapour cycle systems - Evaporative air cycle systems - Fire protection systems, Deicing and anti icing systems.

UNIT V AIRCRAFT INSTRUMENTS 9

Flight Instruments and Navigation Instruments – Gyroscope - Accelerometers, Air speed Indicators – TAS, EAS - Mach Meters, Altimeters: Principle and operation - Study of various types of engine Instruments - Tachometers - Temperature gauges - Pressure gauges: Principle and operation.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. S.Nagabhashana, L.K.Sudha, “Aircraft Instrumentation and Systems”, L.K. International Publishing Limited, 2010.
2. McKinley J.L., and Bent R.D., “Aircraft Maintenance & Repair”, McGraw-Hill, 1993.

REFERENCES

1. Mckinley J.L. and Bent R.D., “Aircraft Power Plants”, McGraw-Hill, 1993.
2. Pallet E.H.J., “Aircraft Instruments & Principles”, Pitman & Company, 1993.
3. Treager S., “Gas Turbine Technology”, McGraw-Hill, 2002.
4. Pallet E.H.J “Aircraft Instruments”, Pearson, 2009.

15EI16E NON - DESTRUCTIVE TESTING L T P C

3 0 0 3

COURSE OUTCOMES

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

CO1: illustrate the Visual inspection and liquid penetrant testing procedures (K2)

CO2: explain the principles and procedures for ultrasonic and Acoustic emission testing of industrial components (K2)

CO3: compare the principles, procedures and Instrumentation used for non-destructive testing of ferromagnetic materials (K2)

CO4: classify the various sources and detectors used for the thermography and radiography techniques. (K2)

CO5: critically appraise the NDT techniques available and select the most appropriate one for a given situation/application. (K3)

UNIT I VISUAL INSPECTION AND LIQUID PENETRANT TESTING 9

Introduction: Comparison of Destructive and Non-Destructive Tests -Conditions for Effective Non-Destructive Testing

Visual Inspection:-Optical aids used for visual Inspection-Applications

Liquid Penetrant Testing: Physical Principles-Procedure for Penetrant Testing-Penetrant Testing Materials –Penetrant Testing Methods-Water washable and Post-Emulsifiable Method.

UNIT II ULTRASONIC AND ACOUSTIC EMISSION TESTING 9

Ultrasonic Testing: Principle- Ultrasonic Transducers-Flaw detection equipment-Modes of display- Variables affecting Ultrasonic Test-Pulse echo, through transmission and Angle Beam Testing- Applications, Advantages and Limitations.

Acoustic Emission Testing: Principle – Instrumentation –Advantages, Limitations and applications- Acoustic Emission testing of metal pressure vessels-Fatigue crack detection in Aerospace structures.

UNIT III MAGNETIC PARTICLE, EDDY CURRENT AND MAGNETIC FLUX LEAKAGE TESTING 9

Magnetic Particle Testing: Principle- magnetizing techniques- Procedure used for testing a component – Advantages, Limitations and applications

Eddy current Testing: Principles –Instrumentation for Eddy current testing – Inspection of ferromagnetic materials-Pulsed eddy current testing- Applications.

Magnetic Flux Leakage (MFL) Testing: Principle- Magnetizing and Demagnetizing methods – MFL sensors – Flaw detection and analysis in ferromagnetic specimen – advantages, Limitations and applications.

UNIT IV THERMOGRAPHY AND RADIOGRAPHY TESTING 9

Thermography: Principle- Detectors and Equipments for active thrermography –heating sources – applications-Thermal imaging for condition monitoring of Industrial Components

Radiography: Principle- Electromagnetic radiation sources – Radiographic imaging equipments various inspection techniques-Reading and interpretation of radiographs – safety in industrial radiography.

UNIT V INDUSTRIAL APPLICATIONS OF NON DESTRUCTIVE TESTING 9

Industrial Applications of Non Destructive Testing: Railways- Nuclear industry – Concrete structures -aircraft and aerospace industries –automotive industries-Selection of NDT methods –Codes, standards, specifications and Procedures.

L : 45 TOTAL : 45 PERIODS

TEXT BOOK

1. Baldev Raj, Jeyakumar, T., Thavasimuthu, M., “Practical Non Destructive Testing”, Narosa Publishing House, New Delhi, 2014.

REFERENCES

1. Charles J. Hellier, “Hand Book of Non-Destructive Evaluation”, The McGraw-Hill Companies, New York, 2012.
2. Christiane Maierhofer, Hans-Wolf Reinhardt and Gerd Dobmann, “Non-destructive evaluation of reinforced concrete structures”, Volume 2, CRC Press, New York, 2010.
3. Prasad J and C.G.K. Nair, “Non-Destructive Test and Evaluation of Materials”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
4. V.M. Malhotra and N.J. Carino, "Handbook On Nondestructive Testing of Concrete", Second Edition, CRC Press, New York, 2004.
5. Peter J. Shull “Non Destructive Evaluation: Theory, Techniques and Application”, Marcel Dekker, Inc., New York, 2002.

15EI17E SENSOR NETWORKS 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 wireless sensor networks. (K1)
CO2: explain the capabilities and limitations of the sensor nodes in a sensor network and demonstrate the basic networking philosophy. (K2)
CO3: illustrate the principles of digital communications over wireless channels and various routing mechanisms. (K2)
CO4: discuss the naming and addressing issues in networking. (K2)
CO5: explain the various applications of sensor networks in different facets of networking. (K2)

UNIT I INTRODUCTION 9

Introduction to Sensor Networks - Unique constraints and challenges – Advantages and applications of Sensor Networks - Sensor Taxonomy -Tracking multiple objects - Sensor models.

UNIT II SENSOR NODE HARDWARE AND NETWORK ARCHITECTURE 9

Single-Node Architecture - Hardware Components - Energy Consumption of Sensor Nodes - Operating Systems and Execution Environments: Programming paradigms and DPM - Network Architecture - Sensor Network Scenarios - Optimization Goals and Figures of Merit - Design principles - Gateway.

UNIT III COMMUNICATION PROTOCOLS 9

Physical layer, MAC Protocols- Fundamentals, S-MAC Protocol, IEEE 802.15.4 standard, Link layer protocol, DAQ, Zigbee, Bluetooth - Error control, framing, link management, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

UNIT IV DEPLOYMENT AND CONFIGURATION 9

Naming and Addressing-Assignment of MAC address, content based and geographic addressing, Localization and positioning- Single-hop and multihop localization, Coverage and deployment.

UNIT V SENSOR NETWORK TOOLS AND APPLICATIONS 9

Sensor Node Hardware – Berkeley Motes, Sensor network Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming - Mobile sensing systems: CarTel - Acoustic sensor networks : VoxNet - Camera-based sensor networks : Camera-based object tracking - Underwater sensor networks : Underwater MAC.

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

1. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks", John Wiley& Sons, 2007.
2. Feng Zhao, Leonidas Guibas, “Wireless Sensor Network”, Elsevier, 1st Edition, 2004.

REFERENCES

1. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
2. Mohammad Ilyas and ImadMahgoub, “Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems”, CRC Press, 2009.
3. http://nms.csail.mit.edu/~girod/ipsn08.pdf
4. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.84.7153& rep=rep1&type=pdf
5. http://www.mit.edu/~millitsa/resources/pdfs/marcal.pdf

15EI18E FIBRE OPTICS AND LASER INSTRUMENTS L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: explain the basic concepts of optical fibres and Laser fundamentals. (K2)
CO2: illustrate principles of optical fibres in Industrial applications. (K2)
CO3: summarize Industrial application of lasers. (K2)
CO4: explain the principle and application of hologram. (K2)
CO5: discuss the various Medical applications of Lasers. (K2)

UNIT I OPTICAL FIBRES AND LASER FUNDAMENTALS 9

Optical Fibres: Principles - Different types of fibres, fibre characteristics - losses - Connectors and splicers – Fibre termination - sources and detectors, Laser: Properties, Types, Modes, Resonator configuration – Q-switching and mode locking – Cavity damping

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9

Fibre optic sensors – Fibre optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

UNIT IV HOLOGRAM 9

Holography – Basic principle – Formation of Hologram, Holographic Process – Multiplex Hologram – White light reflection Hologram - Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components – Measurement of stress, strain and vibration by holography.

UNIT V MEDICAL APPLICATIONS 9

Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology- Laser Treatment of Vascular Lesions, Scars and Keloids, Tattoos.

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

1. J.M. Senior, “Optical Fibre Communication – Principles and Practice”, Prentice Hall of India, 2009.
2. J. Wilson and J.F.B. Hawkes, “Introduction to Opto Electronics”, Prentice Hall of India, 2001.
3. F. J Duarte, “Tunable laser applications 2nd Edition”, CRC press, Tailor and Francis group, 2009.

REFERENCES

1. G. Keiser, “Optical Fibre Communication”, McGraw Hill, 2008.
2. John F. Read, “Industrial Applications of Lasers”, Academic Press, 1997.
3. Monte Ross, “Laser Applications”, Academic Press, 1984.

15EI24E INDUSTRIAL DRIVES AND CONTROL L T P C

3 0 0 3

COURSE OUTCOMES

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

CO1: explain the fundamentals of electric drives and speed control characteristics. (K2)

CO2: explain the operation of the Converter with continuous and discontinuous modes. (K2)

CO3: describe the performance of closed loop speed control of a DC motor using DC Chopper.

CO4: illustrate various modulation techniques and single and three phase inverters. (K2)

CO5:describe the performance of converter fed and inverter fed motors for industrial applications. (K2)

UNIT I ELECTRICAL DRIVES 9

Components of Electric drive system, Types of Electrical Drives (DC and AC) speed – torque relation, steady state stability, methods of speed control, braking for DC motor – Multi quadrant operation, Speed torque relation of AC motors, Methods of speed control and braking for Induction motor.

UNIT II CONVERTER FED DC DRIVES 9

Separately excited DC motors – single phase semi converter, single phase full converter for continuous - discontinuous modes of operation-Three phase semi converter - Three phase full converter for continuous, discontinuous modes of operation- Multiquadrant operation of fully-controlled rectifier-fed motor - ZCS and ZVS resonant converters.

UNIT III CHOPPER FED DC DRIVES 9

Principle of operation of the chopper – Four quadrant chopper circuit, closed loop operation - speed controlled drive system – current control loop – pulse width modulated current controller - modeling of current controller – design of current controller.

UNIT IV PWM INVERTERS (SINGLE-PHASE &THREE-PHASE) 9

Principle of operation – single phase bridge inverter – evaluation of output voltage and current with resistive, inductive and capacitive loads – Voltage control of single phase inverters – single PWM – Multiple PWM – sinusoidal PWM – modified PWM – Advanced modulation techniques. Three phase inverters – analysis of 180 degree and 120 degree conduction – voltage control of three phase inverters - Current source inverter - Resonant Pulse Inverters: series-resonant inverter frequency response, parallel-resonant inverters, voltage control of resonant inverters, , resonant DC-link inverters.

UNIT V APPLICATIONS 9

Digital techniques in speed control – Advantages and limitations – Microprocessor / Microcontroller and PLC based control of drives – Selection of drives and control schemes for Steel rolling mills – Paper mills – Cement mills – Machine tools – Lifts and Cranes – Solar and battery powered drives.

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

1. G. K. Dubey, “Fundamentals of Electrical Drives”, Narosa Publishing House, 2nd Edition, 2015.
2. R. Krishnan, “Electric motor drives: Modeling, analysis and control” Pearson education, 2005.

REFERENCES

1. Mohan, Undeland, Robbins “Power Electronics: Converters, Applications and design”, John Wiley & Sons,3rd Edition, 2007.
2. Bimal K. Bose, “Modern power electronics and AC drives” Pearson Education, 2005.
3. Werner Leonard, “Control of electrical drives”,Springer-Verlag,3rd Edition,2006.
4. http://electrical-all.blogspot.in/p/power-electronics-basics.html
5. http://en.wikipedia.org/wiki/Inverter%28electrical%29

15EI25E SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL 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 model structures for a system. (K2)
CO2: apply the Non parametric methods to identify the system model.(K3)
CO3: explain the different parameter estimation methods for a system. (K2)
CO4: explain the different adaptive controller system. (K2)
CO5: apply the adaptive mechanism for real time process.(K3)

UNIT I MODELS FOR IDENTIFICATION 9

Models of LTI systems**:**A family of transfer function model -State space model - Distributed parameter model - Models for Time-varying and Non-linear systems**:**Linear time varying models – Non-linear state-space models-Black box models

UNIT II NON PARAMETERIC METHODS AND MODEL VALIDATION 9

Non Parameter Methods: Transient response and Correlation Analysis – Frequency response analysis – Spectral Analysis - Model structure selection based on Preliminary data analysis – Model validation

UNIT III PARAMETER ESTIMATION 9

Prediction error approach – Frequency domain expressions for the asymptotic variance - Correlation approach - Recursive Least Square –Recursive IV methods –Maximum Likelihood – Instrumental Variable methods.

UNIT IV ADAPTIVE COTROL AND ADAPTATION TECHNIQUES 9

Auto tuning – Self tuning Regulators (STR) – Model Reference AdaptiveControl (MRAC) – Types of STR and MRAC – Different approaches to self tuning regulators –Stochastic Adaptive control – Gain Scheduling.

UNIT V CASE STUDIES 9

Inverted Pendulum, Aircraft Flight Control, Process control application: Heat exchanger, Distillation column, Wind mill application, Ship steering control.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Ljung, “System Identification Theory for the User”, PHI, 2008.
2. Astrom and Wittenmark, “Adaptive Control”, Pearson Education, 2009

REFERENCES

1. TorstenSoderstrom, PetreStoica, “System Identification”, Prentice Hall International (UK) Ltd, 1994.
2. Narendra and Annasamy, “Stable Adaptive Control Systems”, Prentice Hall, Dover Edition 2005.

15EI26E INTELLIGENT CONTROLLERS L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: describe the architecture of intelligent control system. (K2)
CO2: compare the various architecture of neural networks. (K2)
CO3: explain the basic concept and optimization techniques in genetic algorithms. (K2)
CO4: illustrate the concept of fuzzy set theory and its architecture. (K2)
CO5: apply fuzzy logic controller to simple applications. (K3)

UNIT I INTRODUCTION 9

Approaches to intelligent control – Architecture for intelligent control – Symbolic reasoning system - rule-based systems – conventional AI to computational intelligence – AI approach – Knowledge representation. Expert systems – evolutionary computation – characteristics of soft computing.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Concept of Artificial Neural Networks and its basic mathematical model – McCulloch Pitts - neuron model – simple perceptron – Adaline and Madaline – Feed-forward Multilayer Perceptron - Learning and training the neural network. Hopfield network – Self-organizing network and Recurrent network – Neural Network based controller.

UNIT III GENETIC ALGORITHM 9

Basic concept of Genetic algorithm and algorithmic steps – adjustment of free parameters – Solution of typical control problems using genetic algorithm - tabu search – ant colony search techniques for solving optimization problems - PID controller tuning.

UNIT IV FUZZY LOGIC SYSTEM 9

Introduction to crisp sets and fuzzy sets – basic fuzzy set operation and approximate reasoning – Introduction to fuzzy logic modeling and control – fuzzification – inferencing and defuzzification - fuzzy knowledge and rule base- fuzzy modeling and control schemes for linear systems – Self organizing fuzzy logic control – fuzzy logic control for linear time-delay system.

UNIT V APPLICATIONS 9

Fuzzy logic control – Case studies: Inverted pendulum – Home heating system – Blood pressure during anesthesia – Identification and control of linear dynamic systems – Cart and Pole System with a varying pole length.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Padhy.N.P., “Artificial Intelligence and Intelligent System”, Oxford University Press, 2005.
2. Kosk.O.B., "Neural Networks and Fuzzy Systems", 10th Edition, Prentice-Hall of India Pvt. Ltd., 2005.

REFERENCES

1. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 2005.
2. Zimmerman H.J., "Fuzzy set theory and its Applications" - Kluwer Academic Publishers, 2005.
3. Klir G.J. and Folger T.A., "Fuzzy sets, uncertainty and Information", Prentice-Hall of India Pvt. Ltd., 2007.
4. Goldberg D.E., “Genetic algorithms in Search, Optimization and Machine learning”, Addison Wesley, 2005.

15EI27E PROCESS CONTROL COMPONENTS L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: describe the component in generalized closed loop system. (K2)
CO2: select the suitable valve, control panels and actuators for a real time process. (K3)
CO3: explain the operation of regulators and throttling devices. (K2)
CO4:choose the control schemes for Industrial applications (K3)

UNIT I CONTROLLERS, TRANSMITTERS, CONVERTERS AND RELAYS 9

Analog versus Digital Instruments – Electronic versus Pneumatic Instruments – Controllers: Pneumatic – Electronic – Analog and Digital – Converters – Function Generators – Computing relay: Telemetering systems – Thermostats – Transmitters: Pneumatic – Electronic and Intelligent.

UNIT II CONTROL CENTERS, PANELS AND DISPLAYS 9

Annunciators and Alarms – Control centers and panels – Indicators – Analog Displays – Lights-Recorders – Digital Recorders – Oscillographs – Loggers –Speech synthesis and voice recognization – switches , Push buttons and key boards – UPS and UVS.

UNIT III ACTUATORS AND CONTROL VALVES 9

Actuators: Pneumatic, Hydraulic, Solenoid, Electric and Digital – Valves: Ball valve – Butterfly valves – Digital valves – Globe valves – Pinch valves – Plug valves – Saunders Diaphragm valves – sliding gate valves.

UNIT IV REGULATORS AND OTHER THROTTLING DEVICES 9

Dampers – Electric Energy modulation – Pumps as control elements – Regulators: Flow, Level, Pressure and Temperature – Variable speed drives.

UNIT V APPLICATIONS OF PROCESS CONTROL SYSTEMS 9

An Industrial application: Batch reactor – Batch Process and their automation – Boiler control and optimization – Centrifuge control – Chiller control and optimization

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Bela G.Liptak, "Instrument Engineers" Handbook, (Volume 2), "Process Control", CRC Press, 3rd Edition, 2007.
2. Stephanopoulos, G., "Chemical Process Control - An Introduction to Theory and Practice", Prentice Hall of India, 2005.

REFERENCES

1. Donald P.Eckman, "Automatic Process Control", Wiley – India Pvt. Ltd., New Delhi, 2011.
2. Peter Harriott. "Process Control", Tata McGraw - Hill publishing Co.Ltd., New Delhi, 30th Edition, 2008.

15EI28E BUILDING AUTOMATION L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: identify various systems of building automation and their characteristics. (K3)
CO2: outline the performance of controllers, heating and cooling systems of building management system. (K2)
CO3: outline the general information in energy considerations SCADA for energy management system. (K3)
CO4: explain the concept and principles of fire safety systems in building automation. (K2)
CO5: illustrate the principle of electronic security systems and their functions. (K2)

UNIT I INTRODUCTION 9

Introduction to building automation system – features - characteristics, drawbacks of building automation system. various systems of building automation – Building management system -Energy management system - Security system - Safety system - Video management system.

UNIT II BUILDING MANAGEMENT SYSTEM 9

Introduction to Heating Ventilation and Air Conditioning system - Standards and codes of HVAC - Modes of heat transfer in a building - Basic components of air conditioning- Types of refrigeration cycles: Vapor absorption - Vapor compression refrigeration system - Study on psychometric charts: Properties of Air (DBT, RH, WB, DPT, enthalpy)- Study on refrigerants: Types of refrigerants - Evaporating and condensing properties of refrigerants – Heat: types - heat transfer principles - measurement of heat transfer- Earthling systems: Types and Installation.

UNIT III ENERGY MANAGEMENT SYSTEM 9

Energy management centers and their functions – architectures - recent developments-analysis of power quality- energy reports - energy conservation-SCADA functional requirements –components - General features - functions and applications – benefits -

configurations of SCADA, RTU (Remote Terminal Units) connections - SCADA in power system automation.

UNIT IV FIRE SAFETY SYSTEM 9

Introduction – fire and combustion-Classification of fire- Fire extinguisher types - Fire Protection Systems: Active - Passive - Fire suppression and Detection systems: Sprinklers type – Detectors types - Smoke, Heat, Beam and Flame Detectors - Fire Alarm System: conventional and addressable FAS, fire alarm control panel- FAS component: single stage and two stage – class B and class A initiation circuit - types of cables and wiring - wiring methods.

UNIT V SECURITY SYSTEMS 9

Electronic access control- Badge making- Biometrics- Exterior and Interior - security sensors - Closed Circuit Television - Intercoms and Controls- Security Control Center- Security design process – introduction to IOT for building automation.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Reinhold A. Carlson Robert A. Di Giandomenico, “Understanding Building Automation Systems”: (Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lighting, Building), R.S. Means Company Ltd., 1st Edition 2007.
2. In Partnership with NJATC “Building Automation: Control Devices and Applications”, American Technical Publishers, 1st Edition, 2008.

REFERENCES

1. Morawski.E, “Fire Alarm Guide for Property Managers”, Lulu.Com, 2007.
2. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, “Guide to Energy Management”, Fairmont Press, 7th Edition, 2011.
3. R.Pearson, “Electronic Security Systems”, A Manager's Guide to Evaluating and Selecting System Solutions, Butterworth- Heinemann Publisher, 1st Edition, 2006.
4. Juliana Barbu, Cornel Barbu, “Electrician’s book-Fire Alarm System”, Lulu.com, 2011.

15EI29E COMPUTER CONTROL OF PROCESS L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1:describe the discretization of the process.(K2)
CO2: illustrate the analysis of sampled data systems with its responses.(K2)
CO3: explain the design fundamentals of advanced control schemes. (K2)
CO4: explain the design of Internal Model Control with uncertainty and Disturbances. (K2)
CO5: describe the real time Applications of controllers. (K2)

UNIT I DISCRETIZATION OF THE PROCESS 9

The Z Transformation: Z Transform of Various Functions - Properties of Z Transforms - The Inverse Z Transformation-Pulse Transfer Functions: Complex Series Representation of the Sampler - Development of the Pulse Transfer Function-Data Holds: Transfer Function of the Zero - Order Hold - Transfer Function of the First-Order Hold-Sampling Frequency Considerations - Selection of Optimum Sampling Period

UNIT II ANALYSIS OF SAMPLED DATA SYSTEM 9

Open-loop response of sampled - data systems: Example of Open-Loop Response - Open-Loop Response of Sampled - Data Systems: Closed - Loop Pulse Transfer Functions - Example to Determine Closed - Loop Transient Response - Design of Sampled - Data Control Systems Deadbeat Algorithm - Dahlin Algorithm - Digital Equivalent to a Conventional Controller Treatment of Noisy Process Signals- Stability of Sampled

UNIT III DESIGN OF ADVANCED CONTROL SCHEMES 9

Modified Z Transforms: Definitions and Evaluation of Modified Z Transforms - Application of Modified Z Transforms to Systems with Dead Time - Application of Modified Z Transforms to Determine Output Between Sampling Instants - Design and Application of Advanced Control Concepts: Process Modeling from Step - Test Data - Pulse Testing for Process Identification – Time Domain Process Identification.

UNIT IV INTERNAL MODEL CONTROL 9

Introduction to Model-Based control - Open loop controller design - Model Uncertainty and Disturbances - Development of Internal Model Control (IMC) structure – IMC based PID controller design.

UNIT V APPLICATIONS OF CONTROLLERS 9

An Industrial Applications of Feed forward control : Heat Exchanger- Drum Boiler – Distillation Column – CSTR – Inferential Control : Distillation Column – Split range control : Chemical reactor – Cascade control : Heat exchanger – Distillation Column

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

1. Pradeep B.Deshpande and Raymond H.Ash, “Elements of Computer Process Control with Advanced Control Applications”, Prentice Hall 2005.
2. Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hall of India, 2005.

REFERENCES

1. Astrom, K. J. and B. Wittenmark, “Computer Controlled Systems”, Prentice Hall, 2005.
2. Franklin, G. F. and J. D. Powell, Digital Control of Dynamic Systems, Addison-Wesley, 2007.
3. John Doyle, Bruce Francis and Allen Tannenbaum, “Feedback Control Theory”, Macmillan Publishing Co., 1990.
4. Benjamin C.Kuo, Digital Control Systems, Oxford University Press, 2010.

15EI30E NONLINEAR CONTROL L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: develop a describing function for a nonlinear system.(K3)
CO2: Apply the concepts of phase plane analysis and Phase portraits for the nonlinear system.(K3)
CO3: explain the concept of Lyapunov theory for stability analysis. (K2)
CO4: explain the basic linearization methods for nonlinear system. (K2)
CO5: describe the sliding mode control of nonlinear system. (K2)

UNIT I DESCRIBING FUNCTION 9

Common Nonlinear behavior, Common Nonlinearities - Definitions – Computing Describing Functions - Common Nonlinearities and its Describing Functions - Nyquist Criterion and its Extension - Existence of Limit Cycles - Stability of Limit Cycles.

UNIT II PHASE PLANE ANALYSIS 9

Concepts of phase plane analysis – Phase portraits- Constructing Phase Portraits Phase plane Analysis of Linear and Nonlinear Systems.

UNIT III STABILITY ANALYSIS OF NONLINEAR SYSTEM 9

Nonlinear Systems and Equilibrium Points - Concepts of Stability - Lyapunov's Direct Method - Lyapunov theory for stability analysis - Krasovski's Method-Variable Gradient Method

UNIT IV FEED BACK LINEARIZATION 9

Feedback Linearization and the Canonical Form - Input-State Linearization of SISO Systems - input-Output Linearization of SISO Systems- Inverse Dynamics and Non-Minimum-Phase Systems - Feedback Linearization of MIMO Systems.

UNIT V SLIDING MODE CONTROL 9

Sliding Surfaces – Continuous approximations of Switching Control laws - Sliding modes in variable structure system conditions for existence of sliding regions.

L : 45 TOTAL : 45 PERIODS

TEXT BOOKS

1. H. Khalil, "Nonlinear systems", Prentice Hall, 3rd Edition, 2002
2. J.A.E. Slotine and W. Li, "Applied Nonlinear Control", PHI, 1991.

REFERENCES

1. M.Gopal, "Digital Control and State Variable Methods, Conventional and Intelligent Control Systems", McGraw – Hill, 4th Edition, New Delhi, 2009.
2. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall Inc., 2009.
3. G.J.Thaler, "Automatic Control Systems", Jaico publishers, 2006.

15EI31E INDUSTRIAL CHEMICAL PROCESS L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: illustrate the process of wood extracts and the raw materials. (K2)
CO2: analyze the various components and the extraction methods of synthetic detergents. (K3)
CO3: explain the petroleum refining processes and products obtained from various processes.(K2)
CO4: outline the general properties of resins and processing methods of rubbers. (K2)
CO5: summarize the process description and functional block details of raw materials preparation for iron and steel. (K2)

UNIT I PULP, PAPER, SUGAR AND STARCH INDUSTRIES 9

Wood and Wood extracts – Wood Chemicals - Cellulose derivatives, Manufacture of pulp – different processes of pulping – Manufacture of paper – Manufacture of Boards - Raw and refined sugar - by products of sugar industries, Starch and starch derivatives.

UNIT II OILS, FATS, SOAPS AND DETERGENT INDUSTRIES 9

Vegetable oils and animal fats – their nature analysis – extraction methods. Hydrogenation of oils – fatty acids and alcohols – waxes – soaps – synthetic detergents.

UNIT III PETROLEUM AND PETROCHEMICAL INDUSTRIES 9

Petroleum refining : physical and chemical conversion products – lubricating oils – petrochemical precursors - Methane – olefins – acetylenes and aromatics – products obtained from them by various unit processes.

UNIT IV RUBBER AND POLYMERS 9

Monomers – Thermosetting and Thermoplastic materials – General properties and Applications of Resins – Polymerization processes – different types - Natural rubber - Synthetic rubber such as SBR, NBR, CR - Fundamental methods of processing of synthetic Rubbers.

UNIT V IRON AND STEEL 9

The need for iron and steel in the civilized world : history of steel making – Process description in diagrammatic and functional block details – raw materials preparation – operation of Blast Furnace (BF) and auxiliary units including stoves – Basic oxygen Furnace (BOF) – Electric Furnace (EF) – Open Hearth Furnace (OHF) - relative merits of various steel making furnaces.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. M.Gopala Rao, Marshall Sittig, “Dryden’s Outlines of Chemical Technology”, East – West press 3rd Edition, 2014.
2. Shreve's “Chemical Process Industries Handbook”, McGraw-Hill, 5th Edition, 2007.

REFERENCES

1. Kent and Riegel's "Hand Book of Industrial Chemistry and Biotechnology", Springer, 11th Edition, 2007.
2. Liptak B.G., "Instrument Engineers Handbook", Volume II, CRC press 4th edition 2005.

15EI32E AUTOMOTIVE INSTRUMENTATION AND CONTROL L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: explain the fundamentals of automotive Electronics. (K2)
CO2: infer the use of instruments in automotive industry. (K2)
CO3: outline the design instruments for automotive applications.(K2)
CO4: explain the various automatic control system. (K2)
CO5: summarize communication protocols to perform advanced monitoring and control. (K2)

UNIT I SENSORS AND ACTUATORS 9

Air flow rate Sensor - Engine Crank Shaft Angular position Sensor - Optical Crankshaft, Magnetic Reluctance and Hall effect position Sensor-Engine oil pressure, Temperature sensor – Air pressure Sensor–Air/Fuel Sensor-Emission Sensor -Detonation Sensor -- Throttle Angle Sensor - Knock Sensor - Sensor for feedback control - Rain Sensor - Lambda Sensor - Wheel Speed Sensor - Automotive Engine Control Actuators.

UNIT II INSTRUMENTATION AND MEASUREMENT AIR / FUEL SENSOR 9

Computer Based Instrumentation System – Fuel Quantity Measurement Coolant Temperature ML Oil Pressure ML - Vehicle Speed MF - VFD Display Odometer – Taximeter – Traficators - Music Horn - Embedded System in control of Automotive system.

UNIT III WARNING INSTRUMENTS 9

Collision avoidance Radar warning system – Engine oil pressure warning system engine over heat warning system - Airbags and belttensiomers – other safety and comfort system - Adaptive noise control system - Brake actuation warning system - Speed warning system, wind shield wiper and washer.

UNIT IV AUTOMOTIVE CONTROL 9

Electronic Engine - Control System - Ignition and Fuel Control System - Electronic Steering Control - Electronic Suspension Control System - Advantages of Control - Automatic Temperature Control - Anti-lock Brake System Control.

UNIT V VEHICLE COMMUNICATION PROTOCOLS 9

Controller area network protocols - Automotive Inertial Navigation System, Automotive GPS navigation system - Vehicle location and Navigation – Bluetooth - OWB, RFID, Satellite Radio.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Robert Bosch GmbHBosch, “Automotive Electrics and Automotive Electronics: Systems and Components Networking and Hybrid Drive”, 5th Edition, Springer, 2013.
2. William Ribbens, “Understanding Automotive Electronics: An Engineering perspective”, Butterworth-Heinemann, Elsevier Incorporation, Massachusetts, 7th Edition, 2012.

REFERENCES

1. Tom Denton, “Automobile Electrical and Electronic Systems”, Elsevier Butter worth – Heinemann Publications, Elsevier Incorporation, Massachusetts, 7th Edition, 2012.
2. Robert N. Brandy, “Automotive Computers & Digital Instrumentation,” Prentice Hall, 1988.
3. Tomwather J. R., Cland Hunter, “Automotive Computer & Control System”, Prentice Inc. NJ.

B.E. – ELECTRONICS AND INSTRUMENTATION ENGINEERING

ONE CREDIT ELECTIVE COURSES

15EI01L PLC PROGRAMMING L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: develop PLC program for simple automation applications.
CO2: interface electrical drives and sensors with PLC.

LIST OF EXPERIMENTS

1. Develop the function block diagram for logic gates
2. Develop the function block diagram for traffic light control system
3. Develop the function block diagram for bottle filling system
4. Develop the function block diagram for batch process
5. Develop the function block diagram for motor control
6. Develop the function block diagram for temperature control
7. Design and develop the signal condition circuits for electrical appliance
8. Interfacing the signal conditional circuit and driver circuit with PLC

P: 30 TOTAL: 30 PERIODS

REFERENCE

1. Petruzella, “Programmable Logic Controller”, McGraw Hill, 3rd Edition, 2009.

15EI02L PROGRAMMING IN ARDUINO L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: apply the basic programming to monitor and indicate the process variable.
CO2: apply the basic programming to control real time process.

LIST OF EXPERIMENTS

1. Introduction to ARDUINO
2. LED Blinking Waves
3. Automatic control of Temperature process
4. Traffic light control
5. Voltage and Temperature Indicator
6. Robot path control
7. Robot Arm position control
8. Home appliances control using IR remote
9. MATLAB and Arduino interface (Hardware in loop)
10. Temperature logging system
11. Introduction to IOT

P: 30 TOTAL: 30 PERIODS

REFERENCE

1. https://www.arduino.cc/

15EI03L CONTROL SYSTEM USING GRAPHICAL PROGRAMMING L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: outline the fundamentals of LabVIEW

CO2: explain the concepts of design techniques in Time domain and Frequency domain

LIST OF EXPERIMENTS

1. Create simple logics using VI
2. Mathematical models of electrical system
3. Closed loop response for a given transfer function
4. Root locus analysis and design for a given transfer function
5. Open and closed loop sinusoidal frequency analysis and design
6. Study the characteristics of linear system
7. Stability analysis of feedback system

P: 30 TOTAL: 30 PERIODS

REFERENCE

1. Norman S Nise, “Control systems Engineering” Willey, 6th Edition, 2012.

15EI04L DCS FUNDAMENTALS & INDUSTRIAL COMMUNICATION PROTOCOLS L T P C
1 0 0 1

COURSE OUTCOMES

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

CO1: explain the basic concepts of DCS and its Interfacing.

CO2: describe knowledge of various communication protocols.

CONTENT

DCS Hardware studies - implementation using functional logic: Basic logic gate, Model of cement, beverage plant - Automation of pressure process using DCS.

HART communication Protocol - Communication modes – HART networks – HART commands – HART applications. Field bus: Introduction – General Field bus architecture – CAN bus for automation – PROFI bus – MOD bus

One day Industrial Visit

L: 15 TOTAL: 15 PERIODS

REFERENCES

1. Michael P. Lukas, “Distributed Control System”, Van Nostrand Reinhold Co., Canada, 2001.
2. Lawrence M Thompson, “Industrial Data Communications” 4th Edition, ISA-The Instrumentation, Systems and Automation Society.

15EI05L EMBEDDED SYSTEM DESIGN USING ARM MICROCONTROLLER **L T P C 0 0 2 1**

COURSE OUTCOMES

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

CO1: develop programs in LPC2148

CO2: design interfacing applications in ARM7 processors

LIST OF EXPERIMENTS

1. Study of ARM evaluation system
2. Interfacing ADC and DAC.
3. Interfacing LED and generation of PWM signal.
4. Interfacing real time clock and serial port.
5. Interfacing keyboard and LCD.
6. Interfacing EPROM and interrupt.
7. Interrupt performance characteristics of ARM and FPGA.
8. Interfacing stepper motor and temperature sensor.
9. Implementing zigbee protocol with ARM.

P: 30 TOTAL: 30 PERIODS

15EI06L HANDS ON TRAINING USING FPGA **L T P C 0 0 2 1**

COURSE OUTCOMES

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

CO1: synthesis, simulate and develop schematic of various digital combinational circuits using FPGA on Xilink simulator.

CO2: develop interfacing application using FPGA

LIST OF EXPERIMENTS

1. Study of Synthesis tools Half and full adder
   - Decoder – 2 x 4, 3 x 8
   - Priority encoder.
   - Ripple adder.
   - 4 – Bit ripple counter.
   - Code conversion

   All the above synthesis in three modeling styles - data flow, structural and behavioral
2. Study of Simulation using tools Half adder
   - Multiplexer – 2 x 1, 4 x 1
   - Demultiplexer – 1 x 2, 1 x 4

   All the above synthesis in three modeling styles - data flow, structural and behavioral
3. Study of Simulation using tools Flipflop – D, T
   - Priority encoder.

- Ripple adder.
- 4 – Bit ripple counter.

All the above synthesis in three modeling styles - data flow, structural and behavioral

4. Study of development tool for FPGAs for schematic entry and verilog
   - Full adder, half adder.
   - Demultiplexer – 1 x 2, 1 x 4.
5. Design and simulation of pipelined serial / parallel adder to add/ subtract 8 number of size, 12 bits each in 2's complement.
6. Place and Root and Back annotation for FPGAs
7. Design and simulation of back annotated verilog files for multiplying two signed, 8 bit numbers in 2's complement.
8. Study of FPGA board and testing on board LEDs and switches using verilog code.
9. Design a Realtime Clock (2 digits, 7 segments LED displays each for HRS., MTS, and SECS.) and demonstrate its working on the FPGA board. to display binary number on the FPGA.
10. Design of traffic light controller using verilog tools . Movement of vehicles in any direction or pedestrian in any direction.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Stephen Brown and Zvonko Vranesic Mc graw Hill, “Fundamentals of Digital Logic wht Verilog design”, Mc Grew, 2003.
2. Bhasker, J., VHDL Primer, Prentice Hall 1995
3. Zainalatsedin Navabi, ‘VHDL Analysis and Modelling of Digital Systems’, 2nd Edition, Tata McGraw Hill, 1998.
4. Douglas Perry, ‘VHDL Programming by example’, Tata McGraw Hill, 3rd Edition, 2003.

15EI07L GRAPHICAL PROGRAMMING FOR ELECTRONIC CIRCUITS L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: Build multisim circuits.
CO2: Experiment with different application of Diodes, Transistors and Op-Amps
CO3: Infer fundamental concepts of semiconductor devices working and their characteristics

LIST OF EXPERIMENTS

1. Introduction to Multisim
2. Design of Regulated Power Supply using Diodes.
3. Design of Voltage regulator using Zener Diode.
4. Fundamentals of Transistor-VI characterisitics, Simple applications.

5. Biasing Circuits, Amplifier circuits.
6. Design of Power amplifier circuits.
7. Design of Single stage and Multistage amplifier circuits.
8. Fundamentals of Fet and its Applicationts.
9. Design of Oscillator circuits-RC phase shift and Wein Bridge
10. Design of Square waveform circuits-Multivibrator and Schmitt trigger
11. Fundamentals of Op-Amp and simple circuits of Op-Amp.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Introduction to Electronics-Multisim lab manual by National Instruments
2. Electronic Devices-Thomas L Floyd.

15EI08L SOFT COMPUTING TECHNIQUES USING FUZZY AND NEURAL NETWORK **L T P C 0 0 2 1**

COURSE OUTCOMES

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

CO1: describe the concept of fuzzy and neural network.
CO2: develop Matlab coding for fuzzy and neural network.

Fuzzification, defuzzification techniques, Fuzzy knowledge and rule bases. . Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Case studies: FIS in matlab environment - tipper, washing machine and Temperature control.

Concept of Artificial Neural Networks ,Neural Network based controller Matlab-neural network toolbox. Neural-Network interconnection systems. Case studies: NN in matlab environment for clustering and classification problems.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. J.S.R.Jang, C.T.Sun and E.Mizutani, ‘ Neuro- Fuzzy and Soft Computing’ Pearson Education, New Delhi, 2004
2. Jacek M. Zurada, ‘Introduction to Artificial Neural Systems’, Jaico Publishing home, 2002.
3. John Yen and Reza Langari, ‘Fuzzy Logic – Intelligence, Control and Information’, Pearson Education, New Delhi, 2003.
4. Robert J.Schalkoff, ‘ Artifical Neural Networks’, McGraw Hill, 1997.

15EI09L INSTRUMENTATION DETAIL ENGINEERING **L T P C 1 0 0 1**

COURSE OUTCOMES

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

CO1: explain the basic concept of the piping and instrumentation diagrams.
CO2: describe the standards used in industries for different applications.

CONTENTS

1. Process Flow diagrams
2. What is a P&ID-How to read P&ID
3. Standards and symbols
4. Indications on P&ID
5. Conventions in P&ID
6. Instrumentation Standards
7. Loop diagram - Data sheet preparation
8. Hook up diagram
9. Cable schedule
10. Instrument index
11. Selection and sizing of instruments-
12. Selection and sizing of valves-
13. Project Management.

One day Industrial Visi

L: 15 TOTAL: 15 PERIODS

REFERENCES

1. Instrumentation symbols and identification, ISA 5.1
2. Process Measurement Instrumentation API RP 551

15EI10L VIRTUAL GRAPHICAL PROGRAMMING FOR BEGINNERS L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: express the need of Graphical programming.(K2)
CO2: explain the hardware and software involved in programming techniques of VI. (K2)
CO3: describe the basics of Arrays, Graphs and structures in VI. (K2)

Need for Virtual Instrumentation- Virtual instrumentation through LabVIEW- Software Environment palettes- Data Types- Dataflow Programming- Debugging Technique.

Creating Sub VI and Express VI as Icons- Creating Sub VI from section of VI- Expandable Nodes- Creating a Standalone Application- Looping- Shift Registers- Feedback Nodes- Control Timing- Interval- Timed Structure- Timing Sources- Execution and priority

Numeric Type- Strings- Array- Initializing Array- Polymorphism- Clusters- Cluster Control and indicators - Cluster Functions and Operations- Types of Waveform- Waveform Charts and Graphs- Customizing Charts and Graphs- Special Planes on Graphs- Structures- Case Structure- Sequence Structure- Timed Structure- Event Structure- Special VI- Math Script- Formula Node.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Ronald W. Larsen 2010, Labview for Engineers: International Version, 1 Ed., Pearson.
2. Gary W. Johnson, Richard Jennings 2006, LabVIEW Graphical Programming, McGraw-Hill Professional
3. Jeffrey Travis, Jim Kring 2006, *LabView for Everyone*, Prentice Hall PTR.

15EI11L FIELD INSTRUMENTS FOR PROCESS CONTROL L T P C
1 0 0 1

COURSE OUTCOMES

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

CO1: describe the working principles and installation procedures of field instruments.(K3)

CO2: discuss the control valve performance and safety devices. (K2)

Differential pressure transmitter- DP transmitter construction and its behaviour- applications – inferential measurement application- 2-3-4 wire temperature transmitter- Temperature switch-magnetic type flow meters with flow transmitter- Level transmitters in Hydrostatic interface and boiler drum level control.

Control Valves Performance – Dead Band – Actuator positioner Design – Selection of Control Valve based on flow characteristics - Solenoid Valves -Pressure Relief Valves/Bursting Discs -On/Off Valve Actuators -Choke Valves -HVAC Actuators- Conveyor safety devices - Pull chord switch , Belt sway switch , Slow speed switch -Vibration Field Instruments -Fire & Gas Detectors

One day Industrial Visit

L: 15 TOTAL: 15 PERIODS

REFERENCES

1. Bela G Liptak-Instrument Engineers Handbook Process Measurement and Analysis- Vol-I, 3rd Edition, CRC Press.
2. Tony R. Kuphaldt – Lesson in Industrial Instrumentation, Vol-I.
3. Douglas O.J desa – Instrumentation Fundamentals for Process Control, Taylor & Francis, 2nd Edition, 2001.

15EI12L INSTRUMENTATION IN CEMENT INDUSTRIES L T P C
1 0 0 1

COURSE OUTCOMES

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

CO1: explain fundamental concepts of Sensors, Protocols & Automation.

CO2: Outline the concepts on Cement production and quality control.

Cement manufacturing process-Sensors :Temperature, Pressure, Level, Flow–Calibration of Sensors-Industrial Protocols-Fundamentals of PLC,SCADA,DCS -Bagging Process-Gas Analysers: SOx,NOx-Cement Quality Analysers.

One day Industrial Visit

L: 15 TOTAL: 15 PERIODS

15EI13L CLINICAL LABORATORY INSTRUMENTATION L T P C
1 0 0 1

COURSE OUTCOMES

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

CO1: Explain the principle of operation of biomedical instruments with their widespread use and requirements. (K2).

CO2: Select Instrument for a particular analysis with idea of its merits, demerits and limitations. (K3).

CONTENTS

Clinical Laboratory Instruments: Colorimeters, Spectrophotometers, Clinical Flame Photometers, Electrophoresis, Electronic devices for measuring blood characteristics, Chromatography-GC & HPLC, Blood cell counters, Clinical thermometer probes, Measurement of Heart rate & Pulse rate.

Albumin analyzer, Bench top clinical chemistry analyzer, Bilirubinimeter, Cardiac marker analyzer, C-Reactive protein analyzer, Co-oximeter, Osmometer, Immuno turbidmetric analyzer, Measurement of body temperature using AD590 / LM34, Urine chemistry analyzer.

One day Industrial Visit

L: 15 TOTAL: 15 PERIODS

REFERENCES

1. Handbook of Biomedical Instrumentation – by R.S.Khandpur, 3rd Edition, Tata McGraw Hill, 2014.
2. Biomedical Transducers and Instruments – by Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.
3. Biomedical Instrumentation and Measurements – by Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, Prentice-Hall India Pvt. Ltd, 2010.
4. Introduction to Biomedical Equipment Technology- Joseph J.Carr, 4th Edition, Pearson education ltd, 2000.
5. Biomedical Equipment: Use, Maintenance & Management - Joseph J.Carr, Fascimile edition, Prentice Hall, 1991.

15EI14L DIGITAL SIGNAL PROCESSING USING MATLAB L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: generate discrete complex signal using MATLAB. (K2, S2)

CO2: compute convolution and FFT for the signals using MATLAB. (K2, S2)

CONTENT

Overview of the Digital Signal Processing - Discrete-time signal generation and Discrete systems - Discrete Fourier Transform - linear convolution using DFT - circular convolution - Fast Fourier Transform and the basics of digital filter design.

P: 30 TOTAL: 30 PERIODS

REFERENCE

1. Vinay K. Ingle and John G. Proakis, 'Digital Signal Processing Using MATLAB V.4', Bookware Companion Series.

15EI15L DESIGN OF PID CONTROLLERS USING MATLAB L T P C
0 0 2 1

COURSE OUTCOMES

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

CO1: Interpret the meaning of three term in Control engineering (K2, S2)

CO2: Construct PID models and analyze the Time domain and Frequency domain specifications (K2, S2)

CO3: Apply softcomputing techniques in design of PID Controller.(K2, S2)

LIST OF EXPERIMENTS

1. Three term Control
2. PID Controller implementation issues
3. Industrial PID Control
4. Design of PID Control using Root Locus Method
5. Design of PID Control using Frequency Response Method
6. Study of P,PI,PD,PID controller response for single tank system
7. Tuning of PID controller for single tank system using ZN open and closed loop method
8. Relay based Automatic tuning of PID controller for two tank system
9. IMC-PID controller design for a Single and Two tank system
10. Fuzzy Logic and Genetic Algorithm methods in PID Tuning

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. PID Control New Identification and Design Methods-Michael A Johnson and Mohammad H.Moradi
2. Control Engineering-Jacqueline Wilkie,Micheal Johnson and Reza Katabi

15EI16L **CO-SIMULATION IN LABVIEW** **L T P C**
0 0 2 1

COURSE OUTCOMES

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

CO1: develop VI files for simple applications (K2, S2)
CO2: solve electrical /electronic circuits using Multisim (K2, S2)
CO3: develop Co simulation files for Power Electronics Converter (K2, S2)

LIST OF EXPERIMENTS

1. Introduction to Fundamentals of LabVIEW
2. Introduction to Multisim
3. Introduction to Control Design and Simulation Module in LabVIEW
4. Study of Open loop and Closed Loop simulation of Power Electronic Converters using State space Technique
5. Implementing Co-simulation concepts in Fundamental Power Electronics Converters
6. Introducing the concepts of myRIO for real time interfacing

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Graphical System Design Guide to Power Electronics Co-Simulation with Multisim and LabVIEW-NI manual
2. NI myRIO user guide-NI manual

15EI17L **PYTHON PROGRAMMING FOR IOT** **L T P C**
0 0 2 1

COURSE OUTCOMES

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

CO1: write basic programming in python (K2, S2)
CO2: develop python programming for an IOT application (K2, S2)

LIST OF EXPERIMENTS

1. Write a python program using if and for loop.
2. Write a python program using while loop.
3. Write a python program to plot using matplotlib library.
4. Write a python program for array operations using numpy library.
5. Study of Raspberry Pi and installation of Raspbian operating system.
6. Develop a python program for serial communication between python and arduino
7. Create a local server and client using python
8. Create MySQL database system for data storage.

P: 30 TOTAL: 30 PERIODS

15EI18L	**PCB DESIGN**	**L T P C** **0 0 2 1**

COURSE OUTCOMES

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

CO1: sketch a PCB layout for electronic circuits using open source software. (K2, S2)

CO2: implement an electronic circuit on PCB board. (K2, S2)

LIST OF EXPERIMENTS

1. Introduction to various open source software for PCB layout design
2. Sketch a single layer PCB layout for power supply circuit using simulation software.
3. Sketch PCB layout for Astable multi-vibrator circuit using simulation software.
4. Sketch a double layer PCB layout for voltage divider circuit using simulation software.
5. Implementation of power supply circuit on printed circuit board using the layout.
6. Implementation Astablemultivibrator circuit on printed circuit board using the layout.
7. Study about the advancement in the PCB board development

P: 30 TOTAL: 30 PERIODS

B.E. – ELECTRONICS AND INSTRUMENTATION ENGINEERING

OPEN ELECTIVE COURSES

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

		L	T	P	C
15ID01E	**PRODUCT DESIGN AND DEVELOPMENT**	**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”, Lexisexis 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. EI-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 – Cattele and Big Five - Psychodynamic Theories - Carl Jung and MBTI - Transactional Analysi - 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 forming 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 ANCIENTY 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. Majumdur 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.