ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R – 2013

B.E. ROBOTICS AND AUTOMATION

I - VIII SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	HS6151	Technical English – I	3	1	0	4
2.	MA6151	Mathematics – I	3	1	0	4
3.	PH6151	Engineering Physics – I	3	0	0	3
4.	CY6151	Engineering Chemistry – I	3	0	0	3
5.	GE6151	Computer Programming	3	0	0	3
6.	GE6152	Engineering Graphics	2	0	3	4
PRACTICALS						
7.	GE6161	Computer Practices Laboratory	0	0	3	2
8.	GE6162	Engineering Practices Laboratory	0	0	3	2
9.	GE6163	Physics and Chemistry Laboratory - I	0	0	2	1
		TOTAL	**17**	**2**	**11**	**26**

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	HS6251	Technical English – II	3	1	0	4
2.	MA6251	Mathematics – II	3	1	0	4
3.	PH6251	Engineering Physics – II	3	0	0	3
4.	CY6251	Engineering Chemistry – II	3	0	0	3
5.	GE6252	Basic Electrical and Electronics Engineering	4	0	0	4
6.	GE6253	Engineering Mechanics	3	1	0	4
PRACTICALS						
7.	GE6261	Computer Aided Drafting and Modeling Laboratory	0	1	2	2
8.	GE6262	Physics and Chemistry Laboratory - II	0	0	2	1
		TOTAL	**19**	**4**	**4**	**25**

SEMESTER – III

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	MA6351	Transforms and Partial Differential Equations	3	1	0	4
2.	EC6302	Digital Electronics	3	0	0	3
3.	RO6301	Sensors and Instrumentation	3	0	2	4
4.	EC6202	Electronic Devices and Circuits	3	1	0	4
5.	EE6356	Electrical Machines and Power Systems	3	0	0	3
6.	GE6351	Environmental Science and Engineering	3	0	0	3
PRACTICAL						
7.	EC6362	Electronic Circuits and Digital Laboratory	0	0	3	2
8.	EE6363	Electrical Machines Laboratory	0	0	3	2
		TOTAL	**18**	**2**	**8**	**24**

SEMESTER – IV

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	MA6451	Probability and Random Processes	3	1	0	4
2.	RO6401	Automatic Control Systems	3	0	0	3
3.	MF6505	CNC Machining Technology	3	0	0	3
4.	EC6301	Object Oriented Programming and Data Structures	3	0	0	3
5.	EC6404	Linear Integrated Circuits	3	0	0	3
6.	AN6402	Kinematics and Dynamics of Machinery	3	1	0	4
PRACTICAL						
7.	RO6411	CNC and Metrology Laboratory	0	0	3	2
8.	ME6511	Dynamics Laboratory	0	0	3	2
9.	EC6467	LIC and Control Systems Laboratory	0	0	3	2
		TOTAL	**18**	**2**	**9**	**26**

SEMESTER – V

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	ME6015	Operations Research	3	0	0	3
2.	RO6501	Programmable Logic Controllers	3	0	2	4
3.	RO6502	Basics of Robotics	3	0	0	3
4.	EE6502	Microprocessors and Microcontrollers	3	0	0	3
5.	RO6503	Mechanical Design	3	1	0	4
6.	CS6303	Computer Architecture	3	0	0	3
PRACTICAL						
7.	RO6511	Engineering Design Laboratory	0	0	3	2
8.	MT6712	Robotics Laboratory	0	0	3	2
9.	RO6512	Innovation Laboratory	0	0	2	1
		TOTAL	**18**	**1**	**10**	**25**

SEMESTER – VI

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	EC6653	Power Electronics and Drives	3	1	0	4
2.	EC6655	Embedded and Real time Systems	3	0	0	3
3.	RO6601	Vision Systems and Image processing	3	0	0	3
4.	RO6602	Automation System Design	3	0	0	3
5.	EC6665	Economics for Engineers	2	1	0	3
6.		Elective I	3	0	0	3
PRACTICAL						
7.	EC6663	Power Electronics and Drives Laboratory	0	0	3	2
8.	RO6611	Automation System Design Laboratory	0	0	3	2
9.	RO6612	Industrial Visit cum Lecture	0	0	3	2
		TOTAL	**17**	**4**	**9**	**25**

SEMESTER – VII

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	RO6701	Precision Equipment Design	3	1	0	4
2.	RO6702	Field and Service Robotics	3	0	0	3
3.	RO6703	Totally Integrated Automation	3	0	0	3
4.		Elective II	3	0	0	3
5.		Elective III	3	0	0	3
6.		Elective IV	3	0	0	3
PRACTICAL						
7.	RO6711	Totally Integrated Automation Laboratory	0	0	3	2
8.	RO6712	Product Design Laboratory	0	0	3	2
9.	RO6713	Design and Fabrication Project	0	0	4	2
		TOTAL	**18**	**3**	**10**	**25**

SEMESTER – VIII

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.		Elective V	3	0	0	3
2.		Elective VI	3	0	0	3
PRACTICAL						
3.	RO6811	Project Work	0	0	12	6
		TOTAL	**6**	**0**	**12**	**12**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 195

ELECTIVES FOR ROBOTICS AND AUTOMATION ENGINEERING

ELECTIVE – I

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
1.	EC6073	Advanced Microprocessors and Microcontrollers	3	0	0	3
2.	CS6078	Computer Architecture and Parallel Processing	3	0	0	3
3.	CS6081	System Software	3	0	0	3
4.	RO6001	Lean Manufacturing	3	0	0	3
5.	RO6002	Industrial Design and Applied Ergonomics	3	0	0	3
6.	ME6005	Process Planning and Cost Estimation	3	0	0	3

ELECTIVE – II

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
1.	EE6071	Special Machines and Controllers	3	0	0	3
2.	CS6076	Artificial Intelligence for Robotics	3	0	0	3
3.	IC6601	Advanced Control Systems	3	0	0	3
4.	RO6003	Indian Ethos and Values	3	0	0	3
5.	MG6851	Principles of Management	3	0	0	3

ELECTIVE – III

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
1.	EC6601	VLSI Design	3	0	0	3
2.	CS6009	Nano Computing	3	0	0	3
3.	RO6004	Renewable Energy Sources	3	0	0	3
4.	MT6005	Virtual Instrumentation	3	0	0	3
5.	MG6071	Entrepreneurship Development	3	0	0	3

ELECTIVE – IV

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
1.	EC6077	Digital Signal Processors and its Applications	3	0	0	3
2.	RO6005	Maintenance and Safety Engineering	3	0	0	3
3.	RO6006	Software Project Management and Quality Assurance	3	0	0	3
4.	CS6086	Neural Networks and Fuzzy Systems	3	0	0	3
5.	RO6007	Industrial Robotics and Material Handling Systems	3	0	0	3
6.	MG6571	Human Resource Management	3	0	0	3

ELECTIVE – V

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
1.	RO6008	Embedded Systems Design	3	0	0	3
2.	EC6801	Wireless Communication	3	0	0	3
3.	EE6007	Micro Electro Mechanical Systems	3	0	0	3
4.	RO6009	Industrial Networking	3	0	0	3
5.	RO6010	Internet Tools and Java Programming	3	0	0	3

ELECTIVE – VI

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
1.	CE6071	Advanced Strength of Materials	3	0	0	3
2.	ME6602	Automobile Engineering	3	0	0	3
3.	MG6089	Supply Chain Management	3	0	0	3
4.	ME6703	Computer Integrated Manufacturing Systems	3	0	0	3

HS6151 **TECHNICAL ENGLISH – I** **L T P C**
3 1 0 4

OBJECTIVES:

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

UNIT I **9+3**

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II **9+3**

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking and answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Process descriptions (general/specific) - Definitions - Recommendations – Instructions; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association (connotation); E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III **9+3**

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause and effect / compare and contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV **9+3**

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations and acronyms; E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V **9+3**

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email; Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar and Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

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

OUTCOMES:

Learners should be able to

- speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- read different genres of texts adopting various reading strategies.
- listen/view and comprehend different spoken discourses/excerpts in different accents

TEXTBOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

REFERENCES:

1. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice. Oxford University Press, New Delhi. 2011.
2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006.
3. Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi. 2005
4. Rutherford, Andrea. J Basic Communication Skills for Technology. Pearson, New Delhi. 2001.
5. Viswamohan, Aysha. English for Technical Communication. Tata McGraw-Hill, New Delhi. 2008.

EXTENSIVE Reading (Not for Examination)

1. Kalam, Abdul. Wings of Fire. Universities Press, Hyderabad. 1999.

WEBSITES:

1. http://www.usingenglish.com
2. http://www.uefap.com

TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like self introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
- Discussions
- Role play activities
- Short presentations
- Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.

EVALUATION PATTERN:

Internal assessment: 20%

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Reviews
- Creative writing
- Poster making, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual speaking activities, Pair work activities like role play, Interview, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded from simple to complex, from direct to inferential
- ✓ Writing assessment: Writing paragraphs, essays etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content.

End Semester Examination: 80%

MA6151	**MATHEMATICS – I**	**L T P C**
		3 1 0 4

OBJECTIVES:

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II SEQUENCES AND SERIES 9+3

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 9+3

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT V MULTIPLE INTEGRALS 9+3

Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

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

OUTCOMES:

- This course equips students to have basic knowledge and understanding in one fields of materials, integral and differential calculus.

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

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

PH6151 ENGINEERING PHYSICS – I L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I CRYSTAL PHYSICS 9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Elasticity- Hooke's law - Relationship between three modulii of elasticity (qualitative) – stress -strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending- I-shaped girders

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

UNIT III QUANTUM PHYSICS 9

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

UNIT IV ACOUSTICS AND ULTRASONICS 9

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies.

Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications - Sonogram

UNIT V PHOTONICS AND FIBRE OPTICS 9

Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients - derivation. Types of lasers – Nd:YAG, CO_2, Semiconductor lasers (homojunction & heterojunction)- Industrial and Medical Applications.

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will have knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.

TEXT BOOKS:

1. Arumugam M. Engineering Physics. Anuradha publishers, 2010
2. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009
3. Mani Naidu S. Engineering Physics, Second Edition, PEARSON Publishing, 2011.

REFERENCES:

1. Searls and Zemansky. University Physics, 2009
2. Mani P. Engineering Physics I. Dhanam Publications, 2011
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009
4. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011
6. Senthilkumar G. Engineering Physics I. VRB Publishers, 2011.

CY6151 ENGINEERING CHEMISTRY - I L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.

UNIT II CHEMICAL THERMODYNAMICS 9

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore(problems).

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

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

UNIT IV PHASE RULE AND ALLOYS 9

Phase rule: Introduction, definition of terms with examples, One Component System- water system - Reduced phase rule - Two Component Systems- classification – lead-silver system, zinc-magnesium system. Alloys: Introduction- Definition- Properties of alloys- Significance of alloying, Functions and effect of alloying elements- Ferrous alloys- Nichrome and Stainless steel – heat treatment of steel; Non-ferrous alloys – brass and bronze.

UNIT V NANOCHEMISTRY 9

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

TOTAL :45 PERIODS

OUTCOMES:

- The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

TEXT BOOKS:

1. Jain P.C. and Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010
2. Kannan P., Ravikrishnan A., “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009

REFERENCES:

1. Dara S.S, Umare S.S, “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi 2010
2. Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3. Gowariker V.R. , Viswanathan N.V. and JayadevSreedhar, “Polymer Science”, New Age International P (Ltd.,), Chennai, 2006.
4. Ozin G. A. and Arsenault A. C., “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2005.

GE6151 COMPUTER PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

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

UNIT I INTRODUCTION 8

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS 10

Problem formulation – Problem Solving - Introduction to ‘ C’ programming –fundamentals – structure of a ‘C’ program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in ‘C’ – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS 9

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design C Programs for problems.
- Write and execute C programs for simple applications.

TEXTBOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
3. Yashavant P. Kanetkar. " Let Us C", BPB Publications, 2011.

REFERENCES:

1. Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Dromey R.G., "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.
4. Rajaram.M. and Uma Maheswari, 'Computer programming with C', pearson 2014.

GE6152 ENGINEERING GRAPHICS L T P C
2 0 3 4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING 5+9

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 5+9

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 5+9

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+9

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+9

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

COMPUTER AIDED DRAFTING (Demonstration Only) 3

Introduction to drafting packages and demonstration of their use.

TOTAL : 75 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- perform free hand sketching of basic geometrical constructions and multiple views of objects.
- do orthographic projection of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- prepare isometric and perspective sections of simple solids.
- demonstrate computer aided drafting.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
2. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.
5. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE6161 COMPUTER PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

The student should be made to:

- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.
- Develop recursive programs.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

GE6162 ENGINEERING PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

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

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 9

Buildings:

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

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 13

Welding:

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

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

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

Machine assembly practice:

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

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 10

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 an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 13

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR 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.

TOTAL: 45 PERIODS

OUTCOMES:

- ability to fabricate carpentry components and pipe connections including plumbing works.
- ability to use welding equipments to join the structures.
- ability to fabricate electrical and electronics circuits.

REFERENCES:

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

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos

(e) Hand Drilling Machine 2 Nos
(f) Jigsaw 2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets.
7. Moulding table, foundry tools 2 Sets.
8. Power Tool: Angle Grinder 2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner One each.

ELECTRICAL

1. Assorted electrical components for house wiring 15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1 No.
5. Power Tools: (a) Range Finder 2 Nos
   (b) Digital Live-wire detector 2 Nos

ELECTRONICS

1. Soldering guns 10 Nos.
2. Assorted electronic components for making circuits 50 Nos.
3. Small PCBs 10 Nos.
4. Multimeters 10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply

GE6163 PHYSICS AND CHEMISTRY LABORATORY – I L T P C
0 0 2 1

PHYSICS LABORATORY – I

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS

(Any FIVE Experiments)

1. (a) Determination of Wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of Young's modulus by Non uniform bending method
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge

OUTCOMES:

- The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Diode laser, lycopodium powder, glass plate, optical fiber.
2. Ultrasonic interferometer
3. Spectrometer, mercury lamp, grating
4. Lee's Disc experimental set up
5. Traveling microscope, meter scale, knife edge, weights
6. Carey foster's bridge set up
   (vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

CHEMISTRY LABORATORY- I

OBJECTIVES:

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

LIST OF EXPERIMENTS

(Any FIVE Experiments)

1 Determination of DO content of water sample by Winkler's method.
2 Determination of chloride content of water sample by argentometric method.
3 Determination of strength of given hydrochloric acid using pH meter.
4 Determination of strength of acids in a mixture using conductivity meter.
5 Estimation of iron content of the water sample using spectrophotometer.
(1,10- phenanthroline / thiocyanate method).
6 Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
7 Conductometric titration of strong acid vs strong base.

TOTAL: 30 PERIODS

OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

REFERENCES:

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore 1994.
3. Jeffery G.H., Bassett J., Mendham J.and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Iodine flask	-	30 Nos
2.	pH meter	-	5 Nos
3.	Conductivity meter	-	5 Nos
4.	Spectrophotometer	-	5 Nos
5.	Ostwald Viscometer	-	10 Nos

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

HS6251 **TECHNICAL ENGLISH II** **L T P C**
3 1 0 4

OBJECTIVES:

- To make learners acquire listening and speaking skills in both formal and informal contexts.
- To help them develop their reading skills by familiarizing them with different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace contexts.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

UNIT I **9+3**

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; Grammar - Regular and irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II **9+3**

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercises on Grammar and vocabulary, Extensive reading activity (reading stories / novels), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III **9+3**

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret, etc.); Reading - Speed reading – reading passages with time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading articles from journals - Format for journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar and vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU and RIE materials – Attending a meeting and writing minutes.

UNIT IV **9+3**

Listening - Listening to a telephone conversation, Viewing model interviews (face-to-face, telephonic and video conferencing); Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on

Grammar and Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V **9+3**

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading; Writing – Checklist - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises; Language Lab - Different models of group discussion.

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

OUTCOMES:

Learners should be able to

- speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
- listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

TEXTBOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008
2. Muralikrishna, & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011
3. Riordan, Daniel. G. Technical Communication. Cengage Learning, New Delhi. 2005
4. Sharma, Sangeetha & Binod Mishra. Communication Skills for Engineers and Scientists. PHI Learning, New Delhi. 2009
5. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA. 2007

EXTENSIVE Reading (Not for Examination)

1. Khera, Shiv. You can Win. Macmillan, Delhi. 1998.

Websites

1. http://www.englishclub.com
2. http://owl.english.purdue.edu

TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc
- Long presentations using visual aids
- Listening and viewing activities with follow up activities like discussions, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc
- Projects like group reports, mock interviews etc using a combination of two or more of the language skills

EVALUATION PATTERN:

Internal assessment: 20%

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Report
- Creative writing, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual presentations, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded following Bloom's taxonomy
- ✓ Writing assessment: Writing essays, CVs, reports etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content graded following Bloom's taxonomy.

End Semester Examination: 80%

MA6251 MATHEMATICS – II L T P C
3 1 0 4

OBJECTIVES:

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

UNIT I VECTOR CALCULUS 9+3

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

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 9+3

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

UNIT III LAPLACE TRANSFORM 9+3

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

UNIT IV ANALYTIC FUNCTIONS 9+3

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, kz, $1/z$, z^2, e^z and bilinear transformation.

UNIT V COMPLEX INTEGRATION 9+3

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

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

OUTCOMES:

- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions. Students will be able to solve problems related to engineering applications by using these techniques.

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd.,2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

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

PH6251 ENGINEERING PHYSICS – II L T P C
3 0 0 3

OBJECTIVES:

- To enrich the understanding of various types of materials and their applications in engineering and technology.

UNIT I CONDUCTING MATERIALS 9

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

UNIT II SEMICONDUCTING MATERIALS 9

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – compound semiconductors -direct and indirect band gap- derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration –– Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its applications

Superconductivity: properties – Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) - High T_c superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS 9

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V ADVANCED ENGINEERING MATERIALS 9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, Nanomaterials– Preparation -pulsed laser deposition – chemical vapour deposition – Applications – NLO materials –Birefringence- optical Kerr effect – Classification of Biomaterials and its applications

TOTAL: 45 PERIODS

OUTCOMES:

- The students will have the knowledge on physics of materials and that knowledge will be used by them in different engineering and technology applications.

TEXT BOOKS:

1. Arumugam M., Materials Science. Anuradha publishers, 2010
2. Pillai S.O., Solid State Physics. New Age International(P) Ltd., publishers, 2009

REFERENCES:

1. Palanisamy P.K. Materials Science. SCITECH Publishers, 2011
2. Senthilkumar G. Engineering Physics II. VRB Publishers, 2011
3. Mani P. Engineering Physics II. Dhanam Publications, 2011
4. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009

CY6251 ENGINEERING CHEMISTRY - II L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- Principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.

UNIT I WATER TECHNOLOGY 9

Introduction to boiler feed water-requirements-formation of deposits in steam boilers and heat exchangers- disadvantages (wastage of fuels, decrease in efficiency, boiler explosion) prevention of scale formation -softening of hard water -external treatment zeolite and demineralization - internal treatment- boiler compounds (phosphate, calgon, carbonate, colloidal) - caustic embrittlement -boiler corrosion-priming and foaming- desalination of brackish water –reverse osmosis.

UNIT II ELECTROCHEMISTRY AND CORROSION 9

Electrochemical cell - redox reaction, electrode potential- origin of electrode potential- oxidation potential- reduction potential, measurement and applications - electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion- causes- factors- types- chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Paints- constituents and function. Electroplating of Copper and electroless plating of nickel.

UNIT III ENERGY SOURCES 9

Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion- differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor- solar energy conversion- solar cells- wind energy. Batteries and fuel cells:Types of batteries- alkaline battery- lead storage battery- nickel-cadmium battery- lithium battery- fuel cell H_2 -O_2 fuel cell- applications.

UNIT IV ENGINEERING MATERIALS 9

Abrasives: definition, classification or types, grinding wheel, abrasive paper and cloth. Refractories: definition, characteristics, classification, properties – refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, porosity; Manufacture of alumina, magnesite and silicon carbide, Portland cement- manufacture and properties - setting and hardening of cement, special cement- waterproof and white cement–properties and uses. Glass - manufacture, types, properties and uses.

UNIT V FUELS AND COMBUSTION 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. Vairam S, Kalyani P and SubaRamesh.,"Engineering Chemistry"., Wiley India PvtLtd.,New Delhi., 2011
2. DaraS.S,UmareS.S."Engineering Chemistry", S. Chand & Company Ltd., New Delhi , 2010

REFERENCES:

1 Kannan P. and Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009

2. AshimaSrivastava and Janhavi N N., "Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
3. RenuBapna and Renu Gupta., "Engineering Chemistry", Macmillan India Publisher Ltd., 2010.

4 Pahari A and Chauhan B., "Engineering Chemistry"., Firewall Media., New Delhi., 2010

GE6252 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
4 0 0 4

OBJECTIVES:

- To explain the basic theorems used in Electrical circuits and the different components and function of electrical machines.
- To explain the fundamentals of semiconductor and applications.
- To explain the principles of digital electronics
- To impart knowledge of communication.

UNIT I ELECTRICAL CIRCUITS & MEASURMENTS 12

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS 12

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS 12

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL: 60 PERIODS

OUTCOMES:

- ability to identify the electrical components explain the characteristics of electrical machines.
- ability to identify electronics components and use of them to design circuits.

TEXT BOOKS:

1. Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
2. Sedha R.S., "Applied Electronics", S. Chand & Co., 2006.

REFERENCES:

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, 2006.
2. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press 2005.
3. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, 1994.
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5. Premkumar N, "Basic Electrical Engineering", Anuradha Publishers, 2003.

GE6253 ENGINEERING MECHANICS L T P C
3 1 0 4

OBJECTIVES:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I BASICS AND STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces –– Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas –

Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 12

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 60 PERIODS

OUTCOMES:

- ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
- ability to analyse the forces in any structures.
- ability to solve rigid body subjected to dynamic forces.

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES:

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
3. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
4. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
5. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
6. Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi 2008.

GE6261 COMPUTER AIDED DRAFTING AND MODELING LABORATORY L T P C
0 1 2 2

OBJECTIVES:

- To develop skill to use software to create 2D and 3D models.

List of Exercises using software capable of Drafting and Modeling

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and

dimensioning.

5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

TOTAL: 45 PERIODS

OUTCOMES:

- ability to use the software packers for drafting and modeling
- ability to create 2D and 3D models of Engineering Components

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No	Description of Equipment	Quantity
1.	Pentium IV computer or better hardware, with suitable graphics facility	30 No.
2.	Licensed software for Drafting and Modeling.	30 Licenses
3.	Laser Printer or Plotter to print / plot drawings	2 No.

GE6262 PHYSICS AND CHEMISTRY LABORATORY – II

L	T	P	C
0	0	2	1

PHYSICS LABORATORY – II

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS
(Any FIVE Experiments)

1. Determination of Young's modulus by uniform bending method
2. Determination of band gap of a semiconductor
3. Determination of Coefficient of viscosity of a liquid –Poiseuille's method
4. Determination of Dispersive power of a prism - Spectrometer
5. Determination of thickness of a thin wire – Air wedge method
6. Determination of Rigidity modulus – Torsion pendulum

OUTCOMES:

- The students will have the ability to test materials by using their knowledge of applied physics principles in optics and properties of matter.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Traveling microscope, meter scale, Knife edge, weights
2. Band gap experimental set up
3. Burette, Capillary tube, rubber tube, stop clock, beaker and weighing balance
4. spectrometer, prism, sodium vapour lamp.
5. Air-wedge experimental set up.
6. Torsion pendulum set up.
    a. (vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

CHEMISTRY LABORATORY - II

OBJECTIVES:

- To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

LIST OF EXPERIMENTS
(Any FIVE Experiments)

1 Determination of alkalinity in water sample
2 Determination of total, temporary & permanent hardness of water by EDTA method
3 Estimation of copper content of the given solution by EDTA method
4 Estimation of iron content of the given solution using potentiometer
5 Estimation of sodium present in water using flame photometer
6 Corrosion experiment – weight loss method
7 Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4
8 Determination of CaO in Cement.

TOTAL: 30 PERIODS

OUTCOMES:

- The students will be conversant with hands-on knowledge in the quantitative chemical analysis of water quality related parameters, corrosion measurement and cement analysis.

REFERENCES:

1. Daniel R. Palleros, “Experimental organic chemistry” John Wiley & Sons, Inc., New York, 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., “Vogel’s Textbook of practical organic chemistry, LBS Singapore ,1994.
3. Jeffery G.H, Bassett J., Mendham J. and Denny R.C., “Vogel’s Text book of quantitative analysis chemical analysis”, ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4. Kolthoff I.M. and Sandell E.B. et al. Quantitative chemical analysis, McMillan, Madras 1980

- **Laboratory classes on alternate weeks for Physics and Chemistry.**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Potentiometer - 5 Nos
2. Flame photo meter - 5 Nos
3. Weighing Balance - 5 Nos
4. Conductivity meter - 5 Nos

Common Apparatus : Pipette, Burette, conical flask, percelain tile, dropper (30 Nos each)

MA6351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4

OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

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

UNIT II FOURIER SERIES 9 + 3

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

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

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

UNIT IV FOURIER TRANSFORMS 9 + 3

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

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9 + 3

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

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

OUTCOMES:

- The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.

REFERENCES:

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd , 2007.

2. Ramana.B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata Mc Graw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.

EC6302 DIGITAL ELECTRONICS L T P C
3 0 0 3

OBJECTIVES:

- To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of combinational circuits
- and sequential circuits
- To introduce the concept of memories and programmable logic devices.
- To illustrate the concept of synchronous and asynchronous sequential circuits

UNIT I MINIMIZATION TECHNIQUES AND LOGIC GATES 9

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

Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND–NOR implementations – Multi
level gate implementations- Multi output gate implementations. TTL and CMOS Logic and their characteristics – Tristate gates

UNIT II COMBINATIONAL CIRCUITS 9

Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.

UNIT III SEQUENTIAL CIRCUITS 9

Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation –Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor- Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment - Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.

UNIT IV MEMORY DEVICES 9

Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle - Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

UNIT V SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits

Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits. Design of Combinational and Sequential circuits using VERILOG.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to:

- Analyze different methods used for simplification of Boolean expressions.
- Design and implement Combinational circuits.
- Design and implement synchronous and asynchronous sequential circuits.
- Write simple HDL codes for the circuits.

TEXT BOOK:

1. M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.

REFERENCES:

1. John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008
2. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
3. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4. Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
5. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011
6. Donald D.Givone, "Digital Principles and Design", TMH, 2003.

RO6301 SENSORS AND INSTRUMENTATION L T P C
3 0 2 4

OBJECTIVES:

- To introduce the terminologies associated with the measuring system.
- To impart knowledge on sensors and transducer for temperature measurements.
- To understand and calibrate the method of measuring pressure, displacement and velocity.
- To introduce flow measuring devices and operations
- To practically expose the students to different measurement devices and use of them to measuring different variable.

UNIT I MEASURING SYSTEM: 7+3

Factors in making the measurements-accuracy, precision, resolution, repeatability, reproducibility, hysteresis, sensitivity, range. International standards for measurement. Errors in Measurement – Gross Errors, Systematic Errors, Mounting and deformation Error – Thermally Induced Error – Interpolation Error – Dynamic Error, Calibration techniques.

UNIT II SENSORS AND TRANSDUCERS FOR TEMPERATURE MEASUREMENT 8+6

Terminology, principle of operation, Characteristics and signal conditioning- Bimetallic thermostats, Resistance Temperature Detectors, Thermistors, Thermocouples, solid state temperature sensors.

UNIT III PRESSURE & FLOW MEASUREMENT: 8+6

Principle of operation, Characteristics and signal conditioning- Liquid manometers, Capacitance diaphragms, piezoelectric diaphragm, Venturi flow meters, Magnetic flow meter, float switch.

UNIT IV DISPLACEMENT & VELOCITY MEASUREMENT: 10+9

Linear and angular measurement systems, Potentiometer type- resistive- strain gauge, capacitive and inductive, LVDT, Limit switches, inductive and capacitive proximity switches, ultrasonic and photo-electric sensors- linear scales, Laser Interferometers, tachogenerator, Encoders-absolute and incremental ,Synchros and resolvers.

UNIT V OTHER SENSORS: 15+3

Sensors for measurement of vibration, Acoustics, humidity, weight, volume and radiation. Tactile sensors: force, torque. Pressure.

Signal Conditioning And Interfacing: Passive circuit Techniques – Active circuit Techniques Introduction to Wireless sensors.

LIST OF EXPERIMENTS:

1. Measuring quantities using instruments
2. Measurement of temperature using Platinum RTD and plotting its characteristics
3. Measurement of temperature using NTC Thermistor and plotting its characteristics.
4. Study of strain measurement using strain gauges and cantilever assembly.
5. Flow measurement
6. Study of Input Output characteristics of LVDT.
7. To determine linear Range of operation and Sensitivity of LVDT.
8. Measurement of speed using a proximity switch
9. Velocity and displacement measurement using Encoder.
10. Tactile sensors for force and torque measurement

TOTAL (L:45+T:30): 75 PERIODS

OUTCOMES:

- ability to explain the different terms related to measurement system
- ability to calibrate and use the sensors and transducer for temperature, force, pressure, velocity and displacements.
- ability to demonstrate different measurement techniques for measuring different variables.

TEXT BOOKS:

1. Peter Elgar ,"Sensors for Measurement and Control", Addison-Wesley Longman Ltd, 1998
2. A.K.Sawhney "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co., 2010

REFERENCES:

1. Patranabis D, "Sensors and Transducers", Prentice-Hall of India Private Limited, New Delhi, 2003.
2. Ernest O Doebelin, "Measurement systems Application and Design", Tata McGraw-Hill Book Company, 2010.

EC6202 ELECTRONIC DEVICES AND CIRCUITS L T P C
3 1 0 4

OBJECTIVES:

- To know the structure, operation and applications of the basic electronic devices.

UNIT I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, diffusion and transient capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diode-characteristics-Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristor and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS 9

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response-High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Explain the structure of basic electronic devices.
- Design applications using basic* electronic devices..

TEXT BOOKS:

1. David A. Bell ,"Electronic devices and circuits", Prentice Hall of India, 2004.
2. Sedra and smith, "Microelectronic circuits " Oxford University Press, 2004.

REFERENCES:

1. Rashid, "Micro electronic circuits" Thomson publications, 1999.
2. Floyd, "Electron devices" Pearson Asia 5th Edition, 2001.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

EE6356 ELECTRICAL MACHINES AND POWER SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To know about basic electrical prime movers, electrical transmission and distribution systems.

UNIT I D.C. MACHINES 10

Constructional details – EMF equation – methods of excitation – self and separately excited generators – characteristics of series, and shunt generators – principle of operation of D.C. Motor – back emf and torque equation – characteristics of series and shunt motors - starting of D.C. Motors – types of starters - speed control and braking of DC. motors.

UNIT II TRANSFORMERS 10

Constructional Details – Principle Of Operation – EMF Equation – Transformation Ratio – Transformer on No Load – Parameters Referred To HV/LV Windings – Equivalent Circuit – Transformer on Load – Regulation - Testing – Load Test - 3- PHASE Transformers connections.

UNIT III INDUCTION MOTORS 10

Construction – types – principle of operation of three-phase induction motors – equivalent circuit – starting and speed control – single-phase induction motors (only qualitative analysis).

UNIT IV SYNCHRONOUS AND SPECIAL MACHINES 8

Construction of Synchronous machines-types – induced emf – brushless alternators – reluctance motor – stepper motor servo motor.

UNIT V INTRODUCTION TO POWER SYSTEM 7

Structure of electric power systems – generation, transmission, sub-transmission and distribution systems - EHVAC and EHVDC transmission systems – substation layout. (Concepts only).

TOTAL: 45 PERIODS

OUTCOMES:

- understanding the principles of operations and characteristics of DC machines
- knowledge of electrical transformers and induction motors
- able to visualise the operation of synchronous motors stepper and sevo motors.
- comprehending the power transmission and distributing systems.

TEXT BOOKS :

1. Murugesh Kumar K. , ‘Electric Machines Vo I’, Vikas Publishing House Pvt Ltd, 2010.
2. Murugesh Kumar K. , ‘Electric Machines Vol II’, Vikas Publishing House Pvt Ltd, 2010
3. Mehta V.K. and Rohit Mehta, ‘Principles of Power System’, S.Chand and Company Ltd, 2003

REFERENCES:

1. Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, ‘Electric Machinery’, Tata McGraw Hill publishing Company Ltd, 2003.
2. Gupta J.B., ‘Theory and Performance of Electrical Machines’, S.K.Kataria and Sons, 2002
3. Kothari D.P. and Nagrath I.J., ‘Electric Machines’, Tata McGraw Hill Publishing Company Ltd, 2002.
4. Bhimbhra P.S. , ‘Electrical Machinery’, Khanna Publishers, 2003.

GE6351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To the study of nature and the facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins – Biochemical

degradation of pollutants, Bioconversion of pollutants.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS :

1. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, 2nd edition, Pearson Education 2004.
2. Benny Joseph, ‘Environmental Science and Engineering’, Tata McGraw-Hill, New Delhi, 2006.

REFERENCES:

1. R.K. Trivedi, ‘Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards’, Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, ‘Environmental Encyclopedia’,Jaico Publ.,House, Mumbai, 2001.
3. Dharmendra S. Sengar, ‘Environmental law’, Prentice hall of India PVT LTD,New Delhi, 2007.
4. Rajagopalan, R, ‘Environmental Studies-From Crisis to Cure’, Oxford University Press 2005

EC6362 ELECTRONIC CIRCUITS AND DIGITAL LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To practically train the student to study the characteristics of electronic components and circuits.

LIST OF EXPERIMENTS:

1. Characterisitics of diode and clipper circuits.
2. Characterisitics of Zener diode and Zener voltage regulator
3. Characteristics of BJT.
4. Characterisitics of JFET
5. Application of BJT as an amplifier and switch.
6. Study of Basic Digital ICs.
7. Implementation of Adder and Subtractor circuits
8. Design of Code converters.
9. Study of Multiplexer and Demultiplexer.
10. Design and Implementation of Counters and registers

TOTAL : 45 PERIODS

OUTCOMES:

- ability to use the electronics components and use of them to built electronic circuits for process the signals.

REFERENCES:

1. Poornachandra Rao S and Sasikala B, "Handbook of Experiments in Electronics and Communication Engineering", Vikas Publishing House Pvt. Ltd., New Delhi 2003.
2. Laboratory Manual Prepared by R&AE Department.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

SL.No.	NAME OF THE EQUIPMENT	Qty.
1	0 – 30V RPS	12
2	0 – 50V RPS	2
3	0 – 5V RPS	2
4	0 – 30V Voltmeter	10
5	0 – 10V Voltmeter	5
6	0 –50V Voltmeter	2
7	0 – 1V Voltmeter	3
8	0 – 30mA Ammeter	5
9	0 – 100mA AC Amplifier	2
10	Audio Oscillator	5
11	CRO (30 MHZ)	15
12	Diodes, Zener Diodes	20
13	Transistors (PNP & NPN)	10
14	UJT	10
15	SCR	10
16	JFET	10
17	MOSFET	10
18	DIAC & TRIAC	10
19	Photodiode	5
20	Photo Transistor	5
21	Required Passive Components	
22	Variable Resistor	

EE6363 ELECTRICAL MACHINES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics and simulation of time response.
- To expose the students to the basic operation of electrical machines and help them to develop experimental skills.

LIST OF EXPERIMENTS:

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator.
3. Load test on D.C. shunt motor.
4. Load test on D.C. series motor.
5. Swinburne's test
6. speed control of D.C. shunt motor.
7. Load test on single phase transformer
8. open circuit and short circuit tests on single phase transformer(Determination of equivalent circuit parameters).
9. Load test on single phase induction motor.
10. No load and blocked rotor tests on three phase induction motor (Determination of
11. equivalent circuit parameters)
12. Load test on Three phase induction motor.
13. Study of Starters

TOTAL: 45 PERIODS

OUTCOMES:

- ability to verify the circuit laws and theorems and measure the circuit parameter.
- ability to operate electrical machines.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	DC Shunt Motor with Loading Arrangement	3 nos
2	Single Phase Transformer	4 nos
3	DC Series Motor with Loading Arrangement	1 No.
4	Three Phase Induction Motor with LoadingArrangement	2 nos
5	Single Phase Induction Motor with LoadingArrangement	1 No.
6	DC Shunt Motor Coupled With DC Compound Generator	2 nos
7	DC Shunt Motor Coupled With DC Shunt Generator	1 No
8	Tachometer -Digital/Analog	8 nos
9	Single PhaseAutoTransformer	2 nos
10	Three PhaseAutoTransformer	1 No.
11	Single Phase Resistive Loading Bank	2 nos
12	Three Phase Resistive Loading Bank	2 nos
13	SPST switch	2 nos

MA6451 PROBABILITY AND RANDOM PROCESSES L T P C
3 1 0 4

OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems etc in communication engineering.

UNIT I RANDOM VARIABLES 9+3

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 9+3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables.

UNIT III RANDOM PROCESSES 9+3

Classification – Stationary process – Markov process - Poisson process – Random telegraph process.

UNIT IV CORRELATION AND SPECTRAL DENSITIES 9+3

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 9+3

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and Cross correlation functions of input and output.

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

OUTCOMES

- The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable. Able to analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS

1. Ibe.O.C.,"Fundamentals of Applied Probability and Random Processes", Elsevier,1st Indian Reprint, 2007.
2. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, 4th Edition, New Delhi, 2002.

REFERENCES

1. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.
2. Stark. H., and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing", Pearson Education, Asia, 3rd Edition, 2002.
3. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press, 2004.
4. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
5. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.

RO6401 **AUTOMATIC CONTROL SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the basics of control system and its response .stability of mechanical and electrical systems . Use of MATLAB to design a stable control system.

UNIT I INTRODUCTION **9**

Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function - Modeling of physical systems – Mechanical, Thermal, Hydraulic systems and Electric Networks - Transfer function of DC generator, DC servomotor, AC servomotor ,Potentiometer, Synchros, Tacho-generator, Stepper motor - Block diagram - reduction techniques, Signal flow graph – Mason' gain formula. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT II TIME DOMAIN ANALYSIS **9**

Standard Test signals – Time response of second order system - Time domain specifications - Types of systems - Steady state error constants - Introduction to P, PI and PID modes of feed back control. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT III FREQUENCY DOMAIN ANALYSIS **9**

Frequency domain specifications - Time and frequency response correlation – Polar plot – Bode plot – All pass minimum phase and non-minimum phase systems. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT IV SYSTEM STABILITY **9**

Characteristic equation - Routh Hurwitz criterion of stability - Absolute and Relative stability - Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT V ROOT LOCUS METHOD **9**

Root locus concepts - Construction of root loci – Root contours. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

STATE SPACE ANALYSIS: Limitations of conventional control theory - Concepts of state, state variables and state model – state model for linear time invariant systems - Introduction to state space representation using physical - Phase and canonical variables. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

TOTAL : 45 PERIODS

OUTCOMES:

- To expose students to the state space representation and its analysis.
- To introduce non-linear systems and their control. To impart knowledge on advanced control techniques

TEXT BOOKS:

1. Nagrath I J, and Gopal, M, 'Control Systems Engineering" Prentice Hall of India, New Delhi, 2008.
2. Richard C Dorf and Robert H Bishop, "Modern Control Systems.", Addison-Wesley -2007

REFERENCES:

1. Ogata K, "Modern Control Engineering", Pearson Education, New Delhi, 2006.
2. Kuo B C, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd, New Delhi, 2004.
3. Norman C. Nise S, "Control system Engineering', John Wiley & Sons, Singapore, 2004.

MF6505 CNC MACHINING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

Upon completion of this subject, student will be able to:

- Understand evolution and principle of CNC machine tools
- Describe constructional features of CNC machine tools
- Explain drives and positional transducers used in CNC machine tools
- Write simple programs for CNC turning and machining centres
- Generate CNC programs for popular CNC controllers
- Describe tooling and work holding devices for CNC machine tools

UNIT I INTRODUCTION TO CNC MACHINE TOOLS 6

Evolution of CNC Technology, principles, features, advantages, applications,CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection

UNIT II STRUCTURE OF CNC MACHINE TOOL 10

CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.

UNIT III DRIVES AND CONTROLS 9

Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer.

UNIT IV CNC PROGRAMMING 11

Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages.

UNIT V TOOLING AND WORK HOLDING DEVICES 9

Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts classification- PMK, NSH, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course the students can able to understand evolution and principle of CNC machine tools and describe constructional features of CNC machine tools

TEXT BOOKS:

1. "Mechatronics", HMT, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2. Warren S.Seamers, "Computer Numeric Control", Fourth Edition, Thomson Delmar, 2002.

REFERENCES:

1. James Madison, “CNC Machining Hand Book”, Industrial Press Inc., 1996.
2. Ken Evans, John Polywka & Stanley Gabrel, “Programming of CNC Machines”, Second Edition, Industrial Press Inc, New York, 2002
3. Peter Smid, “CNC Programming Hand book”, Industrial Press Inc., 2000
4. Berry Leathan – Jones, “Introduction to Computer Numerical Control”, Pitman, London, 1987.
5. Radhakrishnan P “Computer Numerical Control Machines”, New Central Book Agency, 2002.
6. Rao P.N., CAD/CAM, Tata McGraw Hill Publishing Company Limited, New Delhi, 2002.

EC6301 OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I DATA ABSTRACTION & OVERLOADING 9

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

UNIT II INHERITANCE & POLYMORPHISM 9

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

UNIT III LINEAR DATA STRUCTURES 10

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

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search - Connected components.

UNIT V SORTING and SEARCHING 8

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the concepts of Object oriented programming.
- Write simple applications using C++.
- 8Discuss the different methods of organizing large amount of data.

TEXT BOOKS:

1. Deitel and Deitel, “C++, How To Program”, Fifth Edition, Pearson Education, 2005.
2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Third Edition, Addison-Wesley, 2007.

REFERENCES:

1. Bhushan Trivedi, “Programming with ANSI C++, A Step-By-Step approach”, Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, 7th Edition, Wiley. 2004.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, Mc Graw Hill, 2002.
4. Bjarne Stroustrup, “The C++ Programming Language”, 3rd Edition, Pearson Education, 2007.
5. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, “Fundamentals of Data Structures in C++”, Galgotia Publications, 2007.

EC6404 LINEAR INTEGRATED CIRCUITS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits.
- To teach the linear and non-linear applications of operational amplifiers.
- To introduce the theory and applications of analog multipliers and PLL.
- To teach the theory of ADC and DAC.
- To introduce the concepts of waveform generation and introduce some special function ICs.

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode *R 2R* Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS 9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design linear and non linear applications of op – amps.
- Design applications using analog multiplier and PLL.
- Design ADC and DAC using op – amps.
- Generate waveforms using op – amp circuits.
- Analyze special function ICs.

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2000.
2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 3rd Edition, Tata Mc Graw-Hill, 2007.

REFERENCES:

1. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2001.
2. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.
3. B.S.Sonde, “System design using Integrated Circuits” , 2nd Edition, New Age Pub, 2001
4. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International, 2005.
5. Michael Jacob, “Applications and Design with Analog Integrated Circuits”, Prentice Hall of India, 1996.
6. William D.Stanley, “Operational Amplifiers with Linear Integrated Circuits”, Pearson Education, 2004.
7. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH, 2008.

AN6402 KINEMATICS AND DYNAMICS OF MACHINERY L T P C

3 1 0 4

OBJECTIVES:

- To understand the basic components and layout of linkages in the assembly of a system/ machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

UNIT I KINEMATIC OF MECHANICS 10

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

UNIT II GEARS and GEAR TRAINS 9

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

UNIT III FRICTION 8

Sliding and Rolling Friction angle – friction in threads – Friction Drives – Friction clutches– Belt and rope drives – brakes – Tractive resistance.

UNIT IV FORCE ANALYSIS 9

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members.

UNIT V BALANCING AND VIBRATION 9

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration solation.

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

OUTCOMES:

- Upon completion of this course, the students can able to apply Students can able to apply fundamentals of mechanism for the design of new mechanisms and analyse them for optimum design.

TEXT BOOKS:

1. Ambekar A.G., "Mechanism and Machine Theory" Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., "Theory of Machines and Mechanisms", Oxford University Press, 2003

REFERENCES:

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh. A, and A.K. Mallick, "Theory and Machine", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. Rao.J.S. and Dukkipatti R.V. "Mechanisms and Machines", Wiley-Eastern Ltd., New Delhi, 1992.
4. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low Prices Student Edition, 1999.
5. V.Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.
6. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

RO6411 **CNC AND METROLOGY LABORATORY** **L T P C**
0 0 3 2

OBJECTIVES:

- To impart knowledge in CNC programming for turning and milling operations and to use measuring systems for the geometrical measurements of gears and threads.

LIST OF EXPERIMENTS:

1. Study of the CNC machine
2. Programming and simulation of a lathe in Keller software
3. Programming and simulation of a machining centre in Keller software
4. Programming a CNC Lathe-Fanuc
5. Programming a CNC machining centre-Fanuc
6. Programming and simulation in Heidenhain controller
7. Optical profile projector - study of profile of gear tooth, screw threads.
8. Tool maker's microscope - to study cutting tool geometry, screw threads.
9. Tool wear and surface finish measurement.
10. Dimensional measurement of machined components using, bore gauge, air gauge and Height master

OUTCOMES:

- Ability to understand the features and operation of CNC machines.
- Ability to prepare CNC program from the component drawings
- Understanding the usage of profile projectors and tool makers microscopes.

TOTAL : 45 PERIODS

REFERENCE:

- Laboratory Manual Prepared by R&AE Department

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	CNC lathe	1 no
2	CNC milling machine	1 no
3	Production type CNC machining centre	1 no
4	CNC lathe and milling programming software (FANUC controller)	10 Licenses
5	CNC lathe and milling programming software (Heidenhain controller)	5 Licenses
6	Optical profile projector	1 no
7	tool makers microscope	1 no
8	measuring gauges for hole depth and height.	

ME6511 **DYNAMICS LABORATORY** **L T P C**
0 0 3 2

OBJECTIVES:

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS

1. a) Study of gear parameters.
   b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.

2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
   b) Kinematics of single and double universal joints.
3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
   b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
   c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7. a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
   b) Multi degree freedom suspension system – Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies.
   b) Vibration Absorber – Tuned vibration absorber.
9. Vibration of Equivalent Spring mass system – undamped and damped vibration.
10. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
11. a) Balancing of rotating masses. (b) Balancing of reciprocating masses.
12. a) Transverse vibration of Free-Free beam – with and without concentrated masses.
    b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
    c) Determination of transmissibility ratio using vibrating table.

TOTAL : 45 PERIODS

OUTCOME

- Ability to demonstrate the principles of kinematics and dynamics of machinery
- Ability to use the measuring devices for dynamic testing.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Cam follower setup.	1 No.
2	Motorised gyroscope.	1 No.
3	Governor apparatus - Watt, Porter, Proell and Hartnell governors.	1 No.
4	Whirling of shaft apparatus.	1 No.
5	Dynamic balancing machine.	1 No.
6	Two rotor vibration setup.	1 No.
7	Spring mass vibration system.	1 No.
8	Torsional Vibration of single rotor system setup.	1 No.
9	Gear Models	1 No.
10	Kinematic Models to study various mechanisms.	1 No.
11	Turn table apparatus.	1 No.
12	Transverse vibration setup of a) cantilever b) Free-Free beam c) Simply supported beam.	1 No.

EC6467 LIC AND CONTROL SYSTEMS LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To impart launch on experience in characterising different LIC
- To train the students in MATLAB simulation of study the characteristics of LIC

LIST OF EXPERIMENTS:

1 Characteristics and Applications of Op-Amp.
2. Waveform Generation using Op-Amp.
3. Performance characteristics of Voltage Regulator ICs.
4. Study of 555 Timer and 566 VCO.
5. Design and Implementation of Active Filters.
6. Determination of transfer function of DC servomotor.
7. Determination of transfer function of AC servomotor and study of synchros.
8. Time domain Response of first order and second order systems using MATLAB.
9. Frequency response of first and second order system using MATLAB.
10. Characteristics of PID controllers using MATLAB.

OUTCOMES:

- ability to design LIC and describe the characteristics.

TOTAL : 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Dual, (0-30V) variable Power Supply	10
2	CRO 30MHz	9
3	Digital Multimeter	10
4	Function Generator 1 MHz	8
5	IC Tester (Analog)	2
6	Bread board	10
7	Computer (PSPICE installed)	1

ME6015 OPERATIONS RESEARCH L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

UNIT I LINEAR MODELS 15

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS 8

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

UNIT III INVENTORY MODELS 6

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS 6

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V DECISION MODELS 10

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems

TEXT BOOK:

1. Taha H.A., "Operations Research", Prentice Hall of India, 2003, Sixth Edition.

REFERENCES:

1. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
2. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Hillier and Libeberman, "Operations Research", Holden Day, 1986
5. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
6. Tulsian and Pasdey V., "Quantitative Techniques", Pearson – Asia 2002.

RO6501 PROGRAMMABLE LOGIC CONTROLLERS L T P C
3 0 2 4

OBJECTIVES:

The student should be made to

- Be familiar with factory automation
- Be exposed to programmable logic controllers
- Learn to programme PLC
- Be exposed to HMI systems
- Learn to install and maintain procedures for PLC
- Be exposed to applications of PLC

UNIT I INTRODUCTION TO FACTORY AUTOMATION 6

History and developments in industrial automation. Vertical integration of industrial automation, Control elements in industrial automation, PLC introduction.

UNIT II PROGRAMMABLE LOGIC CONTROLLERS 12

Basics of PLC, Advantages, Capabilities of PLC, Architecture of PLC, Scan cycle, Types of PLC, Types of I/O modules, Configuring a PLC, PLC wiring,.

UNIT III PROGRAMMING OF PLC 25

Types of Programming - Simple process control programs using Relay Ladder Logic - PLC arithmetic functions - Timers and counters –data transfer-comparison and manipulation instructions, PID instructions, PTO / PWM generation.

UNIT IV HMI SYSTEMS 12

Necessity and Role in Industrial Automation, Text display - operator panels - Touch panels - Panel PCs - Integrated displays, interfacing PLC to HMI.

UNIT V INSTALLATION 20

Installation and maintenance procedures for PLC - Troubleshooting of PLC, PLC Networking- Networking standards & IEEE Standard - Protocols - Field bus - Process bus and Ethernet.

APPLICATIONS OF PLC

Case studies of Machine automation, Process automation, Selection parameters for PLC. Introduction to Programmable Automation Controller.

TOTAL (L:45+T:30) : 75 PERIODS

OUTCOMES:

Upon completion of this course students can able to

- Explain programmable logic controllers
- Program PLC
- Explain HMI systems
- Install and maintain procedures for PLC
- Build application on PLC

TEXT BOOKS:

1. John W Webb & Ronald A Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
2. Frank D Petruzella “Programmable Logic Controllers ", McGraw Hill Inc, 2005

REFERENCES:

1. Bolton W. , “Mechatronics”, Pearson Education, 2009
2. Kelvin T Erikson, “Programmable Logic Controllers ", Dogwood Valley Press, 2005

LIST OF EXPERIMENTS:

1. Wire up a PLC for the given lamp circuit
2. Design a Ladder logic for the given lamp circuit
3. Design and implement ladder logic for the forward and reverse control of a hydraulic cylinder.
4. Design a ladder diagram for performing the given arithmetic operations.
5. Design a ladder diagram for performing the given application using counters
6. Design a ladder diagram for performing the given application using Timers.
7. Interfacing PLC to HMI- text display.
8. Programming a graphical HMI
9. Networking PLCs- drives and a host computer.
10. Troubleshooting PLCs

RO6502 BASICS OF ROBOTICS L T P C

3 0 0 3

OBJECTIVES:

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
- To discuss about the various applications of robots, justification and implementation of robot.

UNIT I INTRODUCTION 9

Specifications of Robots- Classifications of robots – Work envelope - Flexible automation versus Robotic technology – Applications of Robots

ROBOT KINEMATICS AND DYNAMICS

Positions, Orientations and frames, Mappings: Changing descriptions from frame to frame, Operators: Translations, Rotations and Transformations - Transformation Arithmetic - D-H Representation - Forward and inverse Kinematics Of Six Degree of Freedom Robot Arm – Robot Arm dynamics

UNIT II ROBOT DRIVES AND POWER TRANSMISSION SYSTEMS 9

Robot drive mechanisms, hydraulic – electric – servomotor- stepper motor - pneumatic drives, Mechanical transmission method - Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems - Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws,

UNIT III MANIPULATORS 9

Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and Pneumatic manipulators

UNIT IV ROBOT END EFFECTORS 9

Classification of End effectors – Tools as end effectors. Drive system for grippers-Mechanical-adhesive-vacuum-magnetic-grippers. Hooks&scoops. Gripper force analysis and gripper design. Active and passive grippers.

UNIT V PATHPLANNING & PROGRAMMING: 9

Trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion – straight line motion-Robot languages -.computer control and Robot software.

TOTAL : 45 PERIODS

OUTCOMES:

- The Student must be able to design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effectors, sensor, machine vision robot kinematics and programming.

TEXT BOOKS:

1. Deb S. R. and Deb S., “Robotics Technology and Flexible Automation”, Tata McGraw Hill Education Pvt. Ltd, 2010.
2. John J.Craig , “Introduction to Robotics”, Pearson, 2009.
3. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.

REFERENCES:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics : Control, Sensing, Vision and Intelligence", McGraw Hill, 1987

EE6502 MICROPROCESSORS AND MICROCONTROLLERS L T P C
3 0 0 3

OBJECTIVES

- To study the Architecture of uP8085 &uC 8051
- To study the addressing modes & instruction set of 8085 & 8051.
- To introduce the need & use of Interrupt structure 8085 & 8051.
- To develop skill in simple applications development with programming 8085 & 8051
- To introduce commonly used peripheral / interfacing

UNIT I 8085 PROCESSOR 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

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

UNIT III 8051 MICRO CONTROLLER 9

Hardware Architecture, pintouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts-Comparison to Programming concepts with 8085.

UNIT IV PERIPHERAL INTERFACING 9

Study on need, Architecture, configuration and interfacing, with ICs: 8255 , 8259 , 8254,8237,8251, 8279 ,- A/D and D/A converters &Interfacing with 8085& 8051

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Data Transfer, Manipulation, Control Algorithms& I/O instructions – Simple programming exercises-key board and display interface – Closed loop control of servo motor- stepper motor control – Washing Machine Control.

TOTAL : 45 PERIODS

OUTCOMES

- Ability to understand and analyse, linear and digital electronic circuits.
- To understand and apply computing platform and software for engineering problems.

TEXT BOOKS

1. Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall of India, New Delhi , 2007.
2. R.S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.

REFERENCES:

1. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely ‘The 8051 Micro Controller and Embedded Systems’, PHI Pearson Education, 5th Indian reprint, 2003.
2. N.Senthil Kumar, M.Saravanan, S.Jeevananthan, ‘Microprocessors and Microcontrollers’, Oxford,2013.
3. Valder – Perez, “Microcontroller – Fundamentals and Applications with Pic,” Yeesdee Publishers, Tayler & Francis, 2013.

RO6503 **MECHANICAL DESIGN** **L T P C**
3 1 0 4

OBJECTIVES:

- To gain knowledge in the design of common types of machine elements.

UNIT I DESIGN OF GEARS 13

Review of gear fundamentals, interference, gear forces, determining dimensions of a spur gear pair. Design of helical gears-parallel axis helical gear, normal and transverse planes, helix angles, equivalent number of teeth, determining dimension of helical gear pair, nomenclature of straight and bevel gears.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 13

Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength and critical speed. Couplings-types and applications, Design of square keys-use of standards, rigid couplings, flexible flange couplings - selection.

UNIT III SELECTION OF V BELTS AND CHAINS 13

V belts for given power and velocity ratio, selection of micro V-belts, timing belts. Selection of roller chain and power speed ratio, silent chain.

UNIT IV ROLLING CONTACT BEARINGS 8

Static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove and angular contact ball bearings.

UNIT V FRICTION DRIVES 13

Clutches - role of clutches, positive and gradually engaged clutches, toothed claw clutches, design of single plate and multiple plate clutches, variable speed drives, types and selection

TOTAL: 60 PERIODS

OUTCOMES:

- ability to make the design of transmission systems using gear
- understanding shaft and coupling design procedure
- ability to select belts and bearings for given design requirements.
- knowledge of friction drives.

TEXT BOOKS:

1. Robert L Mott, "Machine Elements in Mechanical Design", Macmillan Publishing Co., London, 1992.
2. Shigley and Mische, “Mechanical Engineering Design”, McGraw Hill, Inc., New Delhi, 2000.

REFERENCES:

1. Bandari V B, "Design of Machine Elements ", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2003.
2. Robert L Nortan, “Machine Design-An Integrated Approach”, Pearson Publishers, New Delhi, 2003.
3. Maitra G M, “Handbook of Gear Design”, Tata McGraw Hill, New Delhi, 1998
4. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", M/s. DPV Printers, Coimbatore, 2000

CS6303 COMPUTER ARCHITECTURE L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I OVERVIEW & INSTRUCTIONS 9

Eight ideas – Components of a computer system – Technology – Performance – Power wall – Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions – Logical operations – control operations – Addressing and addressing modes.

UNIT II ARITHMETIC OPERATIONS 7

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

UNIT III PROCESSOR AND CONTROL UNIT 11

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

UNIT IV PARALLELISM 9

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

UNIT V MEMORY AND I/O SYSTEMS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design arithmetic and logic unit.
- Design and anlayse pipelined control units
- Evaluate performance of memory systems.
- Understand parallel processing architectures.

TEXT BOOK:

1. David A. Patterson and John L. Hennessey, "Computer organization and design', Morgan Kauffman / Elsevier, Fifth edition, 2014.

REFERENCES:

1. V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", VI th edition, Mc Graw-Hill Inc, 2012.
2. William Stallings "Computer Organization and Architecture" , Seventh Edition , Pearson Education, 2006.
3. Vincent P. Heuring, Harry F. Jordan, "Computer System Architecture", Second Edition,

Pearson Education, 2005.
4. Govindarajalu, “Computer Architecture and Organization, Design Principles and Applications", first edition, Tata McGraw Hill, New Delhi, 2005.
5. John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata Mc Graw Hill, 1998.
6. http://nptel.ac.in/.

RO6511 ENGINEERING DESIGN LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To expose the students is the usage of CAD/CAE softwares for modeling and analysis purposes.

LIST OF EXPERIMENTS:

1. Solid modeling of engineering components and assembly.
2. Determination of stresses and factor of safety in critical machine components by FEM and experimental validation of the results by strain measurement.
3. Dynamic analysis of chassis frame of an automobile.
4. Crash analysis of an automobile using FEA software.
5. Kinematic and dynamic analysis of mechanisms using mechanism analysis software.

TOTAL : 45 PERIODS

OUTCOMES:

- Exposed to use CAD softwares for modeling of machine components.
- Exposed to use softwares for mechanism analysis
- Knowledge in conducting crash/impact analysis using FEA.

REFERENCE:

1. Laboratory Manual Prepared by RAE Department

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	3-D solid modeling CAD software	10 licences
2	Multibody kinematic and dynamic analysis software	5 licences
3	non linear / crash / impact analysis software	2 licences
4	metal forming / metal cutting simulation software	2 licenses
5	loading and strain measuring set up	1 no
6	workstation configuration computers	15 nos

MT6712 **ROBOTICS LABORATORY** **L T P C**
0 0 3 2

OBJECTIVES:

- To understand the different robotic configurations and their subsystems.

LIST OF EXPERIMENTS

1. Study of different types of robots based on configuration and application.
2. Study of different type of links and joints used in robots
3. Study of components of robots with drive system and end effectors.
4. Determination of maximum and minimum position of links.
5. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
6. Estimation of accuracy, repeatability and resolution.
7. Robot programming exercises

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to visualize the configurations of various types of robots.
- Understanding the components of robots like arms, linkages, drive systems and end effectors.
- Ability to measure the performance of robots

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	FUNUC programmable robot arm	1no
2	rectangular, cylindrical and articulated type robot	1 each
3	software for robot motion control	5 licences
4	mobile& flying robot	1 each
5	robot links, end effectors, drives, control card	1 set

RO6512 **INNOVATION LABORATORY** **L T P C**
0 0 2 1

Students have to do a Mechatronics project based on their idea. It can be a modeling, simulation, design or hardware project.

TOTAL: 30 PERIODS

EC6653 **POWER ELECTRONICS AND DRIVES** **L T P C**
3 1 0 4

OBJECTIVES:

- To get overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers.

- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated invertors and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations.

UNIT I REVIEW OF POWER SEMICONDUCTOR DEVICES 8

Power diodes – Power transistors – Characteristics of SCR, TRIAC, Power MOSFET, IGBT– Thyristor protection circuits – Thyristor triggering circuits.

UNIT II CONVERTERS 12

Single phase – Three phase – Half controlled – Full controlled rectifiers – Dual converters – Effect of source and load inductance – AC regulators. (No derivations)

UNIT III INVERTERS AND CHOPPERS 19

Voltage Source inverters –bridge inverters, Current source inverters – voltage and waveform control of inverters. DC choppers – step up and step down – uninterrupted power supplies.

INTRODUCTION TO DRIVES

Basic Elements of Drive – Load chracteritics – Selection of Drive

UNIT IV DC DRIVES 8

Basic characteristics of DC motor – Operating modes – quadrant operation of chopper – Closed loop control of DC drives.

UNIT V AC DRIVES 13

Induction motor – Performance characteristics – Stator and rotor voltage control, frequency and voltage control – Current Control – Introduction to synchronous motor, stepper motor, switched reluctance motor drives – Basics of vector control.

TOTAL : 60 PERIODS

OUTCOMES:

- ability to understand and analyze, linear and digital electronic circuits.

TEXT BOOKS:

1. Rashid M H, “Power Electronics – Circuits, Devices and Applications”, PHI, New Delhi, 2004.
2. Dubey G K, “Power semiconductors and Drives”, Prentice Hall, 1989.

REFERENCES:

1. Bimal K Bose, “Modern Power Electronics and AC Drives”, Pearson Education, 2002.
2. Joseph Vithyathil, “Power Electronics”, McGraw Hill, USA, 1995.
3. Mohan and Udeland and Robbins, “Power Electronics”, John Wiley and sons, New York,2003.
4. Vedam Subramaniam, “Thyristor control of Electrical Drives”, Tata McGraw-Hill, New Delhi, 1998

EC6655 EMBEDDED AND REAL-TIME SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the architecture and programming of ARM processor.
- Be familiar with the embedded computing platform design and analysis.
- Be exposed to the basic concepts of real time Operating system.
- Learn the system design techniques and networks for embedded systems

UNIT I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9

Complex systems and micro processors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries - ARM Processor – CPU: programming input and output-supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption.

UNIT II EMBEDDED COMPUTING PLATFORM DESIGN 9

The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis - Components for embedded programs-Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

UNIT III PROCESSES AND OPERATING SYSTEMS 9

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real-time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE.

UNIT V SYSTEM DESIGN TECHNIQUES AND NETWORKS 9

Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- Distributed embedded systems – MPSoCs and shared memory multiprocessors.

UNIT V CASE STUDY 9

Data compressor - Alarm Clock - Audio player - Software modem-Digital still camera - Telephone answering machine-Engine control unit – Video accelerator.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Describe the architecture and programming of ARM processor.
- Outline the concepts of embedded systems
- Explain the basic concepts of real time Operating system design.
- Use the system design techniques to develop software for embedded systems
- Differentiate between the general purpose operating system and the real time operating system
- Model real-time applications using embedded-system concepts

TEXT BOOK:

1. Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.

REFERENCES:

1. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
2. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.
3. Raymond J.A. Buhr, Donald L.Bailey, "An Introduction to Real-Time Systems- From Design to Networking with C/C++", Prentice Hall, 1999.
4. C.M. Krishna, Kang G. Shin, "Real-Time Systems", International Editions, Mc Graw Hill 1997
5. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dream Tech Press, 2005.
6. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc Graw Hill, 2004.

RO6601 VISION SYSTEMS AND IMAGE PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To know about the principles and applications of vision system in modern manufacturing environment

UNIT I VISION SYSTEM 9

Basic Components – Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics – Cameras – Camera-Computer interfaces

UNIT II VISION ALGORITHMS 9

Fundamental Data Structures: Images, Regions, Sub-pixel Precise Contours – Image Enhancement : Gray value transformations, image smoothing, Fourier Transform – Geometric Transformation - Image segmentation – Segmentation of contours, lines, circles and ellipses – Camera calibration – Stereo Reconstruction.

UNIT III OBJECT RECOGNITION 9

Object recognition, Approaches to Object Recognition, Recognition by combination of views – objects with sharp edges, using two views only, using a single view, use of dept values.

UNIT IV APPLICATIONS 9

Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering.

UNIT V ROBOT VISION 9

Basic introduction to Robotic operating System (ROS) - Real and Simulated Robots - Introduction to OpenCV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to OpenCV - The cv_bridge Package.

TOTAL : 45 PERIODS

OUTCOMES:

- knowledge or gadgets of vision systems
- ability to understand the image capturing and processing techniques
- knowledge in application of vision and image processing in Robot operations.

TEXT BOOKS:

1. Carsten Steger, Markus Ulrich, Christian Wiedemann, “Machine Vision Algorithms and Applications”, WILEY-VCH, Weinheim,2008.
2. Damian m Lyons,“Cluster Computing for Robotics and Computer Vision”, World Scientific, Singapore, 2011.

REFERENCES:

1. Rafael C. Gonzalez and Richard E.woods, “Digital Image Processing”, Addition - Wesley Publishing Company, New Delhi, 2007.
2. Shimon Ullman, “High-Level Vision: Object recognition and Visual Cognition”, A Bradford Book,
USA, 2000.
3. R.Patrick Goebel, “ ROS by Example: A Do-It-Yourself Guide to Robot Operating System – Volume I”, A Pi Robot Production, 2012.

RO6602 AUTOMATION SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To know about the pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations.

UNIT I FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION 9

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.

UNIT II TRANSFER LINES AND AUTOMATED ASSEMBLY 9

General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

UNIT III PNEUMATIC CONTROL 9

Components, constructional details, filter, lubricator, regulator, constructional features, types of cylinders, control valves for direction, pressure and flow, air motors, air hydraulic equipments.

PNEUMATIC CONTROL SYSTEM DESIGN: General approach to control system design, symbols and drawings, schematic layout, travel step diagram, circuit, control modes, program control, sequence control, cascade method, Karnaugh-Veitch mapping.

UNIT IV PROGRAMMABLE AUTOMATION 9

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.

DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY: Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation.

DESIGN OF MECHATRONIC SYSTEMS:

Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system.

UNIT V ELEMENTS OF HYDRAULIC SYSTEMS 9

Pumps and motors- types, characteristics. Cylinders, types, typical construction details. Valves for control of direction, flow and pressure, types, typical construction details.

HYDRAULIC SYSTEM DESIGN:

Power pack–elements, design. Pipes- material, pipe fittings. seals and packing. maintenance of hydraulic systems. Selection criteria for cylinders, valves, pipes. Heat generation in hydraulic system

ADVANCED TOPICS IN HYDRAULICS AND PNEUMATICS**:** Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLC-construction, types, operation, programming

TOTAL: 45 PERIODS

OUTCOMES:

- knowledge of industrial automation by transfer lines and automated assembly lines.
- understanding of automated controls using pneumatic and hydraulic systems
- ability to understand the electronic control systems in metal machining and other manufacturing processes.

TEXT BOOKS:

1. Mikell P Groover, “Automation Production Systems and Computer- Integrated Manufacturing” Pearson Education, New Delhi, 2001.
2. Wemer Depper and Kurt Stoll, “Pneumatic Application”, Kemprath Reihe, Vogel Buch Verlag Wurzbutg, 1987.
3. Bolton W, “Mechatronics“, Pearson Education, 1999.

REFERENCES:

1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications” , McGraw Hill , New York, USA. 2000.
2. Wemer Deppert and Kurt Stoll, “Pneumatic Application”, Kemprath Reihe, Vovel Verlag , Wurzburg, 1976.
3. Steve F Krar, “Computer Numerical Control Simplified“, Industrial Press, 2001.
4. Joffrey Boothroyd, Peter Dewhurst and Winston A. Knight, “Product Design for manufacture and Assembly”, CRC Press, 2011

EC6665 ECONOMICS FOR ENGINEERS L T P C
2 1 0 3

OBJECTIVES:

- To understand the fundamental economic concepts applicable to engineering.
- To learn the techniques of incorporating inflation factor in economic decision making.

UNIT I INTRODUCTION: **10**

Definition – Nature – Scope and Significance of Economics for Engineers**.**

DEMAND AND SUPPLY: Demand – Types – Determinants – Law of Demand – Elasticity of Demand – Types – Significance –Supply – Market price determination – Case Study in Demand Forecasting –- Meaning – Methods – Consumer Survey – Trend Projections – Moving average.

UNIT II COST AND REVENUE: 12

Concepts – Classifications – Short run and long run cost curves – Revenue – Concepts – Measurement of Profit.(Case Study)

MARKET STRUCTURE: Perfect Competition – Characteristics – Price and output determination in short run and long run – Monopoly – Price Discrimination – Monopolistic Competition – Product Differentiation – Oligopoly and Duopoly.

UNIT III MARKET FAILURE: 12

Causes – Type of Goods – Rivalrous and Non-rivalrous goods – Excludable and Non-excludable goods – Solutions – Government Intervention.

MONEY AND BANKING: Money – Functions – Quantity theory of money – Banking – Commercial Banks – Functions – Central Bank (RBI) – Functions – Case Study in Recent Development in Banking.

UNIT IV FOREIGN EXCHANGE: 6

Terms of Trade – Balance of Payments – Exchange rate determination – Methods of foreign payments – International Institutions – IMF, IBRD.

UNIT V BUSINESS CYCLE AND NATIONAL INCOME: 5

Meaning – Phases of business cycle - Inflation – Causes – Control measures – Deflation - National Income – Concepts – Methods of calculating national income – Problems in calculating national income

Total(L: 30 + T:15): 45 PERIODS

OUTCOMES:

- Upon successful completion of this course, students will get the ability to apply the basics of economics and cost analysis to engineering and take economically sound decisions.

TEXT BOOKS:

1. Dewett. K.K, “Modern Economic Theory”, S. Chand and Company Ltd, New Delhi, 2010.
2. Lipsey and Chrystal, “Economics”, Oxford University Press, 2010.

REFERENCES:

1. Paul A Samuelson and William, “Economics”, Tata McGraw Hill, New Delhi, 2010.
2. Thingan M.L “Money, Banking, International Trade and Public Finance”, Vrinda Publication, 2009.
3. Ahuja H.L, “Macro Economic Theory and Policy”, S.Chand and Co, New Delhi, 2010.
4. Francis Cherinullem “International Economics”, McGraw Hill Education, 2008.
5. Dutt and Sundaram “Indian Economy”, S.Chand and Co, New Delhi, 2011

EC6663 POWER ELECTRONICS AND DRIVES LABORATORY

L	T	P	C
0	0	3	2

OBJECTIVES:

- To provide hands on experience with power electronic converter design and testing

LIST OF EXPERIMENTS:

1. Gate Pulse Generation using R,RC and UJT.
2. Characteristics of SCR and Triac

3. Characteristics of MOSFET and IGBT
4. AC to DC half controlled converter
5. AC to DC fully controlled Converter
6. Step down and step up MOSFET based choppers
7. IGBT based single phase PWM inverter
8. IGBT based three phase PWM inverter
9. AC Voltage controller
10. Switched mode power converter.
11. SimulationofPEcircuits(1Φ&3Φsemiconverter,1Φ&3Φfullconverter,dc-dc converters, ac voltage controllers).

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and analyse, linear and digital electronic circuits.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Device characteristics(for SCR, MOSFET, TRIAC and IGBT kit with built in / discrete power supply and meters)	2 each
2	SinglephaseSCRbasedhalfcontrolledconverterandfullycontrolledconverteralong with built-in/separate/firing circuit/module and meter	2 each
3	MOSFET based step up and step down choppers(Built in/ Discrete)	1 each
4	IGBT based single phase PWM inverter module/Discrete Component	2
5	IGBT based three phase PWM inverter module/Discrete Component	2
6	Switched mode power converter module/Discrete Component	2
7	SCR &TRIAC based 1 phase AC controller along with lamp or rheostat load	2
8	Cyclo converter kit with firing module	
9	Dual regulated Dc power supply with common ground	
10	Cathode ray Oscilloscope	10
11	Isolation Transformer	5
12	Single phase Auto transformer	3
13	Components (Inductance, Capacitance)	3 set for each
14	Multimeter	5
15	LCR meter	3
16	Rheostats of various ranges	2 sets of 10 value
17	Work tables	10
18	DC and AC meters of required ranges	20
19	Component data sheets to be provided	

RO6611 AUTOMATION SYSTEM DESIGN LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To illustrate the design and simulation of multiple actuator systems using pneumatic, electro-pneumatic and PLCs and enable the students to integrate various fringe conditions in multiple actuator systems. To expose the students in sensors/actuators interfaced with computers.

LIST OF EXPERIMENTS:

1. Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method
2. Integration of fringe condition modules in multiple actuator pneumatic systems
3. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using hard – wire programmed control systems
4. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using PLC.
5. Interfacing of an LVDT with a PC for monitoring the displacement of machine slide and raising an alarm if the displacement exceeds specified limit.
6. Inspection using Machine vision System
7. Control of speed, direction and number of revolutions of a stepper motor using PC.
8. Development of an obstacle avoidance robot using servo motors, ultrasonic and touch sensors.

TOTAL :45 PERIODS

OUTCOMES

- Able to design and layout multiple actuator systems with start shop and emergency modules
- Able to develop Ladder logic for electro-pneumatic actuator systems.
- Acquiring skill of interfacing different sensors like LVDT, ultrasonic and touch sensors.
- Ability to develop control system for stepper motors.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Basic Pneumatic Trainer Kit with manual and electrical controls	1 each
2	PNEUMOSIM software / Automation studio	10 sets
3	8051 – Microcontroller kit with stepper motor and drive circuit LABVIEW software	2 sets
4	machine vision system with software	1 no
5	stepper motors with PC interface cards	2 nos
6	servo motor with PC interface card	1 no
7	ultrasonic, touch and non contact sensors	2 each

RO6612 INDUSTRIAL VISIT CUM LECTURE L T P C
0 0 3 2

- ❖ Visits to local industries will be arranged by the department to study the industrial practices.
- ❖ Lectures by experts will be arranged to gain exposure to the trends in design, manufacturing and quality control in industries.

RO6701 PRECISION EQUIPMENT DESIGN L T P C
3 1 0 4

OBJECTIVES:

- To impart knowledge in the increasing quality concepts of parts, accuracy requirement of machine tools and also to introduce latest topics in Manufacturing like micro machining and smart materials so as to equip them to join core electronic manufacturing industries.

UNIT I INTRODUCTION TO PRECISION ENGINEERING: 5

Precision manufacturing, Intelligent manufacturing – objectives, Reconfigurable systems.

UNIT II MOTION ERRORS: 13

Errors and error measurements, Model of measurement, Statistical measurements, Propagation of errors, Motion errors principle –translational body, rotational body, geometric and kinematic errors, Other types of errors in machines – thermal, cutting force induced, environmental, common geometric errors – cosine, abbe, dead path errors, Methodologies of error elimination

UNIT III DESIGN STRATEGIES FOR MACHINE TOOLS 14

Standard sizes, Precision engineering principles –design, modeling and simulation , Design roadmap – conceptual analysis, materials selection, kinematic design of bearing and guide ways, Structural analysis – static and dynamic analysis , Micro machines – design approach, design challenges – kinematics, interactive forces, actuators,

UNIT IV PARALLEL KINEMATIC MACHINES (PKM) 14

Serial and parallel systems, Precision design of PKM – need of PKM ,low cost, degrees of freedom, workspace volume, high stiffness and agility, repeatability in movement, low inertia, Configurations and characteristic issues – degrees of calculation, Design principles – Kinematic modeling.

UNIT V PRECISION CONTROL 14

Fundamentals of motion control , system modeling and performance assessment, linear dynamics, nonlinear dynamics – force ripple, friction, hysteresis, incorporating nonlinear dynamics, Control design strategies – PID feedback, feed forward control, ripple, RBF compensation, internal model control , Case study: Design of piezoelectric actuator – piezoelectric actuator, LVDT, adaptive controller.

TOTAL= L: 45 + T: 15 = 60 PERIODS

OUTCOMES:

- Upon completion of this course the student can able to use of quality concepts parts, accuracy requirements of machine tools and use of latest machining process such as micro machining and micro fabrication.

REFERENCES:

1. Samir Mekid, “Introduction to Precision Machine Design and Error Assessment”, CRC-Press, Taylor and Francis Group, New York, 2009.
2. Alexander H Slocum, “Precision Machine Design”, Prentice Hall Publishers, 1992.
3. Moore W R, “Foundations of Mechanical Accuracy”, The Moore Special Tool Company, Bridgeport, Connecticut, 1970.
4. Nakazawa H, “Principles of Precision Engineering”, Oxford University Press, Oxford, 1994.
5. Smith S.T, Chetwynd D.G, “Foundations of Ultra – Precision Mechanism Design”, Gordon and Breach Publishers, Switzerland, 1992.

RO6702 **FIELD AND SERVICE ROBOTICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the control of robots for some specific applications.

UNIT I INTRODUCTION **9**

History of service robotics – Present status and future trends – Need for service robots - applications- examples and Specifications of service and field Robots. Non conventional Industrial robots.

UNIT II LOCALIZATION **9**

Introduction-Challenges of Localization- Map Representation- Probabilistic Map based Localization- Monte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization.

UNIT III PLANNING AND NAVIGATION **9**

Introduction-Path planning overview- Road map path planning- Cell decomposition path planning- Potential field path planning-Obstacle avoidance - Case studies: tiered robot architectures.

UNIT IV FIELD ROBOTS **9**

Ariel robots- Collision avoidance-Robots for agriculture,mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

UNIT V HUMANOIDS: **9**

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications, Case studies.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course, the student should be able to:

- Explain the basic concepts of working of robot
- Analyze the function of sensors in the robot
- Write program to use a robot for a typical application
- Use Robots in different applications

TEXT BOOKS:

1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, ‘Introduction to Autonomous Mobile Robots”, Bradford Company Scituate, USA, 2004
2. Riadh Siaer, ‘The future of Humanoid Robots- Research and applications’, Intech Publications, 2012.

REFERENCES:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011

RO6703 TOTALLY INTEGRATED AUTOMATION L T P C
3 0 0 3

OBJECTIVES:

- To gain knowledge in various electrical and electronic programmable automations and their applications.

UNIT I TOTALLY INTEGRATED AUTOMATION: 9

Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure.

UNIT II HMI SYSTEMS: 9

Necessity and Role in Industrial Automation, Need for HMI systems. Types of HMI- Text display - operator panels - Touch panels - Panel PCs - Integrated displays (PLC & HMI). Check with PLC 502 and remove

UNIT III SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) 9

Overview – Developer and runtime packages – architecture – Tools – Tag – Internal &External graphics, Alarm logging – Tag logging – structured tags– Trends – history– Report generation, VB & C Scripts for SCADA application.

UNIT IV COMMUNICATION PROTOCOLS of SCADA 9

Proprietary and open Protocols – OLE/OPC – DDE – Server/Client Configuration – Messaging – Recipe – User administration – Interfacing of SCADA with PLC, drive, and other field device

UNIT V DISTRIBUTED CONTROL SYSTEMS (DCS) : 9

DCS – architecture – local control unit- programming language – communication facilities – operator interface – engineering interfaces.

APPLICATIONS OF PLC & DCS: Case studies of Machine automation, Process automation, Introduction to SCADA Comparison between SCADA and DCS.

TOTAL : 45 PERIODS

OUTCOMES:

- knowledge of PLC & PAC automation
- ability to apply SCADA and usage of C programming for report generation
- acquiring informations on communication protocols in automation systems
- ability to design and develop automatic control system using distributed control systems.

TEXT BOOKS:

1. John.W.Webb & Ronald A. Reis, “Programmable logic controllers: Principles and Applications”, Prentice Hall India, 2003.
2. Michael P. Lukas, “Distributed Control systems”, “Van Nostrand Reinfold Company”1995

REFERENCES:

1. Win C C Software Manual, Siemens, 2003
2. RS VIEW 32 Software Manual, Allen Bradly, 2005
3. CIMPLICITY SCADA Packages Manual, Fanuc India Ltd, 2004

RO6711 TOTALLY INTEGRATED AUTOMATION LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To develop skill in developing integrated automatic control of drives and other actuating systems

LIST OF EXPERIMENTS:

1. Study of PAC
2. Programming a PAC for a given task
3. Configuring a text display with PLC
4. Programming and configuring a graphical display with PLC.
5. Study of SCADA
6. Development of screens for SCADA
7. Interfacing a SCADA with PLC
8. Study of DCS
9. Programming a DCS
10. Controlling a variable speed drive through PLC/SCADA

TOTAL:45 PERIODS

OUTCOMES:

- Skill in programming PAC and PLCs.
- Acquiring knowledge in SCADA and interfacing SCADA with PLC and PCs
- Ability to control variable speed drive.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1. PAC
2. PLC
3. SCADA
4. DCS
5. PC'S -4No's

RO6712 PRODUCT DESIGN LABORATORY L T P C
0 0 3 2

Students have to do design a product based on the given topic. It includes modeling, simulation, and design of a particular product.

TOTAL: 45 PERIODS

RO6713 DESIGN AND FABRICATION PROJECT L T P C
0 0 4 2

OBJECTIVES:

- The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if

possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

OUTCOMES:

- Use of design principles and develop conceptual and engineering design of any components.
- Ability to fabricate any components using different manufacturing tools.

RO6811 PROJECT WORK L T P C
0 0 12 6

OBJECTIVES:

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

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. 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 based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 180 PERIODS

OUTCOMES:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

EC6073 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Study the Architecture of 8085 microprocessor.
- Study the Architecture of 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Study about communication and bus interfacing.
- Study the Architecture of 8051 microcontroller.

UNIT I 8086 MICROPROCESSOR 8

Architecture – Pin description – Operating modes – Registers – Interrupts – Bus cycle – Addressing modes – Typical configuration of 8086 system – Overview of Instruction set.

UNIT II 80286 MICROPROCESSOR 8

Functional block diagram - Modes of operation – Real and protected mode – Memory management and protection features.

UNIT III 80386, 80486 PROCESSORS 8

80386: Functional block diagram - Programming model - Addressing modes and instruction set overview – Address translation - Modes of operation - 80486 processor - Functional block diagram - Comparison of 80386 and 80486 processors.

UNIT IV PENTIUM MICROPROCESSOR 6

Introduction – Architecture – Special Pentium registers – Memory management.

UNIT V PIC MICROCONTROLLER 15

Architecture – Memory structure – Register File – Addressing modes – Interrupts – Timers: Modes of operation

PIC PERIPHERAL FUNCTIONS AND SPECIAL FEATURES:

PWM output – Analog to Digital converter – UART – Watchdog timer – RESET Alternatives – Power Down mode – I^2C Bus operation

TOTAL : 45 PERIODS

OUTCOMES:

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

- Design and implement programs on 8085 microprocessor.
- Design and implement programs on 8086 microprocessor.
- Design I/O circuits.
- Design Memory Interfacing circuits.
- Design and implement 8051 microcontroller based systems.

TEXT BOOKS:

1. Barry B Brey, "The Intel Microprocessor 8086/8088, 80186/80188, 80286, 80386, 80486 Pentium and Pentium processor, Pentium II,III,4 , Prentice Hall of India, New Delhi, 2005.
2. Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", McGraw Hill, New Delhi, 2005.
3. John B Peatman, “Design with PIC Microcontroller, McGraw Hill, Singapore, 1st Reprint, 2001

REFERENCES:

1. Mohammed Rafiquzzaman, "Microprocessors and microcomputer based system design", CRC Press, 2005.
2. Walter A Triebel, Avtar Singh .”The 8088 and 8086 microprocessors Programming Interfacing software, Hardware and Applications”,Pearson Education ,2009
3. Myke Pred ko, “Programming and Customising the PIC Microcontroller, “McGraw Hill, USA, 1998

CS6078 COMPUTER ARCHITECTURE AND PARALLEL PROCESSING **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the various number systems.
- Understand the various logic gates.
- Be familiar with various combinational circuits.
- Understand the various components used in the design of digital computers.
- Understand arithmetic algorithms.

UNIT I INTRODUCTION **12**

Computer architectural classification: Flynn's classification – Data flow versus Control flow computers – Parallelism in uniprocessor systems – Balancing of subsystem bandwidth – Parallel processing applications.

MEMORY AND INPUT/OUTPUT SUBSYSTEMS: Hierarchical Memory Structure: Memory hierarchy – Optimisation –Addressing schemes for main memory – Multiple module memories – Memory interleaving – Virtual Memory System: Concepts – Paged Memory System – Segmented memory System – Memory with Paged Segments – Memory allocation and Management: Classification of memory Policies – Optimal Load Control – Memory Management Policies – Cache Memory and Management: Characteristics – Cache Memory Organisation – Fetch and Main Memory Update Policies – Block Replacement Policies – Performance evaluation and enhancement – Input Output Subsystems: Characteristics – Interrupt Mechanisms and Special Hardware – I/O Processors and I/O Channels.

UNIT II PIPELINING AND VECTOR PROCESSING **8**

Principles of pipelining – Instruction and Arithmetic pipelines – Instruction prefetch and branch handling – Data buffering and Busing structures – Internal forwarding and Register tagging – Hazard detection and resolution – Job sequencing and Collision prevention – Vector Processing: Characteristics – Pipelined Vector Processing methods – Vectorization and optimization methods.

UNIT III ARRAY PROCESSING: **9**

SIMD Array Processors – Masking and data routing mechanisms – Inter PE communications – Interconnection networks – Parallel Algorithms for Array Processors – Associative Array Processing – systolic array processing.

UNIT IV MULTIPROCESSOR ARCHITECTURE: **16**

Functional structures: Loosely coupled multiprocessors – Tightly coupled multiprocessors – Processor characteristics for multiprocessing – Multiprocessor scheduling strategies – Interconnection networks– Parallel memory organization – Parallel Algorithms for Multiprocessors

UNIT V INTRODUCTION TO RISC ARCHITECTURE **8**

Instruction execution characteristics – Instruction execution charts – Register files – Register optimization – Reduced Instruction Set Architecture – RISC pipelining – RISC versus CISC.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Perform arithmetic operations in any number system.
- Simplify the Boolean expression using K-Map and Tabulation techniques.
- Use boolean simplification techniques to design a combinational hardware circuit.
- Analyze a given digital circuit – combinational and sequential.
- Identify different functional units in a digital computer system.
- Trace execution of instruction sequence in a processor.

- Explain the implementation of each functional unit .

TEXT BOOKS:

1. Hwang K, and Briggs F A, “Computer Architecture and Parallel Processing”, McGraw Hill, New Delhi, 1989.
2. Stallings W, “Computer Organization and Architecture: Designing for Performance”, Pearson Education, New Delhi, 2010,

REFERENCES:

1. David Patterson and John L Hennessy, “Computer Organisation and Design: The Hardware/Software Interface”, Elsevier Publishers, 2010.
2. Hwang K, “Advanced Computer Architecture – Parallelism, Scalability and Programmability”, Tata McGraw Hill, New Delhi, 2007.

CS6081 SYSTEM SOFTWARE L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the phases in a software project.
- Understand fundamental concepts of requirements engineering and Analysis Modelling.
- Understand the major considerations for enterprise integration and deployment.
- Learn various testing and maintenance measures.

UNIT I ASSEMBLERS 16

General Design procedures – Design of an Assembler – data structures – format of databases – algorithm – flow chart – PASS structures – modular functions.

MACRO LANGUAGE AND MACRO PROCESSORS**:** Macro instructions, features of a macro facility – implementation.

UNIT II LOADERS 8

Loader schemes – compile and go loaders , general load scheme – absolute loaders – direct linking loaders and their design. Other loading schemes : linking loaders, overlays, dynamic binders.

UNIT III COMPILERS 10

Introduction – Structure of a compiler – phases of a compiler - compiler writing tools.

LEXICAL ANALYSIS:

Role of a lexical analyzer – finite automata –regular expressions to finite automata – minimizing the number of states of a deterministic finite automata – implementation of a lexical analyzer.

UNIT IV PARSING TECHNIQUES 6

Context free grammars – derivations and parse trees – ambiguity – capabilities of context free grammars. Top down and bottom up parsing – handles – shift reduce parsing – operator precedence parsing – recursive descent parsing – predictive parsing.

UNIT V INTERMEDIATE CODE GENERATION 5

Postfix notation, Quadruples, triples , indirect triples – Representing information in a symbol table – introduction to code optimization – basic blocks – DAG representation – error detection and recovery - code generation.

TOTAL :45 PERIODS

OUTCOMES:

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

- Identify the key activities in managing a software project.
- Compare different process models.
- Concepts of requirements engineering and Analysis Modeling.
- Apply systematic procedure for software design and deployment.
- Compare and contrast the various testing and maintenance.

REFERENCES:

1. John J Donovan, " Systems Programming", McGraw Hill , 1999.
2. Dhamdhere D M, "Systems Programming", Tata McGraw Hill, 2001.
3. Aho A V, Sethi R and Ullman J D, "Compilers: Principles, Techniques and Tools", Addison Wesley, Longman, 1999.
4. Dhamdhere D M, "Compiler Construction Principles and Practice", Macmillan Company, 1997.
5. Holub Allen I, "Compiler Design in C", Prentice Hall, 2001.

RO6001 LEAN MANUFACTURING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the students the lean manufacturing concepts
- To understand group technology and use of it for part identification
- To teach the tools and method used in lean manufacturing
- To introduce concept of Total Productive Maintenance and other system

UNIT I INTRODUCTION: **14**

Origins and objectives of lean manufacturing – lean process,3M concept key principles and implications of lean manufacturing – traditional Vs lean manufacturing characteristics–roadmap for lean implementation and lean benefits - study of Ford and Toyota production systems - JIT manufacturing, Lean building blocks.

LEAN MANUFACTURING CONCEPTS:

Value creation and waste elimination – seven types of waste – pull production-different models of pull production -the Kanban system-continuous flow-the continuous improvement process / Kaizen-Worker involvement. Design of Kanban quantities – Leveled production - tools for continuous improvement.

UNIT II GROUPTECHNOLOGY AND CELLULARLAYOUT 7

JIT with cell manufacturing – part families- production flow analysis – Composite part concept – machine cell design – quantitative analysis – case studies – single piece flow

UNIT III VALUE STREAM MAPPING 7

The value stream– benefits mapping process - the current state map–mapping icons - mapping steps.VSM exercises - Takt time calculations.

UNIT IV LEAN MANUFACTURING TOOLS AND METHODOLOGIES 7

Standardized work–standard work sequence timing and working progress .Quality at source – Autonomation /Jidoka, Visual management system, Mistake proofing / Poka-Yoke. 5S technique – Elements and waste elimination through 5S, advantages and benefits - 5S-audit - visual control aids for improvement, flexible work force

UNIT V TOTAL PRODUCTIVE MAINTENANCE 10

Goals and benefits – Hidden factory, the six big losses, types of maintenance. Overall equipment effectiveness - pillars of TPM and implementation. Change over and set up timer education techniques. Temple of quality, OEE calculations.

RECONCILING LEAN WITH OTHER SYSTEMS: Study of lean Six-sigma and lean design – lean and ERP- lean with ISO9001:2000 - administrative lean.

TOTAL : 45 PERIODS

OUTCOMES:

- abililty to implement lean manufacturing concepts in industries
- ability to group the parts
- ability to use the lean manufacturing tools and method
- ability to apply Total Productive Maintenance concepts in industries.

TEXT BOOKS:

1. Micheal Wader, "Lean Tools: A Pocket guide to Implementing Lean Practices", Productivity and Quality Publishing, 2002.
2. William M Feld, "Lean Manufacturing: Tools, Techniques and How to use them", APICS, 2001
3. Dennis P Hobbs, "Lean Manufacturing Implementation" ,Narosa Publications, 2004
4. Gopalakrishnan N, "Simplified Lean Manufacture", PHI Learning Pvt Ltd, 2010

REFERENCES:

1. Richard B Chase" Production and Operations Management", McGraw Hill, 2003
2. Taiichi Ohno, "Toyoto Production Systems: Beyond Large Scale Production", Productivity Press, 1988.
3. Askin R G and Goldberg J B," Design and Analysis of Lean Production Systems", John Wiley and Sons, 2003.
4. Mahadevan B," Operations Management", Pearson,2010

RO6002 INDUSTRIAL DESIGN AND APPLIED ERGONOMICS L T P C
3 0 0 3

OBJECTIVES:

- To explain the general principles that governs the interaction of humans and their working environment for improving worker performance and safety.

UNIT I INTRODUCTION 12

Definition, human technological system, multidisciplinary engineering approach, human–machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development.

INFORMATION INPUT:

Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, olfactory displays, speech communications.

UNIT II HUMAN OUTPUT AND CONTROL 12

Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices.

WORKPLACE DESIGN:

Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, and fatigue.

UNIT III ENVIRONMENTAL CONDITIONS 11

Illumination, climate, noise, motion, sound, vibration, colour and aesthetic concepts.
BIOMECHANICS:
Biostatic mechanics, statics of rigid bodies, biodynamic mechanics, human body kinematics, kinetics, impact and collision.

UNIT IV BIOTHERMODYNAMICS AND BIOENERGETICS 5

Biothermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress.

UNIT V HUMAN FACTORS APPLICATIONS 5

Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA's approach, virtual environments.

TOTAL : 45 PERIODS

OUTCOMES:

- The Student should apply ergonomic principles to design workplaces for the improvement of human performance and implement latest occupational health and safety to the work place.

TEXT BOOK:

1. Chandler Allen Phillips, "Human Factors Engineering", John Wiley and Sons, New York, 2000.

REFERENCES:

1. Bridger R S, "Introduction to Ergonomics", Taylor and Francis, London, 2003.
2. Mayall W H, "Indus trial Design for Engineers", London ILIFFEE Books Ltd., UK, 1998.
3. Mark S Sanders, "Human Factors in Engineering and Design", McGraw Hill, New York, 1993.

ME6005 PROCESS PLANNING AND COST ESTIMATION L T P C
3 0 0 3

OBJECTIVES:

- To introduce the process planning concepts to make cost estimation for various products after process planning

UNIT I INTRODUCTION TO PROCESS PLANNING 10

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES 10

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION 8

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 8

Estimation of Different Types of Jobs - Estimation of Forging Shop , Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use the concepts of process planning and cost estimation for various products.

TEXT BOOK:

1. Peter Scalon, "Process planning, Design/Manufacture interface", Elsevier science technology Books, 2002.

REFERENCES:

1. Ostwalal P.F. and Munez J., "Manufacturing Processes and systems", John Wiley, 9th Edition, 1998.
2. Russell R.S and Tailor B.W, "Operations Management", PHI, 4th Edition, 2003.
3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", PHI, 2nd Edition, 2002.

EE6071 SPECIAL MACHINES AND CONTROLLERS L T P C
3 0 0 3

OBJECTIVES:

- To know about special types of electrical motors, their characteristics and applications.

UNIT I STEPPER MOTORS 9

Types - Constructional features – principle of operation – variable reluctance motor – single and Multi stack configurations – Permanent Magnet Stepper motor – Hybrid stepper motor. Different modes of Excitation - theory of torque predictions – Drive systems and circuit for open loop and closed loop control of stepper motor.

UNIT II SWITCHED RELUCTANCE MOTORS 9

Constructional features – principle of operation –Torque Equation - Power Converters for SR Motor – Rotor Sensing Mechanism & Logic Controller – Sensorless Control of SR motor - Applications.

UNIT III PERMANENT MAGNET BRUSHLESS D.C. MOTORS 8

Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control – Applications.

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS 8

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics, Self control, Vector control, Current control Schemes – Applications.

UNIT V LINEAR MOTORS: 11

Linear Induction motor (LIM) classification – construction – Principle of operation – Concept of current sheet – goodness factor – DC Linear motor (DCLM) types – circuit equation - DCLM control applications – Linear Synchronous motor(LSM) – Types–Applications

SERVOMOTORS: Servomotor – Types – Constructional features, principle of operation - control applications

TOTAL : 45 PERIODS

OUTCOMES:

- understanding principles of operation, types and applications of stepper motors
- knowledge in evaluating the performance of DC motors
- ability to understand the working and applications linear motors and servo motors.

TEXT BOOKS:

1. K. Venkataratnam," Special Electrical Machines", Universities Press (India) Private Limited, India, 2009.
2. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989

REFERENCES:

1. Kenjo T, "Stepping Motors and their Microprocessor Controls", Clarendon Press London, 2003.
2. Miller T J E, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989 .
3 Naser A and Boldea L,"Linear Electric Motors: Theory Design and Practical Applications", Prentice Hall Inc., New Jersey 1987.
4. Floyd E Saner," Servo Motor Applications", Pittman USA, 1993.
5. WILLIAM H YEADON, ALAN W YEADON, Handbook of Small Electric Motors, McGraw Hill, INC, 2001

CS6076 ARTIFICIAL INTELLIGENCE FOR ROBOTICS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning.

UNIT I INTRODUCTION 13

History, state of the art**,** Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.

PROBLEM SOLVING:

Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning–knowledge representation – first order logic.

UNIT II PLANNING 8

Planning withforward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

UNIT III REASONING: 8

Uncertainity – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions.

UNIT IV LEARNING: 8

Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

UNIT V AI IN ROBOTICS: 8

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Identify problems that are amenable to solution by AI methods.
- Identify appropriate AI methods to solve a given problem.
- Formalise a given problem in the language/framework of different AI methods.
- Implement basic AI algorithms.
- Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A modern approch”, Pearson Education, India2003.
2. Negnevitsky, M, “Artificial Intelligence: A guide to Intelligent Systems”,. Harlow: Addison-Wesley, 2002.

REFERENCE:

1. David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 19992.

IC6601 ADVANCED CONTROL SYSTEM L T P C

3 0 0 3

OBJECTIVES

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT I STATE VARIABLE DESIGN 9

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control

UNIT II PHASE PLANE ANALYSIS 9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III DESCRIBING FUNCTION ANALYSIS 9

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT IV OPTIMAL CONTROL 9

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples.

UNIT V OPTIMAL ESTIMATION 9

Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems- Kalman Filter- Application examples..

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to apply advanced control theory to practical engineering problems.

TEXT BOOKS

1. Mohandas K. P., "Modern Control Engineering", Sanguine Technical Publishers, 2006
2. Thaler G.J., "Automatic Control Systems", Jaico Publishing House, 1993
3. Gopal ,M. Modern control system theory, New Age International Publishers, 2002.

REFERENCES

1. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group 2011.
2. Ashish Tewari, 'Modern control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
3. Ogata K., 'Modern Control Engineering', 4th edition, PHI, New Delhi, 2002.
4. Glad T. and Ljung L. "Control theory –Multivariable and Non-linear methods", Taylor & Francis, 2002
5. Naidu D.S., "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

RO6003 INDIAN ETHOS AND VALUES L T P C
3 0 0 3

OBJECTIVES:

- To understand the Indian human values work ethics and social responsibilities and impact on the society.

UNIT I HUMAN VALUES AND ETHOS 11

Meaning and Significance of Values – Sources of Individual Values - Value crisis in the Contemporary Indian Society –Moral and Ethical Values.

SOCIAL RESPONSIBILITY AND ETHICS: Concept of Social Responsibility – Need and Importance of Social Responsibility – Business Ethics.

UNIT II APPLICATION OF VALUES 12

Relevance of Values in Management – Personal Values and Values at Work place – Values for Managers.

WORK ETHICS: Professional Values and Ethics – Need – Issues – Challenges – Ethical Leadership – Ethical dilemma - Case Study

UNIT III ORGANIZATIONAL CULTURE AND ITS CHALLENGES 5

Elements of strong organization culture – Brooks Perterson's classification of culture.

UNIT IV SHARED VALUES IN THE ORGANIZATION AND ITS IMPACT 6

Need to identify and share values – the Value Construct and How to Promote Shared Values.

UNIT V UNIVERSAL VALUES 11

Cross Cultural Values - Impact of Culture on Organizations and Managing Workforce Diversity. INTERPERSONAL RELATIONSHIP:

Managing emotions – Emotional Intelligence – Building Better interpersonal Relations –Dealing with Subordinates – Case Study.

TOTAL: 45 PERIODS

OUTCOMES:

- understanding the impart of human values in the society
- evaluation of values in different work environments
- understanding the effect of organizational culture and cross culture values.

TEXT BOOKS:

1. Tripathi A. N., "Human values" – New Age international Pvt. Ltd., New Delhi, 2002
2. Murthy C.S.V., "Business Ethics", Himalaya Publishing House, 2007.

REFERENCES:

1. Jayshree Suresh, Raghavan B.S., "Professional Ethics", S. Chand and Company Ltd., New Delhi, 2005.
2. Nandagopal R. and Ajith Sankar RN., "Indian Ethos and Values in Management", McGraw Hill, New Delhi, 2010.
3. Kiran D. R., "Professional Ethics and Human Values", Tata McGraw Hill, New Delhi, 2007.
4. Proceedings of National Conference on Integrating values and Social Concerns With Technical
   Education, PSG College of Technology, 2010.

MG6851 PRINCIPLES OF MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure

– types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

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

UNIT V CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS

OUTCOMES :

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXTBOOKS:

1. Stephen P. Robbins & Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", Pearson Education, 6th Edition, 2004.

REFERENCES:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999

EC6601 VLSI DESIGN L T P C
3 0 0 3

OBJECTIVES:

- In this course, the MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit is studied.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed.
- The main focus in this course is on the transistor circuit level design and realization for digital operation and the issues involved as well as the topics covered are quite distinct from those encountered in courses on CMOS Analog IC design.

UNIT I MOS TRANSISTOR PRINCIPLE 9

NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Examples of Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS 9

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff

UNIT V IMPLEMENTATION STRATEGIES 9

Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students should

- Explain the basic CMOS circuits and the CMOS process technology.
- Discuss the techniques of chip design using programmable devices.
- Model the digital system using Hardware Description Language.

TEXTBOOKS:

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

REFERENCES:

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

CS6009 NANO COMPUTING L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn nano computing challenges
- Be familiar with the imperfections
- Be exposed to reliability evaluation strategies
- Learn nano scale quantum computing
- Understand Molecular Computing and Optimal Computing

UNIT I NANOCOMPUTING-PROSPECTS AND CHALLENGES 9

Introduction - History of Computing - Nanocomputing - Quantum Computers – Nanocomputing Technologies - Nano Information Processing - Prospects and Challenges - Physics of Nanocomputing

: Digital Signals and Gates - Silicon Nanoelectronics - Carbon Nanotube Electronics - Carbon Nanotube Field-effect Transistors – Nanolithography.

UNIT II NANOCOMPUTING WITH IMPERFECTIONS 9

Introduction - Nanocomputing in the Presence of Defects and Faults - Defect Tolerance - Towards Quadrillion Transistor Logic Systems.

UNIT III RELIABILITY OF NANOCOMPUTING 9

Markov Random Fields - Reliability Evaluation Strategies - NANOLAB - NANOPRISM - Reliable Manufacturing and Behavior from Law of Large Numbers.

UNIT IV NANOSCALE QUANTUM COMPUTING 9

Quantum Computers - Hardware Challenges to Large Quantum Computers - Fabrication, Test, and Architectural Challenges - Quantum-dot Cellular Automata (QCA) - Computing with QCA - QCA Clocking - QCA Design Rules.

UNIT V QCADESIGNER SOFTWARE AND QCA IMPLEMENTATION 9

Basic QCA Circuits using QCA Designer - QCA Implementation - Molecular and Optical Computing: Molecular Computing - Optimal Computing - Ultrafast Pulse Shaping and Tb/sec Data Speeds.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the student should be able to:

- Discuss nano computing challenges.
- Handle the imperfections.
- Apply reliability evaluation strategies.
- Use nano scale quantum computing.
- Utilize Molecular Computing and Optimal Computing.

TEXT BOOK:

1. Sahni V. and Goswami D., Nano Computing, McGraw Hill Education Asia Ltd. (2008), ISBN (13): 978007024892.

REFERNCES:

1. Sandeep K. Shukla and R. Iris Bahar., Nano, Quantum and Molecular Computing, Kluwer Academic Publishers 2004, ISBN: 1402080670.
2. Sahni V, Quantum Computing, McGraw Hill Education Asia Ltd. 2007.
3. Jean-Baptiste Waldner, Nanocomputers and Swarm Intelligence, John Wiley & Sons, Inc. 2008, ISBN (13): 978-1848210097.

RO6004 RENEWABLE ENERGY SOURCES L T P C
3 0 0 3

OBJECTIVES:

- To get exposure on various types of Renewable Energy sources and their usage.

UNIT I PRINCIPLES OF SOLAR RADIATION 10

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II SOLAR ENERGY COLLECTION 8

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III SOLAR ENERGY STORAGE AND APPLICATIONS 7

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT IV WIND ENERGY 10

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT V GEOTHERMAL ENERGY: **9**

Resources, types of wells, methods of harnessing the energy, potential in India.

OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC.

TOTAL : 45 PERIODS

OUTCOMES:

- understanding the physics of solar radiation.
- ability to classify the solar energy collectors and methodologies of storing solar energy.
- knowledge in capturing and applying other forms of energy sources like wind, biogas and Geothermal energies.

TEXT BOOKS:

1. Rai G.D. , “Non-Conventional Energy Sources”, Khanna Publishers, 2011
2. Twidell & Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011

REFERENCES:

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007
2. Ramesh R & Kumar K.U , “Renewable Energy Technologies”,Narosa Publishing House, 2004
3. Mittal K M , “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003
4. Kothari D.P, Singhal ., K.C., “Renewable energy sources and emerging technologies”, P.H.I, New Delhi, 2010

MT6005 VIRTUAL INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES:

- The principle and applications of virtual instruments are introduced in mechatronics systems.

UNIT I REVIEW OF VIRTUAL INSTRUMENTATION 9

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data -flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II VI PROGRAMMING TECHNIQUES 9

VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

UNIT III DATA ACQUISTION BASICS 9

AOC.OAC. 010. Counters & timers. PC Hardware structure, timing. Interrupts OMA, software and hardware installation.

UNIT IV COMMON INSTRUMENT INTERFACES 9

Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office &.Industrial applications, Visa and IVI, image acquisition and processing. Motion control.

UNIT V USE OF ANALYSIS TOOLS 9

Fourier transforms, power spectrum correlation methods, windowing & filtering, VI application in various fields.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to use virtual instruments to design various mechatronics systems.

TEXT BOOK

1. Gupta ," Virtual Instrumentation Using Lab view 2E" Tata McGraw-Hill Education, 2010

REFERENCES:

1. Gary Jonson, Labview Graphical Programming, Second Edition, McGraw Hill, New York, 1997
2. Sokoloff; Basic concepts of Labview 4, Prentice Hall Inc., New Jersey 1998.
3. Gupta S., Gupta J.P: , PC interfacing for Data Acquisition & Process Control, Second Edition, Instrument Society of America, 1994.

MG6071 ENTERPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES :

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

UNIT I ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION 9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of

Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL : 45 PERIODS

OUTCOMES :

- Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.

TEXTBOOKS :

1. S.S.Khanka, "Entrepreneurial Development" S.Chand & Co. Ltd.,Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, " Entreprenuership – Theory, Process and Practice", Cengage Learning 9th edition, 2014.

REFERENCES :

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, Enterprenuership theory at cross roads: paradigms and praxis" Dream tech, 2nd edition 2005.
3. Rajeev Roy, 'Entrepreneurship' Oxford University Press, 2nd edition, 2011.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

EC6077 DIGITAL SIGNAL PROCESSORS AND ITS APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- To understand the concept of information, types of channels
- To understand the capabilities of various source coding theorems and the fundamental limit of transmission over the channel.
- To understand the capabilities of various channel coding theorems.
- To develop the knowledge on pass band communication and spread spectrum.

UNIT I ARCHITECTURE OFTMS320C5X 9

Introduction -Bus structure-Central Arithmetic Logic unit(CALU)-Auxiliary Register ALU(ARAU)-Index register(INDX)-Auxiliary register compare register-Block move address register-,Block repeat registers-parallel logic unit-memory mapped registers-program controllers-on chip features.

UNIT II TMS320C5X PROGRAMMING 9

Assembly language syntax-Addressing modes, Load/store instructions-Addition/subtraction instructions-Move instructions-Multiplication instruction-NORM instruction-Program control instructions-Peripheral instructions-Instruction Pipelining inC5x-Pipeline structure, Pipeline operation-Normal pipeline Operation.

UNIT III APPLICATIONS 9

C50 based starter kit-Programs for familiarization of the addressing modes-Program for familiarization of Arithmetic Instructions-Programs in C5x for Processing Real time signals.

UNIT IV ARCHITECTURE OF TMS320C54X 9

Introduction-Architecture-Buses-Memory Organization-CPU-ALU-Barrel shifter-Multiplier/Adder unit-Compare, Select and store unit-Exponent Encoder-C54X pipeline-On chip Peripherals-Data Address Generation logic-Program address generation logic.

UNIT V TMS320C54X PROGRAMMING 9

Data Addressing-Arithmetic instructions-Move instructions-Load/Store instructions-Logical instructions-Control instructions-Conditional store instructions-Repeat instructions-I/o instructions-Bit manipulation instructions-parallel instructions-special instructions-Application programs.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to

- Discuss the representation of signals and the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- Design the baseband and band pass signal transmission and reception techniques.
- Explain error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels.

TEXT BOOK:

1. Venkataramani B., Bhaskar M. ”Digital Signal Processors: Architecture, Programming and Applications “Tata McGraw Hill, 2008

REFERENCES:

1. Sem.M.Kuo Woon-Seng.s.Gan “Digital Signal Processors: Architectures, Implementations, and Applications “Pearson Education,2005.
2. Steven W smith “Scientist and Engineer’s Guide to Digital signal processing”, 2008.

RO6005 MAINTENANCE AND SAFETY ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge on maintenance and fundamentals and safety engineering practices.

UNIT I MAINTENANCE: 6

Types – breakdown, preventive, predictive, TPM; elements of preventive maintenance – checklist, schedule, procedure.

UNIT II TOTAL PRODUCTIVE MAINTENANCE: 12

Principles; preparatory stages of implementation – TPM organisation structure, creation; basic TPM policies and aids, master plan.

TPM IMPLEMENTATION:

Small group activities, autonomous maintenance, establishing planned maintenance, training, developing equipment management program.

UNIT III SAFETY SYSTEMS ANALYSIS: 6

Definitions, safety systems; safety information system: basic concept, safety cost / benefit analysis; industrial safety engineering, OSHA regulations.

UNIT IV HAZARD ANALYSIS: 10

General hazard analysis: electrical, physical and chemical hazard, detailed hazard analysis. Cost effectiveness in hazard elimination. Logical analysis: map method, tabular method, fault tree analysis and hazop studies.

FIRE PROTECTION SYSTEM: Chemistry of fire, water sprinkler, fire hydrant, alarm and detection system. Suppression system: CO_2 system, foam system, Dry Chemical Powder (DCP) system, **halon** system, portable extinguisher.

UNIT V SAFETY IN MACHINE OPERATION: 10

Design for safety, lock out system, work permit system, safety in use of power press, cranes. Safety in foundry, forging, welding, hot working and cold working, electroplating and boiler operation.

SAFETY AND LAW: Provisions in factory act for safety, explosive act, workmen compensation act, compensation calculation. Boiler act and pollution control act.

TOTAL : 45 PERIODS

OUTCOMES:

- Students must be able to identify and prevent chemical, environmental mechanical, fire hazard through analysis and apply proper safety techniques on safety engineering and management.

TEXT BOOKS:

1. John Ridley, “Safety at Work”, Butter Worth Publisher, Oxford, 1997.
2. Robinson C J and Ginder A P, “Implementing TPM”, Productivity Press, USA, 1995.

REFERENCES:

1. Dhillon B S, “Maintainability, Maintenance and Reliability for Engineers”, CRC Press, 2006.
2. Heinrich H W, “Industrial Accident Prevention”, National Safety Council, Chicago, 1998.
3. National Safety Council, “Personal Protective Equipment”, Bombay, 1998.
4. National Safety Council, “Accident Prevention Manual for Industrial Operations”, Chicago, 1995.
5. Patrick A Michaud, “Accident Prevention and OSHA Compliance”, CRC Press, 1995.
6. Derek James, “Fire Prevention Handbook”, Butter Worth & Co., Oxford, 1991.
7. Dan Peterson, “Techniques of Safety Management”, 1990.

RO6006 SOFTWARE PROJECT MANAGEMENT AND QUALITY ASSURANCE L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the phases in a software project
- Understand fundamental concepts of requirements engineering and Analysis Modelling.
- Understand the major considerations for enterprise integration and deployment.
- Learn various testing and maintenance measures

UNIT I INTRODUCTION 9

Software Projects various other types of projects - Problems with software projects - an overview of project planning - Project evaluation - Project Analysis and technical planning - Project estimates - Preparation of Estimates - COCOMO model - Function Point Analysis - Putnam Model - Non-development overheads.

UNIT II ACTIVITY PLANNING 9

Project schedules - Sequencing and scheduling projects - Network planning models - Shortening project duration - Identifying critical activities.

UNIT III RISK MANAGEMENT 9

Resource allocation - Monitoring and Control - Managing people and organizing teams - Planning for small projects - Handling large projects - Divide and Conquer - Software Project survival.

UNIT IV SOFTWARE CONFIGURATION MANAGEMENT 8

Basic functions, responsibilities, standards, configuration Management, Prototyping - Models of prototyping.

UNIT V SOFTWARE QUALITY ASSURANCE 10

Quality and the quality system - standards and procedures - Technical activities - components - Continuous Improvement - Software Tasks - Management responsibility - Quality System - Contract Review - Document Control - Product identification and trace ability.

CASE STUDY**:** Introduction to Project Management Tools – Typical Applications.(CCPM Critical Chain Project Management

TOTAL : 45 PERIODS

OUTCOMES:

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

- Identify the key activities in managing a software project.
- Compare different process models.
- Concepts of requirements engineering and Analysis Modeling.
- Apply systematic procedure for software design and deployment.
- Compare and contrast the various testing and maintenance

REFERENCES:

1. Mike Cotterell and Bob Hughes, "Software Project Management - Inclination", Tata McGraw Hill, 2001.
2. Robert K Wysocki, Robert Beck Jr and David B. Crane, "Effective Project Management", John Wiley & Sons Inc, 1995.
3. Bennatain E M, "On Time, Within Budget", John Wiley & Sons Inc, 1995.
4. Steve McConnell, "Software Project Survival Guide", Microsoft Press, 1998.
5. Gerald M Weinberg," Quality Software Management", Volume I, Systems Thinking, Dorset House Publishing, 1997.
6. Gerald M Weinberg," Quality Software Management", Volume II, First Order Measurement, Dorset House Publishing, 1997.
7. Pressman R S, "Software Engineering - A Practitioner's Approach" McGraw Hill Book Company, 2001.
8. Darrel Ince,"An Introduction to S/W Quality Assurance and its Implementation", Mc Graw Hill Book Company Ltd, 1994.

CS6086 NEURAL NETWORKS AND FUZZY SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the various soft computing frame works
- Be familiar with design of various neural networks

- Be exposed to fuzzy logic
- Learn genetic programming
- Be exposed to hybrid systems

UNIT I INTRODUCTION TO NEURAL NETWORKS 7

Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, McCulloch - Pitts Neuron, Simple Neural Nets for Pattern Classification, Linear Separability - Hebb Net, Perceptron, Adaline, Madaline - Architecture, algorithm, and Simple Applications.

UNIT II PATTERN ASSOCIATION 7

Training Algorithms for Pattern Association - Hebb rule and Delta rule, Heteroassociative, Autoassociative and Iterative Auto associative Net, Bidirectional Associative Memory - Architecture, Algorithm, and Simple Applications.

UNIT III COMPETITION, ADAPTIVE RESONANCE AND BACKPROPAGATION NEURAL NETWORKS 13

Kohonen Self Organising Maps, Learning Vector Quantization, Counter Propagation - Architecture, Algorithm and Applications - ART1 and ART2 - Basic Operation and Algorithm, Standard Backpropagation Architecture, derivation of Learning Rules, Boltzmann Machine Learning - Architecture, Algorithm and Simple Applications.

UNIT IV CLASSICAL AND FUZZY SETS AND RELATIONS 6

Properties and Operations on Classical and Fuzzy Sets, Crisp and Fuzzy Relations - Cardinality, Properties and Operations, Composition, Tolerance and Equivalence Relations, Simple Problems.

UNIT V MEMBERSHIP FUNCTIONS 15

Features of membership function, Standard forms and Boundaries, fuzzification, membership value assignments, Fuzzy to Crisp Conversions, Lambda Cuts for fuzzy sets and relations, Defuzzification methods.

APPLICATIONS:

Neural Networks: Robotics, Image compression, Control systems - Fuzzy Logic: Mobile robot navigation, Autotuning a PID Controller.

TOTAL:45 PERIODS

OUTCOMES:

Upon completion of the course, the student should be able to:

- Apply various soft computing frame works
- Design of various neural networks
- Use fuzzy logic
- Apply genetic programming
- Discuss hybrid soft computing

TEXT BOOKS:

1. Sivanandam S N, Sumathi S, Deepa S N," Introduction to Neural Networks using Mat lab 6.0," Tata McGraw Hill Publications, New Delhi, 2006.
2. Timothy Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill, Singapore, 2002.

REFERENCES:

1. John Yen and Rezalangari, "Fuzzy Logic, Intelligence, Control and Information ", Pearson Education, New Delhi, 2007.

2. Mohammad H Hassoun, "Fundamentals of Neural Networks", Prentice hall of India, New Delhi, 2002.

RO6007 INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
- To discuss about the various applications of robots, justification and implementation of robot.

UNIT I INTRODUCTION 6

Types of industrial robots, Load handling capacity, general considerations in Robotic material handling, material transfer, machine loading and unloading, CNC machine tool loading, Robot centered cell.

UNIT II ROBOTS FOR INSPECTION 8

Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations.

UNIT III OTHER APPLICATIONS 8

Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications.

UNIT IV END EFFECTORS 11

Gripper force analysis and gripper design, design of multiple degrees of freedom, active and passive grippers.

SELECTION OF ROBOT:

Factors influencing the choice of a robot, robot performance testing, economics of robotisation, Impact of robot on industry and society.

UNIT V MATERIAL HANDLING 12

Concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists, advanced material handling systems, automated guided vehicle systems, automated storage and retrieval systems(ASRS), bar code technology, radio frequency identification technology.

TOTAL: 45 PERIODS

OUTCOMES:

- The Student must be able to design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effectors, sensor, machine vision robot kinematics and programming.

TEXT BOOKS:

1. Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, “Robotic Engineering – An integrated Approach” Prentice HallIndia, New Delhi, 2001.
2. Mikell P. Groover,”Automation, Production Systems, and Computer Integrated Manufacturing“, 2nd Edition, John Wiley & sons, Inc, 2007

REFERENCES:

1. James A Rehg, “Introduction to Robotics in CIM Systems”, Prentice Hall of India, 2002.
2. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 1994

MG6571 HUMAN RESOURCE MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To acquaint students with the issues related to staffing, training, performance and compensation of Human Resources.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 5

The importance of human resources – Objective of Human Resource Management - Human resource policies - Role of human resource manager**.**

UNIT II HUMAN RESOURCE PLANNING 8

Importance of Human Resource Planning – Internal and External sources of Human Resources - Recruitment - Selection – Socialization.

UNIT III TRAINING AND EXECUTIVE DEVELOPMENT 10

Types of training and Executive development methods – purpose – benefits.

UNIT IV EMPLOYEE COMPENSATION 12

Compensation plan – Reward – Motivation – Career Development - Mentor – Protégé relationships.

UNIT V PERFORMANCE EVALUATION AND CONTROL 10

Performance evaluation – Feedback - The control process – Importance – Methods – grievances – Causes – Redressal methods.

TOTAL: 45 PERIODS

OUTCOMES:

- To understand the process of effective Human Resource Management.

TEXTBOOKS :

1**.** Decenzo and Robbins, Human Resource Management, Wiley, 8th Edition, 2007.
2. H. John Bernardin, Human Resource Management – An Experimental Approach, Tata McGraw Hill, 5th ed. 2013, New Delhi.

REFERENCES :

1. Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, ‘Managing Human Resources’, PHI, 7th ed. 2012.
2. Dessler, Human Resource Management, Pearson Education Limited, 2007.

RO6008 EMBEDDED SYSTEMS DESIGN L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the architecture and programming of ARM processor.
- Be familiar with the embedded computing platform design and analysis.
- Be exposed to the basic concepts of real time Operating system.
- Learn the system design techniques and networks for embedded systems

UNIT I INTRODUCTION TO EMBEDDED SYSTEM 7

Embedded system, Functional building block of embedded system, Characteristics of embedded system applications, Challenges in embedded system design, Embedded system design processes.

UNIT II ARCHITECTURE OF EMBEDDED SYSTEM 10

Computer architecture taxonomy, CPUs – Programming input and output, Supervisor mode, Exceptions & Traps, Co - processors, Memory system mechanisms - CPU bus - Memory devices - I/O devices - Component interfacing - Assembly and linking - Basic compilation techniques – Program optimization.

UNIT III OS FOR EMBEDDED SYSTEMS 10

Introduction to RTOS, Multiple tasks and multiple processes, Context switching, Operating system, Scheduling policies, Interprocess communication mechanisms. Introduction to µC/ OS II.

UNIT IV PERFORMANCE ISSUSES OF EMBEDDED SYSTEMS 8

CPU Performance, CPU power consumption, Program level performance analysis, Analysis and optimization of program size, energy and power, Evaluating operating system performance, Power management and optimization strategies for processes, Multiprocessors – CPUs and accelerators, Multiprocessor performance analysis.

UNIT V DESIGN & IMPLEMENTATION 10

Development and debugging, Manufacturing Testing, Program validation and Testing, Distributed embedded architecture, Networks for Embedded Systems - I^2C Bus, CAN Bus, Design examples: Cell phones, Digital Still Cameras, Elevator Controller.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Describe the architecture and programming of ARM processor.
- Outline the concepts of embedded systems
- Explain the basic concepts of real time Operating system design.
- Use the system design techniques to develop software for embedded systems
- Differentiate between the general purpose operating system and the real time operating system
- Model real-time applications using embedded-system concepts

TEXT BOOKS:

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", The Morgan Kaufmann Series in Computer Architecture and Design, Elsevier Publications, 2008.
2. Rajkamal, "Embedded Systems – Architecture, Programming and Design", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010.

REFERENCES:

1. David E Simon, “An Embedded software primer”, Pearson education India, New Delhi, 2004.
2. Sriram V Iyer, Pankaj Gupta, “Embedded Real-time Systems Programming**”,** Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008

EC6801 WIRELESS COMMUNICATION L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Be familiar with the characteristic of wireless channel
- Understand the design of a cellular system
- Learn the various digital signaling techniques and multipath mitigation techniques
- Be exposed to the concepts of multiple antenna techniques

UNIT I WIRELESS CHANNELS 9

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters- Coherence bandwidth – Doppler spread & Coherence time, Fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

UNIT II CELLULAR ARCHITECTURE 9

Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity- trunking & grade of service – Coverage and capacity improvement.

UNIT III DIGITAL SIGNALING FOR FADING CHANNELS 9

Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

UNIT IV MULTIPATH MITIGATION TECHNIQUES 9

Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macrodiversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver,

UNIT V MULTIPLE ANTENNA TECHNIQUES 9

MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Explain the characteristic of wireless channel
- Design a cellular system
- Compare the various digital signaling techniques and multipath mitigation techniques
- Explain the concepts of multiple antenna techniques

TEXTBOOKS:

1. Rappaport,T.S., “Wireless communications”, Second Edition, Pearson Education, 2010.
2. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.

REFERENCES:

1. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
2. Upena Dalal, “ Wireless Communication”, Oxford University Press, 2009.
3. Van Nee, R. and Ramji Prasad, “OFDM for wireless multimedia communications”, Artech House, 2000.

EE6007 MICRO ELECTRO MECHANICAL SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION 9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I 9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT III SENSORS AND ACTUATORS-II 9

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand the operation of micro devices, micro systems and their applications.
- Ability to design the micro devices, micro systems using the MEMS fabrication process.

TEXT BOOKS:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

RO6009 INDUSTRIAL NETWORKING L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the evolution of computer networks using the layered network architecture.
- Understand the concepts of data communications.
- Be familiar with the Transmission media and Tools.
- Design computer networks using sub-netting and routing concepts.

UNIT I INTRODUCTION 10

Modern instrumentation and control systems – OSI model – Protocols – Standards – Common problems and solutions – Grounding/shielding and noise - EIA-232 interface standard – EIA-485 interface standard – Current loop and EIA-485 converters.

FIBRE OPTICS:

Introduction – Fibre optic cable components and parameters – Basic cable types – Connection fibres – troubleshooting.

UNIT II MODBUS 8

Overview – Protocol structure – Function codes – Modbus plus protocol –Data Highway – AS interface (AS-i) –**Device Net:** Physical layer – Topology – Device taps – **Profibus PA/DP/FMS:** Protocol stack – System operation.

UNIT III ETHERNET SYSTEMS 12

IEEE/ISO standards – Medium access control – frames – Reducing collisions – Auto negotiation – LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet.

CAN BUS:
Concepts of bus access and arbitration – CAN: Protocol-Errors: Properties – detection – processing – Introduction to CAN 2.0B

UNIT IV WIRELESS COMMUNICATIONS 9

Radio spectrum – Frequency allocation – Radio modem – Intermodulation – Implementing a radio link – RFID: Basic principles of radio frequency identification – Transponders - Interrogators

UNIT V APPLICATIONS 6

Automotive communication technologies – Design of automotive X-by-Wire systems, **-** The LIN standard – The IEC/IEEE Train communication network: Applying train communication network for data communications in electrical substations.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Apply the concepts of data communications.
- Design computer networks using sub-netting and routing concepts.
- Compare the various medium access control techniques.
- Compare and contrast the characteristics of physical layer.
- Analyze the different protocols.
- Compare and contrast the different network components.

TEXT BOOKS:

1. Steve Mackay, Edwin Wright, Deon Reynders and John Park, “Practical Industrial Data Networks: Design, Installation and Troubleshooting”, Newnes (Elsevier), 2004
2. “Practical Filebus, DeviceNet and Ethernet for Industry”, IDC Technology, 2006

REFERENCES:

1. Richard Zurawski, “The Industrial Communication Technology Handbook”, Taylor and Francis, 2005
2. Dominique Paret, “Multiplexed Networks for Embedded Systems”, John Wiley & Sons, 2007
3. Albert Lozano-Nieto, “RFID Design Fundamentals and Applications”, CRC Press, 2011

RO6010 INTERNET TOOLS AND JAVA PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn Java Programming.
- Understand different Internet Technologies.
- Be familiar with client – side programming and server – side programming.
- Learn to develop web applications.

UNIT I INTERNET TOOLS 11

Major Internet Services – Net Telephony – Internet Relay Chat – Newsgroups – File Transfer Protocol (FTP) – Remote Login – Telnet, Gopher, and Veronica Clients

OBJECT ORIENTATION IN JAVA:

Introduction - Data Types - Operators - Declarations - Control Structures - Arrays and Strings - Input/Ouput.-Java Classes - Fundamentals - Methods - Constructors - Scope rules - this keyword - object based Vs oriented programming.- -Inheritance-Reusability - Composing class.

UNIT II ABSTRACT FUNCTIONS AND PACKAGES 6

Abstract classes - Abstract Functions – Method Overloading and Method Overriding- Wrapper Classes.

Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface - Applying Interface - Variables in Interfaces.

UNIT III EXCEPTION HANDLING 9

Fundamentals - Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested Try statements - Throw - Throws - Java Built-in Exception - Creating your own subclasses.

MULTI THREADED PROGRAMMING:

Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Main thread - Creating the Thread - Synchronization - Interthread Communication - Deadlock.

UNIT IV I/O, APPLETS 12

I/O basics - Stream - Stream Classes - Predefined stream - Reading/Writing console input - Applet fundamentals - Native methods.- GUI Components - Applets - Java Scripts – AWT / Swings.

UNIT V INTRODUCTION TO NETWORK PROGRAMMING 9

Fundamentals - Internet Addresses - Internet Protocols - DNS - Internet Services - Socket programming, UDP, TCP.

JAVA DATABASE PROGRAMMING**:** JDBC –Database Connection and Table Creation – Execution of Embedded SQL Statements - ResultSet and ResultSetMetaData – Examples.

TOTAL :45 PERIODS

OUTCOMES:

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

- Implement Java programs.
- Create a basic website using HTML and Cascading Style Sheets.
- Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.
- Design rich client presentation using AJAX.
- Design and implement simple web page in PHP, and to present data in XML format.
- Design and implement server side programs using Servlets and JSP.

REFERENCES:

1. Patrick Naughton and Herbert Schildt, "JAVA - The Complete Reference", Tata McGraw Hill, 1997.
2. Deitel and Deitel, "JAVA - How to Program", Prentice Hall International Inc, 2003.
3. William Stanek and Peter Norton, "Peter Norton's Guide to Java Programming",Tech Media Publications, 1997.
4. Mark Grand, "JAVA Language Reference", O'Reilly & Associates Inc., 1997.
5. Horstmann and Cornell, "Core Java", Pearson Education, 2001.
6. Kennath Litwak, "Pure Java 2: A Code-Intensive Premium Reference", Tech Media Publications, New Delhi, 2000
7. James K L," The Internet: A Users Guide", Prentice Hall of India, New Delhi, 2003.

CE6071 ADVANCED STRENGTH OF MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- To analyse the stresses and deformations through advanced mathematical models.
- To estimate the design strength of various industrial equipments.

UNIT I ANALYSIS OF PLATES 8

Mathematical modeling of plates with normal loads – Point and Distributed Loads – Support conditions – Rectangular plates - Stresses along coordinate axes – Plate deformations – Axi-symmetric plates – Radial and tangential stresses – plate deflections.

UNIT II THICK CYLINDERS AND SPHERES 10

Equilibrium and compatibility conditions - Lame's Theorem – Boundary conditions – distribution of radial and tangential stresses – compound cylinders – Interference fits - Stresses due to temperature distributions.

UNIT III ROTATING DISCS 10

Lame-Clayperon Theorem – radial and tangential stresses in discs due to centrifugal effects – boundary conditions – solid and hollow discs – Interference fit on shafts –Strengthening of the hub – residual stresses – Autofrettege – Discs of variable thickness – Disc profile for uniform strength.

UNIT IV BEAMS ON ELASTIC FOUNDATION 8

Infinite beam subjected to concentrated load – Boundary Conditions – Infinite beam subjected to a distributed load segment – Triangular load – Semi infinite beam subjected to loads at the ends and concentrated load near the ends – Short beams.

UNIT V CURVED BEAMS AND CONTACT STRESSES 9

Analysis of stresses in beams with large curvature – Stress distribution in curved beams – Stresses in crane hooks and C clamps – Contact Stresses – Hertz equation for contact stresses – applications to rolling contact elements.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply mathematical knowledge to calculate the deformation behavior of simple structures. Critically analyse problem and solve the problems related to mechanical elements and analyse the deformation behavior for different types of loads.

TEXT BOOKS:

1. Boresi A.P., Schmidt R.J., "Advanced Mechanics of Materials", John Wiley and Sons, Sixth edition, 2003.
2. Dally J.W. and Riley W.F, "Experimental Stress Analysis", John Wiley and Sons 2003

REFERENCES:

1. Burr A. H., CheathAm J.B., "Mechanical Analysis and Design", Prentice Hall of India, Second Edition, 2001.
2. Den-Hartog J.P., "Strength of Materials", John Wiley and Sons.

ME6602 **AUTOMOBILE ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

UNIT I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components-functions and materials, variable valve timing (VVT).

UNIT II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints ,Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels – Electric and Hybrid Vehicles, Fuel Cell

Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students will be able to identify the different components in automobile engineering.
- Have clear understanding on different auxiliary and transmission systems usual.

TEXT BOOKS:

1. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Standard Publishers, Seventh Edition, New Delhi, 1997.
2. Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.

REFERENCES:

1. Newton ,Steeds and Garet, “Motor Vehicles”, Butterworth Publishers,1989.
2. Joseph Heitner, “Automotive Mechanics,” Second Edition, East-West Press, 1999.
3. Martin W, Stockel and Martin T Stockle , “ Automotive Mechanics Fundamentals,” The Good heart –Will Cox Company Inc, USA ,1978.

4. Heinz Heisler , 'Advanced Engine Technology," SAE International Publications USA,1998. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.

MG6089 SUPPLY CHAIN MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

UNIT I INTRODUCTION 5

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II SUPPLY CHAIN NETWORK DESIGN 10

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

UNIT III LOGISTICS IN SUPPLY CHAIN 10

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT IV SOURCING AND COORDINATION IN SUPPLY CHAIN 10

Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT V SUPPLY CHAIN AND INFORMATION TECHNOLOGY 10

The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.

TOTAL: 45 PERIODS

OUTCOMES:

- The student would understand the framework and scope of supply chain networks and functions.

TEXTBOOK :

1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management , Strategy, Planning, and operation", Pearson Education, 2010.

REFERENCES:

1. Jeremy F.Shapiro, "Modeling the supply chain", Thomson Duxbury, 2002.
2. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management, PHI, 2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, "Logistics", PHI 2002.
4. James B.Ayers, "Handbook of Supply chain management", St.Lucle press, 2000.

ME6703 COMPUTER INTEGRATED MANUFACTURING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT I INTRODUCTION 10

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING 10

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III CELLULAR MANUFACTURING 9

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) 8

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V INDUSTRIAL ROBOTICS 8

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the Student can able to understand the use of computers in process planning and use of FMS and Robotics in CIM

TEXT BOOKS:

1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCES:

1. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.

2. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach” Chapman & Hall, London, 1995.
3. P Rao, N Tewari &T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Company, 2000.