ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R - 2013

B.E. MECHANICAL ENGINEERING (SANDWICH)

I - X 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.	MS6301	Electrical and Electronics Engineering	4	0	0	4
3.	ME6401	Kinematics of Machiney	3	0	0	3
4.	CE6306	Strength of Materials	3	1	0	4
5.	MS6302	Machine Assembly Drawing	3	1	0	4
PRACTICAL						
6.	MF6512	Machine Drawing	0	0	4	2
7.	CE6315	Strength of Materials Laboratory	0	0	3	2
8.	MS6311	Electrical and Electronics Engineering Laboratory	0	0	2	1
9.	MS6312	Industrial Training I*	0	0	0	2
		TOTAL	**16**	**3**	**9**	**26**

SEMESTER - IV

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	MA6453	Probability and Queueing Theory	3	1	0	4
2.	MS6401	Industrial Metallurgy	3	0	0	3
3.	MS6402	Fluid Machinery and Gas Dynamics##	3	1	0	4
4.	ME6505	Dynamics of Machines	3	0	0	3
5.	MS6403	Instrumentation and Control Systems	4	0	0	4
PRACTICAL						
6.	MS6411	Experimental Fluid Mechanics Laboratory	0	0	3	2
7.	ME6511	Dynamics Laboratory	0	0	3	2
8.	MS6412	Metallurgy Laboratory	0	0	2	1
9.	MS6413	Industrial Visit cum Lecture	0	0	2	1
10.	MS6414	Industrial Training II*	0	0	0	2
		TOTAL	**16**	**2**	**10**	**26**

SEMESTER – V

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	MA6452	Statistics and Numerical Methods	3	1	0	4
2.	MS6501	Economics for Business Decisions	3	0	0	3
3.	ME6302	Manufacturing Technology I	3	0	0	3
4.	MS6502	Applied Thermodynamics	3	1	0	4
5.	MS6503	Metrology and Quality Assurance	3	0	0	3
PRACTICAL						
6.	MS6511	Sensor Interface Laboratory	0	0	2	1
7.	MF6511	Metrology Laboratory	0	0	2	1
8.	MS6512	Manufacturing Process Laboratory I	0	0	2	1
9.	MS6513	Industrial Training III*	0	0	0	2
		TOTAL	**15**	**2**	**6**	**22**

SEMESTER – VI

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	MA6468	Probability and Statistics	3	1	0	4
2.	ME6402	Manufacturing Technology II	3	0	0	3
3.	ME6503	Design of Machine Elements	3	0	0	3
4.	ME6404	Thermal Engineering	3	0	0	3
5.	MG6851	Principles of Management	3	0	0	3
PRACTICAL						
6.	MS6611	Manufacturing Process Laboratory II	0	0	2	1
7.	MS6612	Thermal Engineering Laboratory	0	0	3	2
8.	MS6613	Industrial Training IV*	0	0	0	2
		TOTAL	**15**	**1**	**5**	**21**

SEMESTER – VII

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	MS6701	Mechatronic System Design	4	0	0	4
2.	ME6502	Heat and Mass Transfer	3	0	0	3
3.	ME6601	Design of Transmission Systems	3	0	0	3
4.	ME6603	Finite Element Analysis	3	0	0	3
5.		Elective I	3	0	0	3
PRACTICAL						
6.	MS6711	Heat and Mass Transfer Laboratory	0	0	3	2
7.	ME6712	Mechatronics Laboratory	0	0	3	2
8.	MS6712	Computer Aided Engineering Laboratory	0	0	3	2
9.	MS6713	Mini Project	0	0	3	2
10.	MS6714	Industrial Training V*	0	0	0	2
		TOTAL	**16**	**0**	**12**	**26**

SEMESTER – VIII

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	MS6801	Design for Manufacture and Assembly	3	1	0	4
2.	ME6015	Operations Research	3	0	0	3
3.	MS6802	Manufacturing Systems Design	3	0	0	3
4.	MS6803	Tool Design	3	0	0	3
5.		Elective II	3	0	0	3
PRACTICAL						
6.	MS6811	Manufacturing Systems Laboratory	0	0	2	1
7.	MS6812	Comprehensive Viva Voce	0	0	2	1
8.	MS6813	Industrial Training VI*	0	0	0	2
		TOTAL	**15**	**1**	**4**	**20**

SEMESTER – IX

SL. No.	CODE NO.	COURSE TITLE	L	T	P	C
THEORY						
1.	GE6351	Environmental Science and Engineering	3	0	0	3
2.	MS6901	Industrial Psychology and Work Ethics	3	0	0	3
3.	MS6902	Sociology and Global Issues	3	0	0	3
4.		Elective III	3	0	0	3
5.		Elective IV	3	0	0	3
PRACTICAL						
6.	MS6911	Design and Fabrication Project	0	0	4	2
7.	MS6912	Industrial Training VII*	0	0	0	2
		TOTAL	**15**	**0**	**4**	**19**

SEMESTER – X

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.	MS6111	Project Work	0	0	12	6
			6	**0**	**12**	**12**

*Two weeks Industrial Training during holidays

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 223

LIST OF ELECTIVES FOR B.E. MECHANICAL ENGINEERING (SANDWICH)

Elective I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	MS6001	Manufacture and Inspection of Gears	3	0	0	3
2.	MF6503	Precision Engineering	3	0	0	3
3.	MS6002	IC Engine Design	3	0	0	3
4.	ME6701	Power Plant Engineering	3	0	0	3

Elective II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	MS6003	Biogas Engineering	3	0	0	3
2.	MS6004	Theory of Elasticity and Plasticity	3	0	0	3
3.	MS6005	Quality Engineering	3	0	0	3
4.	MF6504	Hydraulics and Pneumatics	3	0	0	3
5.	GE6084	Human Rights	3	0	0	3

Elective III

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	ME6002	Refrigeration and Air Conditioning	3	0	0	3
2.	MG6089	Supply Chain Management	3	0	0	3
3.	RO6002	Industrial Design and Applied Ergonomics	3	0	0	3
4.	MS6006	Advanced Theory of Internal Combustion Engines	3	0	0	3
5.	GE6083	Disaster Management	3	0	0	3

Elective IV

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	AT6071	Manufacture of Automotive Components	3	0	0	3
2.	MS6007	Gas Dynamics and Space Propulsion	3	0	0	3
3.	RO6001	Lean Manufacturing	3	0	0	3
4.	ME6005	Process Planning and Cost Estimation	3	0	0	3
5.	MS6008	Modelling and Simulation of Internal Combustion Engines	3	0	0	3

Elective V

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	MS6009	Failure Analysis and Design	3	0	0	3
2.	MS6010	Design of Rotating Equipment	3	0	0	3
3.	IE6011	Product Design and Development	3	0	0	3
4.	BM6602	Biomechanics	3	0	0	3
5.	ME6014	Computational Fluid Dynamics	3	0	0	3

Elective VI

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	ME6501	Computer Aided Design	3	0	0	3
2.	ME6602	Automobile Engineering	3	0	0	3
3.	MS6011	Value Analysis and Value Engineering	3	0	0	3
4.	CE6071	Advanced Strength of Materials	3	0	0	3
5.	MS6012	Vibration and Noise Engineering	3	0	0	3
6.	MS6013	Mechanics of Composite Materials	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.

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 McGrawHill Publishing Company Limited, New Delhi, 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 McGraw 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.

MS6301 ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
4 0 0 4

OBJECTIVES:

- Use of AC & DC machines and perform speed control
- Use of different electronic device to design circuit
- Use of LIC to perform different boolean operation.

UNIT I INTRODUCTION 9

Ohms law - Kirchoff's laws – solving simple, DC circuits – Single Phase AC circuits - power, power factor, Introduction to three phase system, Comparison of single phase and Three phase.

ELECTRIC DRIVES:

DC drives, DC motors, principle of operation, torque equation, power developed, speed-torque characteristics of series, shunt and compound motors, speed control-armature control, field control.

UNIT II AC DRIVES 9

AC machines, Three phase Induction motors, principle of operation, torque equation, speed-torque characteristics of Induction motors, cage and wound rotor types, single phase Induction motors-principle of operation, method of starting, types of single phase motors.

INDUSTRIAL APPLICATIONS:

Factors to be considered for selection of motors, determination of power rating of drive motors, selection of motors for cranes, machine tool applications, centrifugal pumps.

UNIT III ELECTRONIC DEVICES 9

Operation of PN junction diodes, VI characteristics, zener diode, BJT-types -CB, CE, CC configurations, input and output characteristics, JFET, difference between FET and BJT-working principle and characteristics. MOSFET- types, principle of operation and characteristics.

ELECTRONIC CIRCUITS:

(Qualitative analysis only) Half wave and full wave rectifier, capacitive filters, zener voltage regulator, RC- DMA Introduction to PLC, coupled amplifier, frequency response.

UNIT IV LINEAR INTERGATED CIRCUITS 9

Operational amplifiers, Ideal op-amp characteristics, Inverting and Non-inverting amplifier, op-amp applications - Adder- Subtractor, integrator, differentiator, comparator, zero crossing detector.

DIGITAL ELECTRONICS:

Number systems-binary, octal, hexadecimal, logic gates – AND,OR, NOT, NAND,NOR, XOR, XNOR, Half adder, full adder, subtractor, Flip flops, RS,JK,JK Master slave, D and T type, counters and shift registers.

UNIT V MICROPROCESSORS 9

Architecture of Intel 8085, addressing modes, instruction set, machine cycles, timing diagrams, memory diagrams, Memory Mapped I/O Mapped I/O – Stack and Subroutines, interrups, DMA, introduction to programmable peripherals.

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

OUTCOMES:

- Upon completion of this course the student can able to apply AC & DC machines and perform speed control and different electronic device to design circuit.

TEXT BOOKS :

1. Murugesh Kumar K., "Basic Electrical Science and Technology", Vikas Publishing House Pvt Ltd., 2002.
2. Muthusubramanian R, Salivahanan S and Muraleedharan K.A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill Publishers., Thirteenth reprint, 2006.
3. Ramesh S Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085", Penram International Publishing (India) Pvt Ltd., Fifth Edition, February 2002.

REFERENCES:

1. Pillai S K,"A first course on Electrical Drives", Wiley Eastern Ltd, Bombay 1989.
2. Allen Mottershad,"Electronic Devices and Circuits", PHI, 1996.
3. Boylested," Eletronic devies and Intergrated circuits", PHI, 1997.

ME6401 KINEMATICS OF MACHINERY L T P C
3 0 0 3

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 BASICS OF MECHANISMS 9

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Universal Joint – rocker mechanisms.

UNIT II KINEMATICS OF LINKAGE MECHANISMS 9

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration – Introduction to linkage synthesis problem.

UNIT III KINEMATICS OF CAM MECHANISMS 9

Classification of cams and followers – Terminology and definitions – Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

UNIT IV GEARS AND GEAR TRAINS 9

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains.

UNIT V FRICTION IN MACHINE ELEMENTS 9

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads –Bearings and lubrication – Friction clutches – Belt and rope drives – Friction in brakes- Band and Block brakes.

TOTAL: 45 PERIODS

OUTCOMES:

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

TEXT BOOKS:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 3rd Edition, Oxford University Press, 2009.
2. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw Hill, 2009.

REFERENCES:

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
3. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
4. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961
5. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
6. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
7. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
8. Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 2002.
9. Khurmi, R.S., "Theory of Machines",14th Edition, S Chand Publications, 2005
10. Sadhu Sigh : Theory of Machines, "Kinematics of Machine", Third Edition, Pearson Education, 2012

CE6306 STRENGTH OF MATERIALS L T P C

3 1 0 4

OBJECTIVES:

To understand the stresses developed in bars, compounds bars, beams, shafts, cylinders and spheres.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains –Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT III TORSION 9

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS 9

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure –Deformation in spherical shells – Lame's theorem.

TOTAL (L:45+T:15): 60 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. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2007
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007

REFERENCES:

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2001
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2007.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2007
4. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.

MS6302 MACHINE ASSEMBLY DRAWING L T P C
3 1 0 4

OBJECTIVES:

- Use of drawing tools to show the assembly view of the component and mark suitable units, fir tolerance data

UNIT I INTRODUCTION 9

Introduction to machine drawing. Importance of sectional views. Computer-aided drafting
CONVENTIONS:
Code of practice for engineering drawing-conventional representation of details- drilled and tapped holes, countersunk and counter bored holes, internal and external threads, undercuts, grooves, chamfers, fillet radii and keyways. Conventions to represent standard components-bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges.

UNIT II ASSEMBLY CONCEPTS 9

Methods and concepts of assemblies-assembly requirements, Bill of materials. Methods of assembly-bolts, nuts, studs, screws and pins. Methods of arresting motion of a member in an assembly. Assembly and dismantling exercise of a typical assembly with emphasis on assembly sequence and appropriate fits.

UNIT III FITS AND TOLERANCES 9

Limits, fits and tolerances-need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances. Geometric tolerance-uses, types of form and position tolerances, symbols, method of indicating geometric tolerances on part drawings. Surface finish symbols- methods of indicating the surface roughness. Blue print reading exercises.

UNIT IV ASSEMBLY DRAWING PRACTICE 9

Making free hand sketches of typical subassemblies-flange coupling, stuffing box, journal bearings, rolling element bearings, keyed joints, cotter joints, C clamp.

UNIT V ASSEMBLY USING SOLID MODELING 9

Modeling and assembly using software-extracting views and sections. Drawing of assemblies-plummer block, machine vice, stop valve, screw jack, tail stock, cylindrical gear box, simple drill jig. Creation of bill of materials, calculation of mass and section properties, interference check between solids.

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

OUTCOMES:

- Upon completion of this course, the students can able to apply the drawing tools to show the assembly view of the component and mark suitable units, fit tolerance data

TEXT BOOKS:

1. Gopalakrishna K R, "Machine Drawing", Seventeenth Edition, Subhas Stores, Bangalore, 2003.
2. CAD/CAM Manual, PSG College of Technology. Coimbatore, 2002.

REFERENCES:

1. Varghese P I and John K C, "Machine Drawing", Jovast Publishers, Thrissur, 2007.
2. SP:46-2003 – “Engineering Drawing Practice for Schools and Colleges", Bureau of Indian Standards, New Delhi, 2003.
3. Faculty of Mechanical Engineering, PSG College of Technology," Design Data Book", M/s. DPV Printers, Coimbatore,1993.
4. ASME Y 14.5M-1994, “Dimensioning and Tolerancing”, ASME, New York, 1995.

MF6512 MACHINE DRAWING L T P C
0 0 4 2

OBJECTIVES:

- To train the students to prepare good and accurate drawing of various machine elements and assembly drawing of selected machine tool parts.

FUNDAMENTALS OF MACHINE DRAWING 8

Code of practice for Machine Drawing – Conventions, Abbreviation and Symbols
Sectional views – Types of sectional views
Selection of Fits and Tolerances – Method of placing limit dimensions.

BASIC MACHINE ELEMENTS **24**

The required sectional view of the following machine elements are to be drawn as per the standards.
Threaded joints
Riveted joints
Welded joints
Key,Cotter and Pin joints
Shaft coupling
Bearing
Pipe joints
Gears
Surface finish and its representation

ASSEMBLY DRAWING **28**

The assembly drawing of the following machine tool parts is to be drawn from the given detailed drawing.
Screw jack, machine vice, swivel bearing
Lathe tailstock, Lathe tool post- Tool head of a shaper
Drilling jig- Drilling machine spindle
Engine piston and connecting rod
Recirculating ball screw, LM guide ways,
Hydraulic and Pneumatic chuck of CNC machine.

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to develop engineering drawing for the industrial components using Indian Standard Code of Practice.

TEXT BOOK:

1. Sidheswar N., Kanniah P. and Sastry V.S., “Machine drawing”, Tata McGraw Hill, 1997.

REFERENCES:

1. Bhatt N.D, “Machine drawing”, published by RC Patel, Chartstar bookstall, Anand, India, 1997.
2. Gopalakrishna K.R., “Machine Drawing”, Subhas publications, Subhas stores, 2004.

CE6315 STRENGTH OF MATERIALS LABORATORY **L T P C**
0 0 3 2

OBJECTIVES

To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison

(i) Unhardened specimen
(ii) Quenched Specimen and
(iii) Quenched and tempered specimen.
11. Microscopic Examination of
(i) Hardened samples and
(ii) Hardened and tempered samples.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to perform different destructive testing
- Ability to characteristic materials

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Universal Tensile Testing machine with double 1 shear attachment – 40 Ton Capacity	1
2	Torsion Testing Machine (60 NM Capacity)	1
3	Impact Testing Machine (300 J Capacity)	1
4	Brinell Hardness Testing Machine	1
5	Rockwell Hardness Testing Machine	1
6	Spring Testing Machine for tensile and compressive loads (2500 N)	1
7	Metallurgical Microscopes	3
8	Muffle Furnace (800 C)	1

MS6311 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY L T P C
0 0 2 1

OBJECTIVES:

- To learn for conducting experiments involving electrical machines and Microprocessors and to analyse and interpret the results.

LIST OF EXPERIMENTS

1. Verification of Ohm's law and Kirchhoff's laws.
2. Load test on DC series motor.
3. Load test on three-phase induction motor.
4. Study of half wave and full wave rectifiers.
5. RC coupled transistor amplifier.
6. Applications of operational amplifier.
7. Study of logic gates and implementation of Boolean functions.
8. Implementation of binary adder/ subtractor.
9. Study of programming of 8085 microprocessor
10. Interfacing a stepper motor with 8085 microprocessor

TOTAL : 30 PERIODS

OUTCOMES:

- Understanding the relation between electrical voltage, current and resistance.
- Ability to measure the performance of electrical machine like DC and AC motors.
- Visualizing the usage of logic gates and Microprocessor in motor control systems.

REFERENCE:

1. Laboratory Manual prepared by Department of Electrical and Electronics Engineering.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	D. C. Motor Generator Set	2
2	D.C. Compound Motor	4
3	Single Phase Transformer	4
4	Three Phase Induction Motor	2
5	Single Phase Induction Motor	2
6	Three Phase Alternator Set	2
7	Ammeter A.C and D.C	20
8	Voltmeters A.C and D.C	20
9.	Watt meters LPF and UPF	12
10.	Resistors & Breadboards	1 set
11.	Cathode Ray Oscilloscopes	4
12.	Dual Regulated power supplies	6
13.	A.C. Signal Generators	4
14.	Voltmeters D.C.	10
15.	Ammeters D.C.	10
16.	Resistors, Capacitors, Diodes	1 set
17.	Transistors (BJT, JFET), SCR, Logic Gates	1 set
18.	Stepper Motor, Interface Card and Power Supply	1 set
19.	Probes	1 set

MS6312 **INDUSTRIAL TRAINING I** **L T P C**
(PROCESS ENGINEERING AND ASSEMBLY TECHNOLOGIES) **0 0 0 2**

Machining, assembly and process engineering - preparation of process sheets for spur gear - helical gear - sprockets - worm - worm wheel and rack - sequence of operations – machine tools used - speed and feed in each type of machine tool-setting time - operating time -cutting tools - Jigs and fixtures - gauges and instruments - study of assembly method for conventional lathe, pre assembly, sub-assembly and final assembly -study of assembly drawings - preparation of ration of loading sheets - assembly flow chart - assembly time - fits and tolerance between components - inspection methods – material flow diagrams.

MA6453 **PROBABILITY AND QUEUEING THEORY** **L T P C**
3 1 0 4

OBJECTIVES:

- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and 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 – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.

UNIT IV QUEUEING MODELS 9 + 3

Markovian queues – Birth and Death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms – Queues with impatient customers: Balking and reneging.

UNIT V ADVANCED QUEUEING MODELS 9 + 3

Finite source models - M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/E_K/1 as special cases – Series queues – Open Jackson networks.

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

OUTCOMES:

- The students will have a fundamental knowledge of the probability concepts.
- Acquire skills in analyzing queueing models.
- It also helps to understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.

TEXT BOOKS

1. Ibe. O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2007.
2. Gross. D. and Harris. C.M., "Fundamentals of Queueing Theory", Wiley Student edition, 2004.

REFERENCES

1. Robertazzi, "Computer Networks and Systems: Queueing Theory and performance evaluation", Springer, 3rd Edition, 2006.
2. Taha. H.A., "Operations Research", Pearson Education, Asia, 8th Edition, 2007.
3. Trivedi.K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd Edition, 2002.
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. Yates. R.D. and Goodman. D. J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

MS6401 INDUSTRIAL METALLURGY L T P C

3 0 0 3

OBJECTIVES:

- To understand and learnthe fundamental principles of metallurgy and material science and heat treatment processes of metals.

UNIT I CRYSTAL STRUCTURE: **9**

BCC, FCC and HCP structure- unit cell –crystallographic planes and directions, miller indices-crystal imperfections, p oint, line, planar and volume defects –Grain size, ASTM grain size number

UNIT II MECHANICAL PROPERTIES AND TESTING: 9

Mechanisms of plastic deformation, slip and twinning- types of fracture – testing of materials under tension, compression and shear loads-hardness tests (Brinell, Vickers and Rockwell). Impact test Izod and charpy, S-N curves, fatigue and creep test. High cycle fatigue, Low cycle fatigue, Axial fatigue, Rolling contact fatigue, Bending fatigue and Torsional fatigue.

NON DESTRUCTIVE TESTING:

Non Destructive Testing basic principles and testing method for Radiographic testing, Ultrasonic testing, Magnetic particle inspection and Liquid penetrant inspections, Eddy current testing.

UNIT III CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS: 9

Constitution of alloys –solid solutions, substitutional and interstitial –phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron- Iron carbide equilibrium diagram-classification of steel and cast iron microstructure, properties and applications.

UNIT IV HEAT TREATMENT: 9

Definition – full annealing, stress relief, recrystallisation and spheroidizing – normalizing, hardening and Tempering of steel. Isothermal transformation diagrams –cooling curves superimposed on I.T.diagram CCR- hardenability, Jominy end quench test – Austempering, martempering- case hardening, carburizing, nitriding, cyaniding, carbonitriding- Flame and Induction hardening.

UNIT V FERROUS MATERIAL: 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) – stainless and tool steels –HSLA-maraging steels – Gray, White malleable, spheroidal – Graphite – alloy castirons.

NON FERROUS MATERIALS:Copper, Aluminium, Nickel, Magnesium, Titanium, Lead, Tin. Important alloys –their composition properties and applications.

NON METALLIC MATERIALS: Introduction to polymers, Composites and Ceramics.

SELECTION OF MATERIALS: Factors to be considered for selection of materials with specific examples. Cost data of metals and alloys.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to relate crystal structure with material properties
- knowledge of material characterisation and testing
- ability to select suitable heat treatment method for improving mechanical properties.
- knowledge of selecting material for engineering application

TEXT BOOK:

1. Kenneth G.Budinski and Michael K. Buinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002

REFERENCES:

1. William D Callister, “Material Science and Engineering”, John Wiley and Sons, 1997.
2. Raghavan V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd., 1999.
3. Sydney H Avner, “Introduction to Physical Metallurgy”, McGraw Hill Book Company, 1994.

MS6402 FLUID MACHINERY AND GAS DYNAMICS[##] L T P C
3 1 0 4

OBJECTIVES:

- Solve problems related to the fundemental principles of fluid machinery and gas dynamics
- Solve turbo machinery problems from the statistical points of fluid mechanics
- Solve problem in the field of steam turbines gas dymanics

UNIT I INTRODUCTION 9

Energy transfer between fluid and a rotor. Euler's energy transfer equation. Components of energy transfer

DEGREE OF REACTION:

Impulse and reaction type, effect of blade angle on degree of reaction and energy transfer. Specific speed and its significance.

UNIT II HYDRAULIC TURBINE 9

Impulse type-Pelton wheel. Reaction type-Francis, Kaplan and Propeller. Principles of operation of turbine calculation of main dimensions, regulation and performance. Draft tube-function and types. Cavitation in turbines.

UNIT III PUMPS 9

Radial flow, axial flow and mixed flow pumps - ideal and actual slip, performance calculation and determination of main dimensions. Cavitation in pumps, net positive suction head (NPSH), effect of speed. Fluid coupling and torque converter.

COMPRESSORS:

Radial flow and axial flow type. Aerofoil analysis. Surge and stall.

UNIT IV STEAM TURBINES 9

Types-single stage impulse and reaction type, 50% reaction. Flow through nozzles. Performance of single stage machine. Compounding of turbines.

GAS TURBINE:

Open cycle, closed cycle, methods of improving the efficiency of a simple cycle, multistage compression, inter-cooling, reheating and regeneration, effect of operating variables on thermal efficiency, work ratio.

UNIT V GAS DYNAMICS 9

Mach number.Basics of Isentropic, Fanno and Rayleigh flows.

JET PROPULSION:

Turbojet-thrust, thrust power, propulsive efficiency, thermal efficiency, combustion chambers and afterburners.

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

OUTCOMES:

- Upon Completion of this course the students can able to apply the solve problems related to the fundemental principles of fluid machinery and gas dynamics and solve problem in the field of steam turbines gas dymanics.

TEXT BOOKS:

1. Kadambi and Manohar Prasad, "An Introduction to Energy Conversion" Vol. III, Wiley Eastern Private Ltd, New Delhi, 1994.
2. Rajput R K, "Thermal Engineering", Laxmi Publications, New Delhi, 2003.
3. Nag P K, "Engineering Thermodynamics", Tata McGraw Hill, Delhi, 2004
4. Ronald L Panton, "Incompressible Flow", Wiley India, 2005.

REFERENCES:

1. Yadav R Y, "Steam and Gas Turbines", Central Publishing House, Allahabad, 1987.
2. Govinda Rao N S, "Fluid Flow Machines", Tata McGraw Hill publishing Company Ltd., New Delhi, 1983.
3. Shephered D G, "Principles of Turbo Machinery", The MacMillan Co., New York, 1956.
4. Dixon S L, "Worked Examples in Turbo Machinery", Pergamon Press, New York, 1975.

- The course includes atleast one assignment with mathematical modeling and / or simulation of a practical situation.

ME6505 DYNAMICS OF MACHINES L T P C
3 0 0 3

OBJECTIVES:

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the effect of Dynamics of undesirable vibrations.
- To understand the principles in mechanisms used for speed control and stability control.

UNIT I FORCE ANALYSIS 9

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses- Dynamics of Cam-follower mechanism.

UNIT II BALANCING 9

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.

UNIT III SINGLE DEGREE FREE VIBRATION 9

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration – Equations of motion – Natural frequency – Types of Damping – Damped vibration– Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

UNIT IV FORCED VIBRATION 9

Response of one degree freedom systems to periodic forcing – Harmonic disturbances –Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

UNIT V MECHANISM FOR CONTROL 9

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the Students can able to predict the force analysis in mechanical system and related vibration issues and can able to solve the problem

TEXT BOOK:

1. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms” ,3rd Edition, Oxford University Press, 2009.
2. Rattan, S.S, “Theory of Machines”, 3rd Edition, Tata McGraw-Hill, 2009

REFERENCES:

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
2. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2005
3. Benson H. Tongue, ”Principles of Vibrations”, Oxford University Press, 2nd Edition, 2007
4. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
5. Allen S. Hall Jr., “Kinematics and Linkage Design”, Prentice Hall, 1961
6. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
7. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
8. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
9. Grover. G.T., “Mechanical Vibrations”, Nem Chand and Bros., 1996
10. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, “Theory of Vibration with Application”, 5th edition, Pearson Education, 2011
11. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002.
12. Khurmi, R.S.,”Theory of Machines”, 14th Edition, S Chand Publications, 2005.

MS6403 INSTRUMENTATION AND CONTROL SYSTEMS L T P C
4 0 0 4

OBJECTIVES:

- To impart knowledge on measurements and variables
- To introduce different parameters in environment and measuring techniques
- To teach the control system principle and build times response of different system

UNIT I TRANSDUCER VARIABLES AND MEASUREMENT SIGNALS 10

Three stages of generalized measurement system – mechanical loading – static characteristics of instruments- factors considered in selection of instruments – commonly used terms, error analysis and classification – sources of error – frequency response – displacement transducers – potentiometer, strain gauge – orientation of strain gauge, LVDT – variable reluctance transducers, proximity sensors, capacitance transducers, tacho generator; smart sensors, integrated sensors, radio telemetry, torque measurements, precision systems like video discs and drives, laser printer etc.,

UNIT II VIBRATION AND TEMPERATURE 9

Elementary accelerometer and vibrometer – seismic instrument for acceleration – velocity measurement, piezo electric accelerometer, temperature measurement-liquid in glass thermometer, pressure thermometer, resistance temperature detector, themcouples and thermopiles, thermistor, total radiation pyrometer, optical pyrometer – temperature measuring problem in flowing fluid.

UNIT III PRESSURE AND FLOW MEASUREMENT 9

Manometer, elastic transducer, elastic diaphragm transducer – pressure cell, bulk modulus pressure gauge – Mc Leod gauge – thermal conductivity gauge, calibration of pressure gauge, flow measurement – turbine type meter, hotwire anemometer, magnetic flow meter; liquid level sensors, light sensors, selection of sensors.

UNIT IV CONTROL SYSTEM PRINCIPLE 16

Basic elements of control systems – open loop and closed loop control – elements of closed loop control system – introduction to sampled data, digital control and multivariable control systems. Elements of lead and lag compensation, elements of proportional, integral - derivative (PID) control.

MODELLING OF SYSTEMS:

Mathematical Model for mechanical and electrical system - Transfer function – transfer function of hydraulic and pneumatic elements – flapper valve. Transfer function of D C Generator, DC servomotor and AC servomotors, tacho generators, gear trains, potentiometers, synchros – Transfer function of closed loop systems: determination of transfer function for position control, speed control system, temperature control system – block diagram reduction and signal flow graph.

UNIT V SYSTEM ANALYSIS 16

Typical test signals – time domain specifications – characteristic equation, time response of first order and second order systems for step input – stability and roots of characteristic equations – roots of characteristic equations – Routh Hurwitz stability concepts.

SUPERVISORY CONTROL AND DATA ACQUISTION (SCADA):

Overview, architecture, tools alarm, tag logging, history, report generation. Communication protocols of SCADA, interfacing SCADA with field devices. Distributed Control Systems (DCS), architecture, communication facilities, operator and engineering interfaces.

TOTAL: 60 PERIODS

OUTCOMES:

- Able to know the working principle of temperature, pressure, vibration, flowing sensors.
- Use of control system principle and use of the sensor to design close loop system.
- Develop mathematical model for mechanical and electrical system.

TEXT BOOKS:

1. Beckwith T G and Buck N L, “Mechanical Measurements”, Addition Wesley Publishing Company Limited, 1995.
2. Gopal M, “Control Systems – Principles and Design”, Tata McGraw Hill Co. Ltd., New Delhi, 2002.
3. Michael P Lukas, “Distributed Control Systems”, Van Nostrand Reinfold Company, 1995.

REFERENCES:

1. Jain R K, “Mechanical and Industrial Measurements”, Khanna Publishers, Delhi, 1999.
2. Rangan, Mani and Sharma, “Instrumentation”, Tata McGraw Hill Publishers, New Delhi, 2004.
3. Nagarath I J and Gopal M, “Control Systems Engineering”, New Age International Publishers, 2007.
4. CIMPLICITY SCADA packages Manual, Fanuc India Ltd., 2004.
5. Alan S Morris, “Measurement and Instrumentation Principles”, Butterworth, 2006.
6. Dominique Placko, “Fundamentals of Instrumentation and Measurement”, ISTE, 2007.
7. Regtien PPL, “Measurement Science for Engineers”, Kogan Page, 2005.

MS6411 EXPERIMENTAL FLUID MECHANICS LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To impart skill in using various fluid flow measuring devices and to conduct performance tests and pumps and turbines.

LIST OF EXPERIMENTS:

1. Flow measurement using mouthpiece and orifice.
2. Calibration and comparison of instruments for measuring flow through pipes-orifice, venturi meter, water meter and rotameter.
3. Calibration and comparison of open channel flow measuring instruments- V-notch and rectangular notch.
4. Experiment on force induced on the vane due to impact of jets.
5. Model study in wind tunnel.
6. Performance test on single stage, multi stage and variable speed centrifugal pumps.
7. Load test on impulse water turbine.
8. Load test on reaction water turbine and cross flow turbine.
9. Performance test on axial flow fan.
10. Performance test on centrifugal blower.

TOTAL : 45 PERIODS

OUTCOMES:

- Able to understand the usage of flow measuring devices in conducting experiments of pipes and channels.
- Ability to calibrate flow meters, performance studies on pumps, turbines fans and blower.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Orifice meter setup	1 no
2	Venturi meter setup	1 no
3	Rotameter setup	1 no
4	Pipe Flow analysis setup	1 no
5	Centrifugal pump/submergible pump setup	1 no
6	Reciprocating pump setup	1 no
7	Gear pump setup	1 no
8	Pelton wheel setup	1 no
9.	Francis turbine setup	1 no
10.	Kaplan turbine setup	1 no
11.	Axial Flow fan	1 no
12.	Centrifugal blower	1 no
13.	Model wind tunnel setup	1 no
14.	V-notch & rectangular notch set up	1 no

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.

MS6412 **METALLURGY LABORATORY** **L T P C**
0 0 2 1

OBJECTIVES:

- To know about the conducting experiments or ferrous and non-ferrous metallic specimens for finding surface and substrate characterisation

LIST OF EXPERIMENTS:

1. a. Study of Metallurgical Microscope
   b. Specimen preparation for metallographic studies
2. Study of unetched Grey cast iron, SG iron and Malleable cast iron.
3. Study of etched Grey cast iron, SG iron and Malleable cast iron
4. Study of low carbon steel and medium carbon steel
5. Study of high carbon steel and white cast iron.
6. Study of hardened steel and case carburized steel
7. Study of tool steel and stainless steel.
8. Study of Al and Cu alloys
9. Inclusion rating
10. Case studies of Metallurgical failure analysis.

TOTAL : 30 PERIODS

OUTCOMES:

- Will be in a position to relate different material properties with composition, structure etc and enable to understand their engineering implications.
- Ability to use metallurgical microscope or stand and specimens and interpret the results with material properties.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Belt Grinder	1 no
2	Emery Pad	1 no
3	Microscope – Binocular Optical	3 nos
4	Jominy Apparatus	1 no
5	Electric furnace with temperature control for heat treatment	1 no
6	Standard metallurgical specimens	1 set
7	Desicator	1 no
8	Micro scope with image analyser	1 no
9	Orsat analysis apparatus	1 no
10	Electric Bunsen Burner	3 nos
11	Universal Foundry Sand	1 no
12	Standard Foundry Sand Test	1 no
13	Permeability tester	1 no
14	Hot air Oven	1 no
15	Single pan balance (0-1 kg range, 10mg accuracy)	1 no
16	Clay washer	1 no
17	Foundry sand sieve shakers	1 no
18	Constant current power supply (0-20v)	1 no

MS6413 **INDUSTRIAL VISIT CUM LECTURE** **L T P C**
0 0 2 1

- ❖ 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.

TOTAL : 30 PERIODS

MS6414 **INDUSTRIAL TRAINING II** **L T P C**
(INSPECTION AND TESTING OF MECHANICAL ASSEMBLIES) **0 0 0 2**

Inspection and testing of lathes, pumps and motors - BIS specification for motors and pump sets - list of testing instrument - functions - foot mounting motor dimensions as per IS: 1231 - importance of name plate and identification of name plate details - trouble shooting of induction motors - type of routine test of induction motor as per IS : 7538 (Performance Calculations) 1) Measurement of stator resistance 2) High voltage test 3) Measurement of insulation resistance 4) Reduced voltage test 5) No load test 6) Full load test 7) Locked rotor test 8) Starting torque and starting current 9) Pull up torque 10) Pull out torque 11) Momentary over load test 12) Temperature rise test - Final inspection and testing for conventional lathes - Test charts - Inspection of the machine tool for BIS and IMTMA standard - Cutting test - Method of inspection testing - Gauges and instruments required - Accuracy requirements - Deviation observed - Study of inspection methods and preparation of inspection format for lathe bed - Head stock body - Tail stock body - Apron body - Threading and feed box - Gear box - Head stock spindle - Tail stock spindle - Gear - Lead screw - Feed shaft - Spine shaft. – Exposure to metrological aspects of components used for lathes, pumps and motors.

MA6452 **STATISTICS AND NUMERICAL METHODS** **L T P C**
3 1 0 4

OBJECTIVES:

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

UNIT I TESTING OF HYPOTHESIS **9+3**

Large sample test based on Normal distribution for single mean and difference of means - Tests based on t, ¡ ^{2} and F distributions for testing means and variances – Contingency table (Test for Independency) – Goodness of fit.

UNIT II DESIGN OF EXPERIMENTS **9+3**

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS **9+3**

Newton Raphson method – Gauss elimination method – pivoting – Gauss Jordan methods – Iterative methods of Gauss Jacobi and Gauss Seidel – Matrix inversion by Gauss Jordan method – Eigen values of a matrix by power method.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations – Milne's predictor corrector methods for solving first order equations – Finite difference methods for solving second order equations.

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

OUTCOMES:

- It helps the students to have a clear perception of the power of statistical and numerical techniques, ideas and would be able to demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.

TEXT BOOKS:

1. Johnson. R.A., and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 11th Edition, 2011.
2. Grewal. B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, New Delhi, 9th Edition, 2007.

REFERENCES

1. Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
2. Spiegel. M.R., Schiller. J., and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 2004.
3. Chapra. S.C., and Canale. R.P, "Numerical Methods for Engineers", Tata McGraw Hill, New Delhi, 5th Edition, 2007.
4. Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.

MS6501 ECONOMICS FOR BUSINESS DECISIONS L T P C
3 0 0 3

OBJECTIVES:

- To know and apply the economic theory of consumer demand
- To know the politicians of there Government intervention in market
- To know the pricing strategies

UNIT I INTRODUCTION TO ECONOMICS: 8

Definitions – Scope and Significance of Economics in Decision Making – Various Economic Tools and Techniques.

CALCULATING PERCENT CHANGE AND COMPOUNDED GROWTH RATES:

Some Mathematical Concepts and Analytical Tools.

UNIT II ECONOMIC THEORY OF CONSUMER DEMAND: 8

Law of Demand – Determinants of Demand – Exceptions to Law of Demand Elasticity of Demand – Various types of Elasticity and measurements of Price Elasticity and Demand Forecasting Methods and its Applications. Law of Supply – Elasticity of Supply – Determinants of Elasticity of Supply.

UNIT III ECONOMIC THEORY OF THE FIRM (Cont'd): 13

(Input Markets) – Production Function – Factors influencing Production – Cobb-Douglas Production Function – Economies of Scale – Returns to Scale – Cost Analysis - Various Cost Concepts - Cost Output Relationship and Short Run and Long Run.

MARKET STRUCTURE AND COMPETITION:

Various Forms of Market Structure – Perfect Competition - Imperfect Competition – Monopoly – Monopolistic – Oligopoly – Pricing Strategies and Price Discrimination in various Market Structures.

MARKET FAILURES AND GOVERNMENT INTERVENTION IN THE MARKET ECONOMY: Basic Functions of Government – Market Efficiency – Tools of Government Intervention.

UNIT IV INTRODUCTION TO MACROECONOMICS: 11

(Measuring Aggregate Output) Meaning – Objective and Issues of Macroeconomics- National Output Concept – GDP, GNP, NNP, Per Capita Income, Disposable Income, Personal Disposable Income – Various Methods of Measuring National Income - Inflation – Deflation.

AGGREGATE EXPENDITURES AND FISCAL POLICY:

(Fiscal Policy) Objectives of Fiscal Policy – Instruments of Fiscal Policy – Taxation. Highlights of Current Fiscal Policy.

UNIT V MONEY AND BANKING: 6

(Monetary Policy) Functions of Money - Value of Money - Objectives and instruments of Monetary Policy – Highlights of Current Monetary Policy – Banking – Types of Banks - Central Bank and Commercial Banks - Objectives and Functions of Central Bank and Various Types of Commercial Banks and Its Functions.

ECONOMIC GROWTH: Meaning – Benefits and Costs of Growth.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course the student can able to apply the economic theory of consumer demand and pricing strategies.

TEXT BOOK:

1. Paul A Samuelson and William D Nordhaus, "Economics", Tata McGraw Hill, New Delhi, 2007.

REFERENCES:

1. Karl E Case and Ray C Fair, "Principles of Economics", Prentice Hall, 2008.
2. Misra S K and Puri V K, "Economic Environment of Business", Himalaya Publishing House, New Delhi, 2002.
3. Richard G Lipsey, Colin Harbury Weidenfeld and Nicolson, "Principles of Economics", London, 1990.

ME6302 MANUFACTURING TECHNOLOGY – I L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

UNIT I METAL CASTING PROCESSES 9

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; **Melting furnaces** : Blast and Cupola Furnaces; **Principle of special casting**

processes : Shell - investment – Ceramic mould – Pressure die casting - Centrifugal Casting - CO_2 process – Stir casting; **Defects in Sand casting**

UNIT II JOINING PROCESSES 9

Operating principle, basic equipment, merits and applications of : Fusion welding processes : Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding – Electro slag welding; **Operating principle and applications of** : Resistance welding - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding and Friction Stir Welding; Brazing and soldering; **Weld defects:** types, causes and cure.

UNIT III METAL FORMING PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – forging operations. Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion.

UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes-Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning– Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming

UNIT V MANUFACTURE OF PLASTIC COMPONENTS 9

Types and characteristics of plastics – Moulding of thermoplastics – working principles and typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding – Typical industrial applications – introduction to blow moulding –Rotational moulding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the students can able to use different manufacturing process and use this in industry for component production

TEXT BOOKS:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997
2. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2006

REFERENCES:

1. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008
2. Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006
3. Paul Degarma E, Black J.T and Ronald A. Kosher, Eigtth Edition, Materials and Processes, in Manufacturing prentice – Hall of India, 1997.
4. Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2004.
5. Rao, P.N. Manufacturing Technology Foundry, Forming and Welding, TMH; 2nd Edition, 2003

MS6502 **APPLIED THERMODYNAMICS** **L T P C**
3 1 0 4

OBJECTIVES:

- To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.

UNIT I BASIC CONCEPTS OF THERMODYNAMICS: 9

System, property, state and equilibrium, process and cycle, work, heat and other forms of energy. Zeroth law and application, first law statement, applications to closed and open systems, general energy equation and applications to thermal equipments.

UNIT II SECOND LAW OF THERMODYNAMICS: 9

Statements**-**heat engines and heat pump, reversibility, Carnot cycle and Carnot theorem
ENTROPY:
Clausius theorem, Clausius inequality, principle of increase in entropy, T-S relations, availability and irreversibility

UNIT III PROPERTIES OF PURE SUBSTANCE: 9

Pure substance, phase-change processes, property diagram for phase processes, properties table, Mollier chart.

VAPOUR POWER CYCLE :
Rankine and modified Rankine cycle, Reheat cycle, Regenerative cycle, Reheat- Regenerative cycle, Binary vapour cycle

UNIT IV PROPERTIES OF IDEAL GASES AND REAL GASES: 9

Ideal gas equation, evaluation of work and heat, entropy changes, real gases, Van der Waals equation, compressibility - universal compressibility chart and general thermodynamic relations.

UNIT V PSYCHROMETRY: 9

Properties – atmospheric air, psychrometry Chart.

THERMODYNAMIC CYCLES:

Air standard cycles-Otto cycle, Diesel cycle, Dual cycle, comparison of Otto, diesel, and Dual Cycle Brayton cycle.

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

OUTCOMES:

- Upon completion of this course, the students can able to apply the Students can able to apply the Thermodynamic Principles to Mechanical Engineering application.
- Apply mathematical fundamentals to study the properties of steam, gas and gas mixtures.

TEXT BOOKS:

1. Cenge Y Al and Boles M A "Thermodynamics, An Engineering Approach" Tata McGraw Hill, 2003.
2. Nag P K, “Engineering Thermodynamics”, Tata McGraw Hill, Delhi, 2004.

REFERENCES:

1. Holman J P, “Thermodynamics”, Tata McGraw Hill, 1998.
2. Sonntag R E, Borgnakke C and Van Wylen G J,“Fundamentals of Engineering Thermodynamics”, John Wiley, 2003.
3. Rogers G FC and Mayhew Y R, “Engineering Thermodynamics Work and Heat Transfer”, Pearson, 2003.

4. Kothandaraman C P and Domkundwar S, “Engineering Thermodynamics, Part I, Dhanpat Rai and Sons, Delhi, 2004.
5. John P O Connell and Haile J M, “Thermodynamics Fundamentals for Applications”, Cambridge, 2011
6. Yunus A Cengel and Michael A Boles,“Thermodynamcis and Engineering Approach”, TMH, 2010
7. Jones J B and Dugan R E, “Engineering Thermodynamcis”, Prentice Hall India, 2007
8. Eugene Silberstein, “Heat Pumps”, Thomson, 2010

MS6503 METROLOGY AND QUALITY ASSURANCE L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge on various Metrological equipments available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

UNIT I BASICS OF MEASUREMENT AND DEVICES: 9

Definition of metrology, economics of measurement, measurement as a comparative process, dimensional properties, terminology and accuracy of measurement, measuring errors, Abbe’s Principle, Principle of interferometry- flatness testing, optical interferometer, laser interferometer. Holography and speckle metrology.

QUALITY STANDARDS: General cares and rules in measurement, International standardization, SI units and quantities, BIS- NPL – advantages, ISO 9000 quality standards, QS 9000 standards, Environment standards, metrology room measuring standards room.

UNIT II LINEAR MEASUREMENTS: 9

Material length standards –line and end measurement – calibration of end bars, datum and reference surfaces, surface plates, gauges – feeler gauges, micrometers, dial test indicator, slip gauges, care of gauge blocks, Comparators- mechanical, electrical, optical and pneumatic, optical projector.

GEOMETRICAL MEASUREMENT:

Angular measurement – plain vernier and optical protractors, sine bar, optical instruments, flatness, parallelism and roundness measurement, need for limit gauge, design of plug gague, Taylor’s principle, three basic types of limit gauges, surface texture, reasons for controlling surface texture, parameters used , specification of surface texture, drawing and symbols, Tomilson surface meter. CMM.

UNIT III METROLOGY OF MACHINE ELEMENTS: 9

Types of screw threads, terminology, proportions of ISO metric thread, measurement of major, minor and effective diameters. Gear terminology and standard proportions, spur gear measurement, checking of composite errors, base pitch measurement, clean room environment.

UNIT IV MACHINE INSTALLATION AND TESTING: 9

Equipment erection, commissioning, testing procedure for lathe, milling, continuous process line. First aid, safety precautions in installation of equipment, protocol for repair and testing, inspection check list.

UNIT V STATISTICAL QUALITY CONTROL: 9

Process capability, steps in using control charts, basic principles of lot sampling – sampling inspection, single and double sampling, determination of sample size, OC curves, AOQ, ABC standards.

QUALITY CONTROL CHARTS:

Types, manufacturing specifications, p chart, np chart, c chart, u chart, X and R chart – solving problems using the charts. Design of tool for inspection, gauging design of plug, snap gauges, thread gauges. Gauge repeatability and reproducibility studies.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the Students can demonstrate different measurement technologies and use of them in Industrial Components.

TEXT BOOKS:

1. Gupta I C, “A text book of Engineering Metrology”, Dhanpat Rai publications, New Delhi, 2003.
2. Jain R K, “Mechanical and Industrial Measurements”, Khanna Publishers Co Ltd., New Delhi, 1985.
3. Holmen J P, “Experimental Methods for Engineers”, Tata McGraw Hill Publications Co Ltd, 2004.
4. John G Nee, “Fundamentals of Tool Design” Society of Manufacturing Engineers, Fourth Edition, 1998.
5. Dominique Placko, “Metrology in Industry: The Key for Quality”, ISTE, 2007.

REFERENCES:

1. Narayana K , “Engineering Metrology”, Scitech Publication, 2006.
2. Kaniska Bedi, “Quality Management”, Oxford University Press, Chennai, 2007.

MS6511 SENSOR INTERFACE LABORATORY L T P C
0 0 2 1

OBJECTIVES:

- To illustrate the students on the interfacing aspects different sensors and usage of sensors for mechanical measurements and controls

LIST OF EXPERIMENTS:

1. Interfacing of Thermo couple, RTD and thermistor with PC
2. Interfacing of LVDT with PC
3 Interfacing of PFCV and Flow Sensor with PC
4. Interfacing of Piezo – electric accelerometer with PC and Microphone and performing order analysis
5. Inspection using Vision System
6. Measurement of force using proving ring
7. Measurement of strain using Wheatstone bridge and interface with PC
8. Control system exercise using PC- stepper motor level
9. Programming motion control system for robot using PC and acoustic sensors
10. Product RFD identification using system identification of a single degree of freedom setup,

TOTAL : 30 PERIODS

OUTCOMES:

- Develop skill of interfacing, acquiring and analyzing data from different sensors like LVDT, accelerometers, etc

- Ability to use sensors for measurement of force, flow and strain.
- Develop skill of robot programming and motion control programming

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Temperature Sensors (Thermocouple, RTD, thermistor) with interfacing circuit compatible for PC control.
2. LUDT interfacing Circuit.
3. PFCV and Flow Sensor interfacing circuit.
4. Piezo-electric accelerometer with PC interfacing and Microphone.
5. Machine Vision System.
6. Force Measurement with proving ring.
7. Strain guges with wheatstone bridge circuit interface.
8. Stepper motor interface.
9. Robot with PC interface with acoustic sensors.
10. RFD indentification set up.
11. PCs for each experiment (10 Nos).

MF6511 **METROLOGY LABORATORY** **L T P C**
0 0 2 1

OBJECTIVES:

- To make the students understand the fundamental principles of measuring techniques by practicing exercises on various measuring instruments.

LIST OF EXPERIMENTS:

Contact methods:

i) Linear and Angular measurement using Autocollimator.
ii) Measurement of composite error using gear tester.
iii) Calibration of optical comparator and measurement of dimension
iv) Determining the accuracy of electrical and optical comparator.
v) Measurement of taper angle using sine bar.
vi) Measurement of various angles using Bevel Protractor.
vii) Surface assessment using contact roughness tester.

Non-contact measurement techniques:

viii) Measurement of Taper angle using Tool Makers Microscope.
ix) Measurement of various elements of screw thread using Tools Makers Microscope.
x) Experiments in CMM.

TOTAL: 30 PERIODS

OUTCOMES:

- Ability to use different metrological equipments and measure different parameters for quality impertion
- Use of the metrological equipments for quality control.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Autocollimator, Gear Tester, Optical Comparator, Sine Bar, Bevel Protractor, Tool Makers Microscope, CMM, Contact roughness tester, Computers with necessary accessories.

MS6512 MANUFACTURING PROCESS LABORATORY I L T P C
0 0 2 1

OBJECTIVES:

- To expose in using the turning machine for various machining operations and to know about metal forming operations using press.

LIST OF EXPERIMENTS:

1. Facing and step turning operation
2. Drilling and taper turning
3. Grooving, chamfering and knurling
4. Thread cutting operation – external and internal
5. Field study involving actual measurement of cutting time inturning, drilling and comparing with theoretical calculations
6. Eccentric turning
7. Pin and bush assembly for H_8 e_8 clearance fit
8. Smooth contour machining
9. Demonstration of press operations
10. Dismantling and assembly of tailstock

TOTAL: 30 PERIODS

OUTCOMES:

- Ability to use lathe for various metal cutting operations like turning, boring, drilling etc.
- Ability to machine components to achieve specific fit.
- Understanding the applications of mechanical press in metal forming operations.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Centre Lathes	15 nos
2	Profile machining attachment for lathes	2 no
3	Precision boring machine	1 no
4	Radial Drilling Machine	1 no
5	small capacity sheet metal forming press	1 no
6	machine time measuring set up	1 no

MS6513 INDUSTRIAL TRAINING III L T P C
(PRODUCT DEVELOPMENT AND QUALITY SYSTEMS) 0 0 0 2

Total product knowledge, reverse engineering and quality system skill (Mini Project- I), Detailed constructional knowledge of product assembly, sub assembly, components, Sequential assembly and disassembly procedure, capturing of all geometrical dimensions, drawings, tolerances, fits, form error, material of construction and to understand the product development skills for lathes, drilling machines, submersible pumps, mono block pumps& electric motors - Comparison of design construction of other makes for above products and analysis -To develop any new product with innovation & creativity - Report preparation, presentation and evaluation -Awareness of TQM, ISO9000, ISO14000 and other standards etc. - Process capability studies – Rejection analysis – Six sigma applications – Calibration needs – Calibration authorities – Records – Charts – Applications – Form error understanding and verification- Case studies in quality systems.

MA6468 PROBABILITY AND STATISTICS L T P C
3 1 0 4

OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.

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 – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 9+3

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 9+3

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 9+3

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

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

OUTCOMES:

- The students will have a fundamental knowledge of the concepts of probability. Have knowledge of standard distributions which can describe real life phenomenon. Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS:

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
2. Johnson. R.A. and Gupta. C.B.,"Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
3. Papoulis. A and Unnikrishnapillai. S., "Probability, Random Variables and Stochastic Processes " McGraw Hill Education India , 4th Edition, New Delhi , 2010.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

ME6402 MANUFACTURING TECHNOLOGY – II L T P C
3 0 0 3

OBJECTIVES:

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching. To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming

UNIT I THEORY OF METAL CUTTING 9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools – nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

UNIT II TURNING MACHINES 9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi automatic – single spindle : Swiss type, automatic screw type – multi spindle:

UNITIII SHAPER, MILLING AND GEAR CUTTING MACHINES 9

Shaper - Types of operations. Drilling ,reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling hobbing and gear shaping processes –finishing of gears.

UNIT IV ABRASIVE PROCESS AND BROACHING 9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centreless grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines

UNIT V CNC MACHINING 9

Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre, part programming fundamentals CNC – manual part programming – micromachining – wafer machining

TOTAL : 45 PERIODS

OUTCOMES:

- The Students can able to use different manufacturing process and use this in industry for component production

TEXT BOOKS:

1. Hajra Choudhury. Elements of Workshop Technology – Vol.II. Media Promoters
2. Rao. P.N “Manufacturing Technology,” Metal Cutting and Machine Tools, Tata McGraw-Hill, New Delhi, 2003.

REFERENCES:

1. Richerd R kibbe, John E. Neely, Roland O.Merges and Warren J.White “Machine Tool Practices”, Prentice Hall of India, 1998
2. HMT – Production Technology, Tata McGraw Hill, 1998.
3. Geofrey Boothroyd, Fundamentals of Metal Machining and Machine Tools, Mc Graw Hill, 1984
4. Roy. A.Lindberg, “Process and materials of manufacture,” PHI/Pearson Education fourth, Edition 2006.

ME6503 **DESIGN OF MACHINE ELEMENTS** **L T P C**
3 0 0 3

OBJECTIVES:

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of acomponent to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

(Use of P S G Design Data Book is permitted)

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS **10**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – curved beams – crane hook and 'C' frame- Factor of safety - theories of failure – Design based on strength and stiffness – stress concentration – Design for variable loading.

UNIT II SHAFTS AND COUPLINGS **8**

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys, keyways and splines – crankshafts - Rigid and flexible couplings.

UNIT III TEMPORARY AND PERMANENT JOINTS **9**

Threaded fastners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, riveted joints for structures - theory of bonded joints.

UNIT IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS **9**

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

UNIT V BEARINGS **9**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs, -- Selection of Rolling Contact bearings.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the Students can able to successfully design engine components

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw Hill Book Co, 2010.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw Hill , 2008.

REFERENCES:

1. SundararajamoorthyT.V., Shanmugam.N,"Machine Design",Anuradha Publications,Chennai, 2003.
2. Robert C. Juvinall and Kurt M. Marshek,
3. Alfred Hall, Halowenko, A and Laughlin, H., ""Fundamentals of Machine Design", 4th Edition,Wiley, 2005Machine Design", Tata McGraw Hill Book Co. (Schaum's Outline), 2010
4. Bernard Hamrock,Steven Schmid,Bo Jacobson, "Fundamentals of Machine Elements",2nd Edition, Tata McGraw-Hill Book Co., 2006.

5. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
6. Ansel Ugural, “Mechanical Design – An Integral Approach, 1st Edition, Tata McGraw Hill Book Co, 2003.
7. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003.

ME6404 THERMAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To integrate the concepts, laws and methodologies from the first course in thermo dynamics into analysis of cyclic processes
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

UNIT I GAS POWER CYCLES 8

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency - Comparison of cycles.

UNIT II INTERNAL COMBUSTION ENGINES 10

Classification - Components and their function. Valve timing diagram and port timing diagram - actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburettor. MPFI, Diesel pump and injector system. Battery and Magneto Ignition System - Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculation.

UNIT III STEAM NOZZLES AND TURBINES 9

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations –Governors.

UNIT IV AIR COMPRESSOR 9

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor

UNIT V REFRIGERATION AND AIR CONDITIONING 9

Refrigerants - Vapour compression refrigeration cycle- super heat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia –Water, Lithium bromide – water systems (Description only) . Air conditioning system - Processes, Types and Working Principles. - Concept of RSHF, GSHF, ESHF- Cooling Load calculations.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the Students can understand different gas power cycles and use of them in IC and R & AC applications.

TEXT BOOKS:

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers , 2000
2. Kothandaraman. C.P., Domkundwar. S, Domkundwar. A.V., "A course in thermal Engineering, "Dhanpat Rai &sons, Fifth edition, 2002

REFERENCES:

1. Sarkar, B.K,"Thermal Engineering" Tata McGraw Hill Publishers, 2007
2. Arora.C.P,"Refrigeration and Air Conditioning," Tata McGraw Hill Publishers, 1994
3. Ganesan V.." Internal Combustion Engines" , Third Edition, Tata McGraw Hill, 2007
4. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw Hill, New Delhi, 2003

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 P.C & Reddy P.N, "Principles of Management", Tata McGraw Hill, 1999

MS6611 MANUFACTURING PROCESS LABORATORY II L T P C
0 0 2 1

OBJECTIVES:

- To introduce the metal machining machines like shaper, milling, grinding and gear cutting machines and to expose to measurements of forces in cutting processes

LIST OF EXPERIMENTS:

1. Internal and external dovetail machining using shaper
2. Experiment in spark erosion process
3. Experiment in surface grinding and cylindrical grinding processes
4. Experiment in tool grinding – single point and multi point tools
5. Experiment in spur gear milling
6. Experiment in keyway slotting
7. Experiment in spur gear shaping
8. Experiment in spline milling and pocket milling
9. Experiment in milling maximum square and hexagon on each end of M S Rod.
10. Measurement of cutting forces using tool dynamometer.

TOTAL: 30 PERIODS

OUTCOMES

- Trained to use machines for cutting different shapes in metals like slotting, gear tooth cutting, contour cutting, etc.
- Usage of grinding machines for finishing operations.
- Exposed to experiments on metal cutting machines

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Centre Lathes	2 nos
2	Turret and Capstan Lathes	1 No each
3	Horizontal Milling Machine	1 no
4	Vertical Milling Machine	1 no
5	Surface Grinding Machine	1no
6	Cylindrical Grinding Machine	1no
7	Tool grinding machine	1no
8	Shaper	2 nos

9	Slotter	1no
10	Radial Drilling Machine	1no
11	latheTool Dynamometer	1no
12	Gear Hobbing Machine	1no
13	EDM machine	1no

MS6612 THERMAL ENGINEERING LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To impart practical knowledge in IC engines, Compressors, Refrigeration and air conditioning and to conduct experiments as the engines under various operating conditions.

LIST OF EXPERIMENTS:

1. Experimental study on valve timing diagram in 4-stroke engine cut model
2. Experimental study on port timing diagram in 2-stroke engine cut model
3. Performance test on constant speed 4-stroke diesel engine
4. Variable speed test on multi-cylinder diesel engine
5. Heat balance test on 4-stroke diesel engine
6. Performance test on constant speed single cylinder petrol engine
7. Performance test on high pressure two stage reciprocating air compressor
8. Performance testing of boilers
9. IC engine performance evaluation using PC interface
10. Experiment of heating, ventilation and air conditioning unit
11. Experiment on Refrigeration tutor

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to demonstrate the working of IC Engines, Compressors and Refrigeration and Air conditioning systems.
- Ability to conduct performance tests on heat engines and the applications of data acquisition system in conducting experiments.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	4 -stroke and 2 –stroke engine cut model	1 no
2	Refrigeration and Air Conditioning Equipments	1set
3	Multi Cylinder Petrol Engine	1set
4	multiCylinder Diesel Engine	1set
5	Two Stroke Petrol Engine	3 nos
6	Two Stroke Diesel Engine Model	1 set
7	Four Stroke Petrol Engine	1 set
8	Four Stroke Diesel Engine Model	1 set
9	Two Stroke Petrol Engine Model	1 set
10	Experimental type low capacity boiler	1 set
11	mechanical & electrical loading system for engines	1 set
12	data acquisition interface set up with for engines	1 set
13	Two stage reciprocating compressor with performance measuring system	1 no

MS6613 **INDUSTRIAL TRAINING IV (DESIGN AND PRODUCTION OF CASTINGS)** **L T P C 0 0 0 2**

Foundry practice, design knowledge of patterns, Moulds, Cores (Mini Project – II), Layout, Pattern shop - Sand plant - Machine moulding - Core shop - Heavy moulding – furnaces -melting-knock-out and shot blasting - fettling -Study of various casting designs-Metallurgy -Inspection-Semi Automation processes-Sand reclamations-Preservations-Rough Machining-Various allowances-Method Engineering-Computational applications-Planning & Scheduling-Costing-Cleanliness-Orderliness-Environmental requirements-Safety needs-Energy Conservations-Bio Mass Power Generators-DISA Machine operations-Material Handling techniques-Case studies for few selected casting to understand steps to design plan right from pattern to finish casting. Inspection of casting, casting defects and remedies, cause and effects diagram, Rejection analysis.

MS6701 **MECHATRONIC SYSTEM DESIGN** **L T P C 4 0 0 4**

OBJECTIVES:

- To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

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. Introduction to HMI systems – text display, touch panels and integrated displays.

TRANSFER LINES AND AUTOMATED ASSEMBLY:

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 II 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 III PROGRAMMABLE LOGIC CONTROLLERS: 9

Basic structure, input/output programming, timers, relays, counters, analogue input/output, interfacing with PC, pneumatic sequencing, control problem using PLC

PROGRAMMABLE AUTOMATION:

Computer Numerical Control-basic theory, advantages of numerical control. Open and closed loop systems, information flow and coding theory. Classification of CNC machine tools. 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.

UNIT IV CNC PART PROGRAMMING 9

Manual and computer aided part programming-G and M functions, canned cycles. Generation using CAM software

UNIT V ROBOTIC SYSTEMS: 9

Basic structure of a robot–robot end effectors. Classification of robots–accuracy, resolution and repeatability of a robot. Drives and control systems–mechanical components of robots–sensors and vision systems. Transducers and sensors-tactile sensors, proximity sensors and range sensors, vision systems. Robot motion control and robot programming.

DESIGN OF MECHATRONIC SYSTEMS:

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

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

OUTCOMES:

- Upon completion of this course, the Students can able to design mechatronics system with the help of Microprocessor, PLC and other electrical and Electronics Circuits.

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, Second Edition, 1999.
4. Steve F Krar, “Computer Numerical Control Simplified“, Industrial Press, 2001.

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. Festo K G, “Pneumatic Tips”, Festo, Germany, 1987.
4. Nitaigour Premchand Mahadik, “Mechatronics”, Tata McGraw Hill, Publishing Company, Ltd., 2003.
5. Rolf Isermann, “Mechatronic Systems Fundamentals”, Springer, 2003.
6. John W Webb and Ronald A Reis, “Programmable Logic Controllers”, Prentice Hall, Inc., 1999.
7. Robert H Bishop, “Mechatronics: Introduction”, Taylor and Franics, 2006.
8. Peter Smid, “CNC Programming Techniques: An Insider’s Guide to Effective Methods and Applications”, Industrial Press, 2006.
9. Wisama Khalil and Etienne Dombre, “Robot Mainpulators Modeling, Performance Analysis and Control”, ISTE, 2007.
10. Mark W Spong and Seth Hutchinson, “Robot Modeling and Control”, Wiley-India Pvt. Ltd., 2006.

ME6502 **HEAT AND MASS TRANSFER** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the mechanisms of heat transfer under steady and transient conditions.
- To understand the concepts of heat transfer through extended surfaces.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer.

(Use of standard HMT data book permitted)

UNIT I CONDUCTION **9**

General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction –– plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT II CONVECTION **9**

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes .

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **9**

Nusselt's theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method.

UNIT IV RADIATION **9**

Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.

UNIT V MASS TRANSFER **9**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy –Convective Mass Transfer Correlations.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the students can able to understand and apply different heat and mass transfer principles of different applications.

TEXT BOOK:

1. Yunus A. Cengel, Heat Transfer A Practical Approach – Tata McGraw Hill, 2010

REFERENCES:

1. Frank P. Incropera and David P. Dewitt, Fundamentals of Heat and Mass Transfer, JohnWiley & Sons, 1998.
2. Venkateshan S.P., Heat Transfer, Ane Books, New Delhi, 2004.
3. Ghoshdastidar, P.S, Heat Transfer, Oxford, 2004,
4. Nag, P.K., Heat Transfer, Tata McGraw Hill, New Delhi, 2002
5. Holman, J.P., Heat and Mass Transfer, Tata McGraw Hill, 2000
6. Ozisik, M.N., Heat Transfer, McGraw Hill Book Co., 1994.
7. Kothandaraman, C.P., Fundamentals of Heat and Mass Transfer, New Age International, New Delhi, 1998.
8. Yadav, R., Heat and Mass Transfer, Central Publishing House, 1995.

9. M.Thirumaleshwar : Fundamentals of Heat and Mass Transfer, "Heat and Mass Transfer", First Edition, Dorling Kindersley, 2009

ME6601 DESIGN OF TRANSMISSION SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements
- To learn to use standard data and catalogues

(Use of P S G Design Data Book permitted)

UNIT I DESIGN OF FLEXIBLE ELEMENTS 9

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears.

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT IV GEAR BOXESES 9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

UNIT V CAMS, CLUTCHES AND BRAKES 9

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the students can able to successfully design transmission components used in Engine and machines.

TEXT BOOKS:

1. Bhandari V, “Design of Machine Elements”, 3rd Edition, Tata McGraw Hill Book Co, 2010.

2. Joseph Shigley,Charles Mischke,Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw Hill, 2008.

REFERENCES:

1. Sundararajamoorthy T. V, Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2003.
2. Gitin Maitra,L. Prasad “Hand book of Mechanical Design”, 2nd Edition, Tata McGraw Hill, 2001.
3. Prabhu. T.J., “Design of Transmission Elements”, Mani Offset, Chennai, 2000.
4. C.S.Sharma, Kamlesh Purohit, “Design of Machine Elements”, Prentice Hall of India Pvt. Ltd., 2003.
5. Bernard Hamrock, Steven Schmid,Bo Jacobson, “Fundamentals of Machine Elements”, 2nd Edition, Tata McGraw-Hill Book Co., 2006.
6. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”,4th Edition,Wiley, 2005
7. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill BookCo.(Schaum’s Outline), 2010
8. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
9. Ansel Ugural, “Mechanical Design – An Integral Approach, 1st Edition, Tata McGraw Hill Book Co, 2003.
10. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, “Design of Machine Elements” 8th Edition, Printice Hall, 2003.
11. U.C.Jindal : Machine Design, "Design of Transmission System", Dorling Kindersley, 2010

ME6603 FINITE ELEMENT ANALYSIS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

UNIT I INTRODUCTION 9

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II ONE-DIMENSIONAL PROBLEMS 9

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION 9

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the Students can able to understand different mathematical Techniques used in FEM analysis and use of them in Structural and thermal problem

TEXT BOOKS:

1. Reddy J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw Hill, 2005
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCES:

1. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butter worth Heinemann, 2004
2. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.
4. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990

MS6711 HEAT AND MASS TRANSFER LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To impart practical knowledge in conducting experiments using heat and mars transfer devices like tubes, tins etc. To make the students to understand different modes of heat transfer mechanisms

LIST OF EXPERIMENTS:

1. Experiment on Pin Fin apparatus
2. Experiment on natural convective heat transfer from vertical cylinder
3. Experiment on forced heat transfer inside tube
4. Determination of Stefan-Boltzmann constant
5. Determination of emissivity of grey surface
6. Effectiveness of parallel /counter flow heat exchanger
7. Experiment on boiling and condensation apparatus
8. Study on heat transfer in compressor and IC engine cylinder heads using finite element analysis software.

TOTAL: 45 PERIODS

OUTCOMES:

- Understanding the various heat and mass transfer mechanisms using experiments.
- Ability to use FEA for analysis of Engine components.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	NAME OF THE EQUIPMENT	Qty.
1	Guarded plate apparatus	1 no
2	Lagged pipe apparatus	1 no
3	Natural convection-vertical cylinder apparatus	1 no
4	Forced convection inside tube apparatus	1 no
5	Pin-fin apparatus	1 no
6	Stefan-Boltzmann apparatus	1 no
7	Emissivity measurement apparatus	1 no
8	Parallel/counter flow heat exchanger apparatus	1 no
9	Finite element thermal loading analysis softwares licenses	5 nos

ME6712 MECHATRONICS LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.

LIST OF EXPERIMENTS:

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
8. Study of PLC and its applications.
9. Study of image processing technique.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the Students can able to design mechatronics system with the help of Microprocessor, PLC and other electrical and Electronics Circuits.

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/ PLC Control each	1 no
2	Basic Hydraulic Trainer Kit	1 no
3	Hydraulics and Pneumatics Systems Simulation Software	10 nos
4	8051 - Microcontroller kit with stepper motor and drive circuit sets	2 no
5	Image processing system with hardware & software	1 no

MS6712 COMPUTER AIDED ENGINEERING LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To expose the students in the usage of software for modeling and analysis of machine components.

LIST OF EXPERIMENTS:

1. Solid modeling of engineering components of a typical assembly and extraction of production drawings of the above 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. Thermal analysis of IC engine components using FEA software.
5. Crash analysis of an automobile using FEA software.
6. Kinematic and dynamic analysis of mechanisms using mechanism analysis software.
7. Thermal Analysis of electronic equipments.
8. Analysis of flow through pipes using CFD software.
9. Simulation of stamping process using metal forming software.
10. Tolerance stack up using simulation software.

TOTAL: 45 PERIODS

OUTCOMES:

- Exposed to use CAD software for creating wire frame and solid models of machine parts
- Ability to conduct kinematic and dynamic simulations of mechanisms
- Knowledge in using softwares for Crash/Impact, flow analysis.
- Usage of FEA softwares in mechanical and thermal load analysis

Note:

Design/Selection of machine elements will be based on estimated loads and other design requirements collected by the student from field data with extensive support from manufacturers catalogues (wherever applicable).

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	1no
6	workstation configuration computers	15 nos

MS6713 MINI PROJECT L T P C
0 0 3 2

The mini-project involves the following:

- **Preparing a project - brief proposal including**
  - Problem Identification
  - A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
  - List of possible solutions including alternatives and constraints
  - Cost benefit analysis

- ❖ Time Line of activities

- ❖ **A report highlighting the design finalization [based on functional requirements & standards (if any)]**

- ❖ **A presentation including the following:**
  - ❖ Implementation Phase (Hardware / Software / both)
  - ❖ Testing & Validation of the developed system
  - ❖ Learning in the Project

- ❖ **Consolidated report preparation**

TOTAL: 45 PERIODS

MS6714	INDUSTRIAL TRAINING V (MANAGERIAL SKILLS, CREATIVITY, SOFT SKILLS, HRM)	L T P C 0 0 0 2

Managerial skills, soft skills and HRM, Generation of creative and innovative ideas, SWOT analysis Executive Skills-Group Discussions-Communication Skills-Project Report preparation methods-Focus on customer needs-Visual Management-Scheduling systems-Maintenance Management-Vendor Developments-Model Preparations-Production, Planning & Controls-Storage & Inventory Management-Supply Chain Management-Lean Methods-Wastage Identifications- Equipment Up Time-Kaizen & Lean Practices, human Resource Management Skills-Innovation & Adaptation Skills-Creative Skills- Patent Right knowledge-Competitive Skills- Interview focusing skills- Product Development Skills- Reverse Engineering Skills- Concurrent Engineering Skills-Prototyping Skills-Costing Skills- Analyzing Skills- Marketability Analysis Skills.

MS6801	DESIGN FOR MANUFACTURE AND ASSEMBLY	L T P C 3 1 0 4

OBJECTIVES:

- Apply the principle of geomatic tolerance in assembly.
- Use of datum system for assembly
- Use of systematic assembly procedure for manufacturing assembly.

UNIT I DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY **9**

DFM approach, DFM guidelines, standardisation, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka - Yoke principle; 6σ concept; design creativity.

UNIT II TOLERANCE ANALYSIS: **9**

Process capability, process capability metrics, Cp, Cpk , cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law.

SELECTIVE ASSEMBLY:

Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft, control of axial play-introducing secondary machining operations, laminated shims, examples.

UNIT III DATUM SYSTEMS: 9

Degrees of freedom, grouped datum systems-different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pin and hole, grouped datum system with spigot and recess pair and tongue-slot pair, computation of translational and rotational accuracy, geometric analysis and applications.

UNIT IV TRUE POSITION TOLERANCING THEORY: 9

Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, examples.

FORM DESIGN OF CASTINGS AND WELDMENTS:

Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols – design considerations for plastic component manufacturing.

UNIT V TOLERANCE CHARTING TECHNIQUE: 9

Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining, datum features - functional and manufacturing, component design-machining considerations, redesign for manufacture, examples.

LEAN MANUFACTURING:

Need for lean concepts, different types of waste, metrics of manufacturing, an overview of value stream mapping- present state map, future state map, evaluation of benefits – Process FMEA, Design FMEA.

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

OUTCOMES:

- Upon completion of this course the student and able to apply the principle of geomatic tolerance in assembly, Use of datum system for assembly and use of systematic assembly procedure for manufacturing assembly.

TEXT BOOKS:

1. Harry Peck, "Designing for Manufacture", Pitman Publications, London, 1983.
2. Matousek R, "Engineering Design- A Systematic Approach", Blackie and Son Ltd., London, 1974.

REFERENCES:

1. Spotts M F, "Dimensioning and Tolerance for Quantity Production", Prentice Hall Inc., New Jersey, 1983.
2. Oliver R Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc., New York, 1967.
3. James G Bralla, "Hand Book of Product Design for Manufacturing", McGraw Hill Publications, 1983.
4. Trucks H E, "Design for Economic Production", Society of Manufacturing Engineers, Michigan, Second Edition, 1987.
5. Poka-Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992.
6. Creveling C M, "Tolerance Design - A Hand Book for Developing Optimal Specifications", Addison Wesley Longman Inc.,USA, 1997.
7. Pahl G and Beitz W, "Engineering Design-Systematic Approach", Springer Verlag Pub., 1996.

8. Mamboed M Farag, "Material Selection for Engineering Design", Prentice Hall, New Jersey, 1997.
9. Dennis P Hobbs, “Lean Manufacturing Implementation: A Complete Execution Manual for any Size Manufacturing”, J Rose Publishing Inc., 2003.

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”, Sixth Edition, Prentice Hall of India, 2003

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.

MS6802 **MANUFACTURING SYSTEMS DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

- Use of different manufacturing models.
- Use of line balancing approch to design automated lines.
- Use of group technology for equational layout planning

UNIT I INTRODUCTION TO MANUFACTURING SYSTEMS AND MODELS: 9

Evolution of industrial engineering, fields and functions of industrial engineering. Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building

UNIT II DESIGN OF AUTOMATED LINES: 9

Assembly lines-Reliable serial systems, approaches to line balancing – COMSOAL and RPW, Transfer lines and general serial systems – paced lines without buffers. Flexible manufacturing systems- system components, Introduction to planning and control.

UNIT III LAYOUT DESIGN : **9**

Group technology- introduction ,part classification and coding, assigning machines to groups-Rank order clustering algorithm, Facility layout – Sequential layout planning.

SUPPORTING COMPONENTS:

Machine setup and operation sequencing, Material handling systems-conveyor analysis, AGV systems. Warehousing-storage and retrieval systems, order picking.

UNIT IV SIMULATION IN SYSTEM DESIGN: 9

Empirical simulation models-Event models, process models, simulation system, example manufacturing system

SYNCHRONIZATION MANUFACTURING:

Synchronization Vs Optimization, defining the structure, identifying the constraint, Exploitation, Buffer Management.

UNIT V PRODUCTION PLANNING AND CONTROL: 9

Introduction, objectives, components of PPC, forecasting, product planning, loading and scheduling, dispatching, production control, material handling principles, case studies.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course the student can able to apply different manufacturing models, use of line balancing approch to design automated lines and use of group technology for equational layout planning

TEXT BOOKS:

1. Ronald G Askin, “Modeling and Analysis of Manufacturing Systems”, John Wiley and Sons, Inc, 1993.
2. Mengchu Zhou, “Modeling, Simulation, and Control of Flexible Manufacturing Systems: A Petri Net Approach”, World scientific Publishing Company Pvt Ltd., 2000.
3. Jean Marie Proth and Xiaolan Xie, “Petri Nets: A Tool for Design and Management of Manufacturing Systems”, John Wiley and Sons, New York, 1996.

REFERENCES:

1. Brandimarte P, Villa A, “Modeling Manufacturing Systems”, Springer Verlag, Berlin, 1999.
2. Richard Crowson, “Factory Operations: Planning and Instructional Methods - Ed2”, CRC Press, Second Edition, 2006.

3. Phillip F Ostwald, Jairo Munoz, “Manufacturing Processes and Systems”, John Wiley and Sons Inc., Nineth Edition, 2002.

- The course includes atleast one assignment with mathematical modeling and / or simulation of a practical situation.

MS6803 TOOL DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To select suitable point cutting tool and multipoint cutting tool for machining process.
- Design Jigs and Fixtures for holding tool and work price respective.
- Use of suitable moulding for the design of die components.

UNIT I CUTTING TOOLS: 9

Materials-properties, classification, selection, insert and coated tools, tool wear, tool life. Recent developments and applications.

UNIT II SINGLE POINT TOOLS: 9

Nomenclature, types and styles, design and manufacture of HSS and carbide insert type tools for turning, boring, shaping, planning and slotting operations. Design of form tools. Tools and holders for CNC applications, tools for dry machining.

MULTIPOINT CUTTERS:

Nomenclature, classification and selection, construction methods, cutter setting, design and manufacture of drills, reamers, taps, dies, thread chasers, milling cutters, broaches, hobs and gear shaper cutters. Grinding-wheel specification and selection.

UNIT III JIGS: 9

Degrees of freedom, principles of location and clamping, principles of jig design, fool proofing, elements of jigs, classification of jigs, design of jigs for drilling and reaming.

FIXTURES:

Principles of fixture design, locators and different types of clamps, elements of fixtures, provision for tool setting, design of fixtures for milling, turning, boring and grinding operations. Fixtures for turning centers and machining centers. Modular fixturing-concepts and applications.

UNIT IV PRESS TOOLS: 9

Design and manufacture of die sets for sheet metal components-simple, compound and progressive dies for punching and blanking operations. Dies for drawing and bending operations. Selection of presses and tools.

UNIT V DESIGN OF INJECTION MOULDING AND DIE CASTING DIES: 9

Product and mould, thermal considerations, design of two plate mould, runner and gate design, mould cooling and ejection, analysis of mould flow.

SPECIAL TOOLS:

Design of limit gauges. Tool maintenance and planning.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course the student can able to apply suitable moulding for the design of die components.

TEXT BOOKS:

1. Arshinov V and Alekseev G, "Metal cutting Theory and Cutting Tool Design", MIR Publishers, Moscow, 1976.

2. Donaldson C and LeCain C H, "Tool Design", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.
3. Bhattacharyya A, “Metal Cutting Theory and Practice”, New Central Books Agency (P) Ltd, Calcutta, 2000.
4. Cracknell P C and Dyson R W, “Handbook of Thermoplastics Injection Mould Design”, Chapman and Hall, 1993.
5. Mikell P Groover, “Fundamentals of Modern Manufacturing”, John Wiley and Sons, Singapore, 2004.

REFERENCES:

1. SME, "Manufacturing Engineers Hand Book", 1998.
2. Kempster, "Introduction to Jig and Tool Design", VIVA Books, New Delhi, 1998.
3. Rodin P, "Design and Production of Metal cutting Tools", MIR Publishers, Moscow, 1968.

MS6811 MANUFACTURING SYSTEMS LABORATORY L T P C
0 0 2 1

OBJECTIVES:

- To expose the students in using programs for manufacturing systems and shop floor simulation.

LIST OF EXPERIMENTS:

1. Solving LPP, Transportation, assignment problems using Excel solver.
2. Solving inventory, scheduling lot sizing problems using manufacturing systems simulation software
3. Solving queuing problem and layout optimization using manufacturing systems simulation software
4. Project evaluation and review based on time and cost
5. Weibull reliability plot creation using component / product failure data
6. Line balancing using manufacturing systems simulation software
7. Current state and future state mapping using value stream mapping software
8. Process capability studies using statistical software
9. Analysis of DoE results using statistical software
10. Materials / process planning using ERP package
11. 5S practice / Poke Yoke for workplace improvement
12. Use of DFA software for evaluation of product design alternatives from assembly consideration.

TOTAL: 30 PERIODS

OUTCOMES:

- Knowledge in usage of softwares for solving optimizations problems involving manufacturing systems
- Exposed to applications of DOE, ERP etc in simulating the manufacturing systems.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Tora, Lindo, Lingo with solver suit, SPSS, Mini Tab, Design Expert, Met Lab, Arina Simulation software, WIT.

MS6812 COMPREHENSIVE VIVA VOCE L T P C
0 0 2 1

The depth of understanding of the courses studied by the students will be evaluated by a panel of faculty.

TOTAL: 30 PERIODS

MS6813 INDUSTRIAL TRAINING VI (INDUSTRIAL VISITS AND COLLOQUIUM I) L T P C
0 0 0 2

Industrial profile - Product range - Catalogue - Infrastructure - Turn over - Quality system - Labor force - Industrial structure - Location - Layout - ISO 9000 and other standards - Material handling system - R & D - Product development - Manufacturing system - Advanced quality systems - Types of industry 1) Auto mobile 2) Foundry 3) Steel 4) Cement 5) Machining 6) Forging 7) Fabrication 8) Electrical. - Industry Lecture-Seminars-Quiz programmes. Training at external industries.

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. Trivedi R.K., '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

MS6901 INDUSTRIAL PSYCHOLOGY AND WORK ETHICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the behavior of self others and society.
- To understand the global work standards and ethical practices.

UNIT I INTRODUCTION TO INDUSTRIAL PSYCHOLOGY: 9

Definitions and Scope. Major influences on industrial Psychology. Performance Management : Training and Development.

UNIT II INDIVIDUAL IN WORKPLACE: 9

Motivation and Job satisfaction, stress management. Organizational culture, Leadership and group dynamics.

WORK ENVIRONMENT AND ENGINEERING PSYCHOLOGY-FATIGUE:

Boredom, accidents and safety. Job Analysis, Recruitment and Selection – Reliability & Validity of recruitment tests

UNIT III SOCIOLOGY: 9

A general over view scope of industrial sociology, industry and education, industry and family, industry and social stratification.

INTRODUCTION TO ETHICS:

History and evolution of values and ethics in social work.

UNIT IV PROFESSIONAL STADARDS: 9

Team work, communication, organizational skills and time management

LEGAL REQUIREMENTS:

Considerations for each jurisdiction that registers, certifies or licenses social workers

UNIT V ETHICAL PRACTICE AND SOCIETY: 9

Professional values and self-awareness about ethical professional behavior, ethical decision making processes and dilemma examples

TOTAL : 45 PERIODS

OUTCOMES:

- ability to develop and demonstrate good inter personal relationship in an organisation.
- ability to handle human resources efficienty
- understanding the sociology, professional work standards and work ethics.

TEXT BOOKS:

1. Miner J B "Industrial/Organizational Psychology" McGraw Hill Inc., New York, 1992
2. Reamer F G, "Social Work Values and Ethics". Second Edition, Columbia University Press, New York, 1999

REFERENCES:

1. Blum and Naylor, "Industrial Psychology. Its Theoretical and Social Foundations" CBS Publication, 1982.
2. Aamodt M G "Industrial/Organizational Psychology : An Applied Approach" Fifth Edition, Wadsworth/Thompson:Belmont, C.A., 2007.
3. Aswathappa K, "Human Resource Management" Fifth Edition, Tata McGraw Hill, New Delhi, 2008.

MS6902 SOCIOLOGY AND GLOBAL ISSUES L T P C
3 0 0 3

OBJECTIVES:

- To understand the human behavior in societal context and to knwo the conceptual tools and methodology for the same.

UNIT I SOCIOLOGICAL PERSPECTIVE: **12**

Social facts, causes, imagination, science, common sense and levels of organization. Interaction and social organization - frame work, statuses and roles, interaction process, social exchange, network and structure of society.

INDIVIDUAL AND SOCIETY:

Elements of culture, culture interaction and diversity. Dynamics of socialization, social class, agents, and secondary socialization

UNIT II SOCIAL GROUPS: 12

Characteristics, dynamics, types, individual commitment and group survival, techniques of formal organization. The effects of urbanization and community, population and society, dynamics of population change.

Politics, the state and war, the economy, business and work, social systems, social institution – the family, marriage, education goals, values and dilemmas. Transformation of society - Science and technology, growth, role, process of science, society and technologies. Collective behavior and social movement

UNIT III GLOBAL ISSUES – ENERGY: 7

The energy crisis, the effect of the energy crisis in less developed nations, climate change, the energy transition, nuclear power

UNIT IV GLOBAL ISSUES – THE ENVIRONMENT: 7

Awakening, the air, the water, the workplace, the use of natural resources.

UNIT V GLOBAL ISSUES – THE TECHNOLOGY: 7

Benefits of technology, short term and long term benefits, unanticipated consequences on the use of technology. Inappropriate use of technology, the threat of nuclear weapons.

TOTAL : 45 PERIODS

OUTCOMES:

- able to study the interactions of people in society
- understanding the effects of societal history, group behavior studies on families etc
- relating the sociology with global issues like energy crisis, environmental pollution etc.

TEXT BOOKS:

1. Craig Calhoun, Donald Light and Suzanne Keller, “Sociology”, McGraw Hill Professional, New York, 1993.
2. Joan Ferrante, “Sociology – A Global Perspective”, Seventh Edition, WADSWORTH Cengage Learning, 2008.
3. John L Seltz, “Global Issues – An Introduction”, Black well publishing, Second Edition, 2003.

REFERENCES:

1. James Henslin, “Sociology – A Down-to-Earth Approach, Core Concepts”, Pearson Education, Fourth Edition, 2009.
2. John Macionis, Ken Plummer, “Sociology – A Global Introduction”, Pearson Education, Fourth Edition, 2009.
3. Michael T, Snarr and D Neil Snarr, “Introducing Global Issues”, Third Edition, Lynne Rienner Publishers, Boulder, 2005.

MS6911 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.

MS6912 INDUSTRIAL TRAINING VII L T P C
(INDUSTRIAL VISIT AND COLLOQUIUM II) 0 0 0 2

Visiting external industries and acquiring knowledge about the following productivity enhancement techniques: Focus on customer – Visual management – Scheduling system – Maintenance management – Model preparation – Vendor development – Production planning and control – Storage and inventory management - Supply chain management, Kanban systems – Layout and material handling system – Orderliness – Safety and environment – Equipment uptime- Study and application of KAIZEN, Lean practices, Value Stream Mapping, Value engineering, Zero defects, Wastage identification, Productivity improvement, Continuous Productivity improvement – Reverse engineering – Poka-Yoke, ISO system needs, Knowledge on TQM, TPM and applications. (Training partially at PSG II and partly at other external industries).

MS6111 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.

MS6001 MANUFACTURE AND INSPECTION OF GEARS L T P C
3 0 0 3

OBJECTIVES:

- To know the different methods to make conical and culindrical gear.
- Suitable selection of material for gear and perform heat treatment for his proving the properties
- To perform imputation of gears.

UNIT I INTRODUCTION TO GEARS: 9

Types of gears-classification, application of gears, gearboxes, drawings for gears, gear production method an overview, types of blanks and blank preparation.

PRODUCTION OF CYLINDRICAL GEARS:

Procedure of cutting gears and obtainable quality in hobbing and gear shaping, cutter selection and work holding methods, setting calculations. Rack type gear shaping machine description and application. Internal gear cutting methods, CNC gear hobbing and gear shaping machines.

UNIT II PRODUCTION OF CONICAL GEARS: 5

Production of straight bevel gears by bevel gear generator, duplex rotary cutter method, Gleason Reva cycle method, spiral and hybrid bevel gear generation. Description of machine, cutter and machine setting.

UNIT III GEAR MATERIAL SELECTION AND HARDENING METHODS: 11

Properties of gear materials-non-metallic, non-ferrous and plastic gears, selection of material for power transmission, high speed application. Selection of material for worm and wheel. Hardening by through hardening, case hardening, induction hardening, flame hardening, nitriding and tuftriding, hardening defects.

GEAR FINISHING METHODS:

Gear finishing advantages, finishing of gears by grinding, shaving, lapping and honing methods, cold rolling of gears - description of process, machine, cutters and process parameters setting.

UNIT IV GEAR INSPECTION: 9

Type of gear errors-gear quality standards and allowable limits-tooth thickness, base tangent length measurement, pitch error, radial run out, involute profile error measurements methods and analysis, composite error measurement, computerized gear inspection, gear failure reasons and remedies.

UNIT V MODERN GEAR PRODUCTION METHODS: 11

Gear production by stamping, die casting, powder metal process, injection and compression moulding of plastic gears, cold and hot rolling. Mass production methods, shear speed shaping, gear broaching, Gleayson G-TRAC – gear generation methods.

ECONOMICAL AND QUALITY PRODUCTION OF GEARS:

Gear production systems – batch production, gear production cells, lean and agile production practices, automobile gear and gear boxes, heavy engineering gear production, gear for instruments and appliances, process and cutter selection for quantity, cost and quality criteria.

TOTAL:45 PERIODS

OUTCOMES:

- Upon completion of this course the student can able to know the different methods to make conical and cylindrical gear and select material for gear and perform heat treatment for his proving the properties

TEXT BOOKS:

1. Watson, “Modern Gear Production”, Persman Press Oxford, 1984.
2. HMT, “Production Technology”, Tata McGraw Hill Co., New Delhi, 1992.

REFERENCES:

1. SAE, “Gear Design Manufacturing Inspection Manual”, SAE, 1990.
2. Weck M., “Hand Book of Machine Tools”, Technology and Sons, 1984.
3. “Gear Technology”, Magazine – Back Volumes.

MF6503 PRECISION ENGINEERING L T P C
3 0 0 3

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 CONCEPTS OF ACCURACY AND MACHINE TOOLS 9

Part Accuracy – errors, accuracy of machine tools – spindle accuracy – displacement accuracy – errors due to numerical interpolation – definition of accuracy of N.C system – errors in the NC machines – feed stiffness – zero stability.

UNIT II STIFFNESS, THERMAL EFFECTS AND FINISH MACHINING 12

Overall stiffness of Lathe – compliance of work piece – errors caused by cutting forces – deformation in turning – boring – milling – heat sources – thermal effects – Finish Turning, boring, grinding – Surface roughness.

UNIT III DIMENSIONING 6

Definition of terms – Key dimension – Superfluous dimension – dimensional stepped shaft – assigning tolerances in the constituent dimensions – dimensional chains.

UNIT IV MICRO-MACHINING MICRO FABRICATION 9

Micro Machining – Photo resist process – Lithography – LIGA Process – Optical, processing of materials – electron beam machining – beam machining – micro forming, diamond turning – micro positioning devices – etching – physical vapour deposition – Chemical vapour deposition

UNIT V SMART STRUCTURES, MATERIALS AND MICRO ACTUATORS 9

Smart structures – Smart materials types and applications - smart sensors – micro valves – MEMS – Micro motors – Micro pumps – micro dynamometer – micro machines – micro optics – micro nozzles.

TOTAL: 45 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.

TEXT BOOKS:

1. Murthy R.L. "Precision Engineering in Manufacturing", New Age Internaional Pvt. Limited, 2009
2. Juliar W.Gardner. Vijay K. Varadan, 'Micro Sensors, MEMS and Smart Devices, John wiley and sons, 2001.

REFERENCES:

1. Stephen A.Campbell, "The Science and Engineering of Micro Electronic Fabrication", Oxford University Press, 1996.
2. Raady Frank, "Understanding smart sensors", Artech. House, Boston, 1996.
3. MEMS Hand Book, CRC Press, 2001

MS6002 IC ENGINE DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To know about the principles of operation of IC engines and to design the IC engines.

UNIT I INTRODUCTION: 14

Principles, design of engine based on vehicle characteristics–engine capacity, calculation of bore and stroke length-balancing and vibration -critical speed and damping.

PISTON:

Introduction –calculation of gas forces– variation of gas forces. Design of piston – calculation of side thrust – piston pin, rings.

UNIT II CONNECTING ROD: **7**

Introduction–design principles, procedure, selection of cross section, materials, manufacturing process – heat treatment.

UNIT III CRANKSHAFT: 8

Introduction, determination of primary and secondary forces– balancing forces, calculation of rotating mass, location of mass. Selection of materials, manufacturing process, heat treatment.

UNIT IV VALVE ACTUATING MECHANISM: 8

Design of valves – valve springs – tappet. Cam design-cam profile generation, cam shaft design. Rocker and rocker shaft design considerations, materials, manufacturing process, heat treatments.

UNIT V FLYWHEELS: 8

Determination of the mass of a flywheel for a given co-efficient of speed fluctuation. Engine flywheel – stresses of rim flywheels, design of hubs and arms of flywheel, turning moment diagram.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to conduct static and dyynamic allways on IC engines.
- understanding the design procedures of IC engines parts like connecting roads, crankshaft and valve trains
- ability to select the fly wheel based engine specifications.

TEXT BOOKS:

1. Heldt P M, "High Speed Combustion Engines", Oxford IBH Publishing Co., Calcutta, 1996.
2. Lichty, "I.C. Engines", Kogakusha Co., Limited, Tokyo, 1986.

REFERENCES:

1. Giles J G, "Engine Design", Illiffee Books Ltd., London, 1968.
2. John Fenton, "Gasoline Engine analysis for CAD", MEP, London, 1986.

ME6701 POWER PLANT ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

UNIT I COAL BASED THERMAL POWER PLANTS 10

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 10

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS 7

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : B*oiling Water Reactor* (BWR), P*ressurized Water Reactor* (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY 10

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, *Solar* Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 8

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the Students can able to understand different types of power plant, and its functions and their flow lines and issues related to them.
- Analyse and solve energy and economic related issues in power sectors.

TEXT BOOK:

1. P.K. Nag, Power Plant Engineering, Tata McGraw Hill Publishing Company Ltd., Third Edition, 2008.

REFERENCES:

1. Power Plant Technology, M.M. El-Wakil, Tata McGraw Hill Publishing Company Ltd., 2010.
2. Black & Veatch, "Power Plant Engineering", Springer, 1996.
3. Thomas C. Elliott, Kao Chen and Robert Swanekamp, "Standard Handbook of Power Plant Engineering", Second Edition, McGraw – Hill, 1998.
4. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

MS6003 BIOGAS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To get exposure on production, processing and application of Biogas.

UNIT I INTRODUCTION: **6**

Bio-Energy. Overview of biogas technology. Technical status of biogas technology. Economic viability of biogas technology. Diffusion status of biogas technology in developing countries. Biogas technology scenario in India.

MATERIALS FOR BIOMETHANATION AND PRODUCTS OF METHANATION:

Biomass and its availability. Biodegradability. Raw materials for biogas production and their characteristics. Conversion principles. Fermented slurry as fertiliser. 6

UNIT II BIO-REACTORS: **8**

Types of bio-reactors- Constant pressure type reactors, Ganesh model, Pragathi model, Astra model, Jwala biogas plant, Batch digester, Manawat digester, German designs, plastic bag digesters, free fabricated steel/plastic digesters, Tunnel type digester, Maya Farms model, Large Farm biogas plants, Anaerobic Contact reactors, Anaerobic Filter reactors

UNIT III DESIGN, SELECTION, CONSTRUCTION AND OPERATION OF BIOGAS PLANTS: . **9**

Design of the digester. Design based on End Use requirements. Scaling of biogas plants - GTZ method - digester sizing for a given end use device efficiency. Optimal design -KVIC. Design of fixed Dome type of digesters. Material estimate for fixed dome plants. Selection of type and size of biogas reactors and their specifications. Constructional aspects. Operational problems in biogas plants methods of improving plant productivity. Measuring and test programs

UNIT IV PURIFICATION, SCRUBBING, COMPRESSION AND STORAGE OF BIOGAS: **8**

Properties of H_2S. Origin of H_2S in biogas plants. Effect of H_2S on biogas plant and devices. Determination of H_2S content in biogas. Methods for removing H_2S from biogas. Process techniques. Requirements of absorbent. Desulphurising apparatus. Operation procedures for desulphurization. Scrubbing, storage, transportation.

UNIT V UTILISATION SYSTEMS OF BIOGAS: **8**

Biogas as an alternative energy source. Biogas utilization. Biogas burners. Design of biogas burners. Stove models. Lighting mantles. Biogas using stationary power plants. Mobile power plants. Pollution control through anaerobic digestion.

TOTAL : 45 PERIODS

OUTCOMES:

- knowledge of materials for biogas production and their by products.
- understanding the working of biogas reactors and bioplants / knowledge in design, construct and operate the biogas plants.
- visualising the applications biogases in power generation.

TEXT BOOKS:

1. Nijaguna B T, "Biogas Technology", New Age International Publishers, New Delhi, 2002.
2. Khandelwal K C and Mahdi S S, " Biogas Technology, Vol. I", Tata McGraw Hill, 1986.
3. Frank Stephan, "Biogas Technology", Fachhochschule Koln Hochschule, Bremerhaven, Germany, 1985.

REFERENCES:

1. Helmut Muche/Harald Zimmerman, "The Purification of Biogas", published by Friedr Vieweg and Sohn, Germany, 1985.
2. Ludwig Sasse, "Biogas Plants", published by Friedr Vieweg and Sohn, Germany, 1985.
3. Singh J B, Reymond Myles and Anil Dhussa, "Manual on Deenabandhu Biogas Plant", Tata McGraw Hill, 1987.
4. Tata Energy Research Institute, "Fixed Dome Biogas Plants, A design, Construction and Operation Manual", 1987.

MS6004 THEORY OF ELASTICITY AND PLASTICITY L T P C
3 0 0 3

OBJECTIVES:

- To understand and use the theory for electric and plastic behavioral analysis of metallic materials.

UNIT I ANALYSIS OF STRESS AND STRAIN: **9**

Stress at a point, stress tensor, stress transformations, principal stresses, octahedral stress, equations of equilibrium, strain tensor, principal strains, strain-displacement relations, compatibility conditions.

UNIT II CONSTITUTIVE EQUATIONS: . **9**

General theory, generalized Hooke's law, equations of elasticity, Mitchel-Beltrami and Navier equations, formulation of the general elasticity problem, boundary conditions

UNIT III SOLUTION OF SOME SPECIAL BOUNDARY VALUE PROBLEMS: 9

Two dimensional problems in rectangular and polar co-ordinates, Airy's stress function. A few representative 3D problems - torsion and bending of non-circular prismatic bars (Saint-Venant's solution), membrane analogy.

UNIT IV PLASTICITY: 8

Plastic flow and its microscopic and macroscopic descriptions, continuum plasticity, stress-strain curves of real materials, definition of yield criterion, concept of a yield surface in principal stress space, yield criteria, tresca, Von Mises.

UNIT V PLASTIC STRAIN ANALYSIS: **10**

Prandtl-Reuss and Levy-Mises equations, deformation in plane stress-yielding of thin sheet in biaxial and uniaxial tension. Plane strain deformation-stress tensor, hydrostatic and deviatoric components, plastic potential, plastic instability, work hardening, effective stress and effective strain, strain rates and temperature effects on flow stress.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to define and calculate stress and strain under various loading conditions within elastic limit.
- understanding constitutive equations defining elastic properties of materials.
- able to model the materials in plastic zone and ability to conduct plastic strain analysis.

TEXT BOOKS:

1. Timoshenko S P and Goodier J N, “Theory of Elasticity”, McGraw Hill International Editions, Third Edition , 1970.
2. Sokolnikoff I S, “Mathematical Theory of Elasticity”, McGraw Hill International Editions, Second Edition, 1956.
3. Jhonson W and Mellor P B, “Engineering Plasticity”, Van Nostrant Reinhold, 1983.
4. Chakrabarthy J., “Theory of Plasticity”, McGraw Hill Co, 1987.

REFERENCES:

1. Boresi A P, Schmidt R J and Sidebottom O M, “Advanced Mechanics of Materials”, John Wiley and Sons, Inc., Fifth Edition, 1993.
2. Durelli A J, Phillips E A and Tsao C H, “Introduction to the Theoretical and Experimental Analysis of Stress and Strain”, McGraw Hill, New York, 1958.
3. Calladine C R, “Plasticity for Engineers”, Ellis Horwood, 1985.
4. Dieter G E, “Mechanical Metallurgy”, McGraw Hill, 1988.
5. Dally J W and Riley W F, “Experimental Stress Analysis”, McGraw Hill International Editions, Third Edition, 1991.

MS6005 QUALITY ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the need of quality engineering in product design, manufacture and service
- To use the statistical methods in the area of quality control and to know online control of quality in process industries.

UNIT I CONCEPT OF QUALITY ENGINEERING: 6

Quality value and engineering- overall quality system-quality engineering in product design - quality engineering in design of production processes - quality engineering in production - quality engineering in service.

UNIT II LOSS FUNCTION: 6

Derivation –use-loss function for products/system- justification of improvements- loss function and inspection- quality evaluations and tolerances-N type, S type, L type.

UNIT III ON-LINE QUALITY CONTROL: 12

On-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production.

On-line process parameter control variable characteristics- process parameter tolerances- feedback control systems- measurement error and process control parameters.

UNIT IV ON-LINE QUALITY CONTROL ATTRIBUTES CHARACTERISTICS: 12

Checking intervals- frequency of process diagnosis.

ON-LINE QUALITY CONTROL METHODS FOR PROCESS IMPROVEMENTS:

Production process improvement method- process diagnosis improvement method- process adjustment and recovery improvement methods.

UNIT V QUALITY ENGINEERING AND TPM: 9

Preventive maintenance schedules- PM schedules for functional characteristics- PM schedules for large scale systems. Quality tools–fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to appreciate the importance of quality systems in engineering applications and identifying appropriate method for quality measurement
- usage of statistical tools to measure the quality, diagnose problems in quality and ability to suggest corrective methods.
- ability to estimate the losses due to in consistant quality
- understanding role of preventive maintenance as applied to process quality.

TEXT BOOKS:

1. De Feo J A and Barnard W W, “Six Sigma: Breaktrough and Beyond”, Tata McGraw Hill, New Delhi, 2005.
2. Pyzdek T and Berger R W, “Quality Engineering Handbook”, Tata McGraw Hill, New Delhi, 1996.
3. Taguchi G, Elsayed E A and Hsiang, T.C.,”Quality Engineering in Production Systems”, McGraw Hill Book company,Singapore, International Edition, 1989.

REFERENCES:

1. Kaniska Bedi, “Quality Management” Oxford University Press, Chennai, 2007.
2. Brue G, “Six Sigma for Managers”, Tata McGraw Hill, New Delhi, Second reprint, 2002

MF6504 HYDRAULICS AND PNEUMATICS L T P C
3 0 0 3

OBJECTIVES:

- This course will give an appreciation of the fundamental principles, design and operation of hydraulic and pneumatic machines, components and systems and their application in recent automation revolution.

UNIT I FLUID POWER PRINCIPLES AND FUNDEMENTALS (REVIEW) 3

Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids Basics of Hydraulics – Pascal's Law- Principles of flow – Work, Power and Torque. Properties of air– Perfect Gas Laws.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 13

Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps, Hydraulic Actuators: Cylinders – Types and construction, Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation- Applications – Types of actuation. Accessories: Reservoirs, Accumulators, Intensifiers, Pressure Switches- Applications- Fluid Power ANSI Symbol.

UNIT III HYDRAULIC CIRCUITS 9

Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Accumulators, Electro hydraulic circuits, Mechanical Hydraulic servo systems.

UNIT IV PNEUMATIC SYSTEM 8

Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems. Introduction to Fluidics, Pneumatic logic circuits.

UNIT V DESIGN OF HYDRALIC AND PNEMATIC CIRCUITS 12

Designing the components of hydraulic system for Drilling, Planning, Shaping, Punching, Press. – Selection, fault finding and maintenance of hydraulic components- Sequential circuit design for simple application using cascade method, Electro pneumatic circuits. Selection criteria of pneumatic components – Installation fault finding and maintenance of pneumatic components. Microprocessor and PLC- Applications in Hydraulic and Pneumatics- Low cost Automation – Hydraulic and Pneumatic power packs- case studies.

TOTAL: 45 PERIODS

OUTCOMES:

- Identify hydraulic and pneumatics components.
- Ability to design hydraulic and pneumatic circuits.

TEXT BOOK

1. Anthony Esposito," Fluid Power with Applications", PHI / Pearson Education, 2005.

REFRENCES

1. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
2. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw Hill, 2001
3. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw Hill, 2007.
4. Micheal J, Pinches and Ashby, J.G., "Power Hydraulics", Prentice Hall, 1989.
5. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

GE6084 **HUMAN RIGHTS** **L T P C**
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

ME6002 **REFRIGERATION AND AIR CONDITIONING** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems

UNIT I INTRODUCTION **5**

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM 10

Vapor compression cycle : p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system - low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III OTHER REFRIGERATION SYSTEMS 8

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems.

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES 10

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 12

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to demonstrate the operations in different Refrigeration & Air conditioning systems and also able to design Refrigeration & Air conditioning systems .

TEXT BOOK:

1. Arora, C.P., Refrigeration and Air Conditioning, McGraw Hill, 3rd ed, New Delhi, 2010.

REFERENCES:

1. Roy J. Dossat, Principles of Refrigeration, Pearson Education Asia, 4th ed, 2009.
2. Stoecker, W.F. and Jones J.W., Refrigeration and Air Conditioning, McGraw Hill, New Delhi, 1986.
3. ASHRAE Hand book, Fundamentals, 2010
4. Jones W.P., Air conditioning engineering, Elsevier Butterworth-Heinemann, 5th ed, 2001

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.

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

OBJECTIVES:

- To understand in developing concepts and specifications that optimise the value and apperance of products and systems.

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 BIOENERGEITICS 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:

- ability to design products by considering human engineering and environmental conditions.
- abillity to layout the workplace for manufacturing products.
- understanding the mechanics of human body biothermodynamics and associated human related factors in product design.

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.

MS6006 ADVANCED THEORY OF INTERNAL COMBUSTION ENGINES L T P C
3 0 0 3

OBJECTIVES:

- To learn different thermodynamics cycles used in IC engine
- To learn different injection systems
- To describe the properties of fuels and its role in combustion
- To manage the engine electronics system
- To discuss the engine emission and control the emission

UNIT I CYCLE ANALYSIS: 10

Operating cycles of S.I. and C.I. engines and Gas turbines - Comparison of Air standard cycle - Fuel air cycle and actual cycle.

SPARK IGNITION ENGINES:

Spark ignition Engine mixture requirements - Carburetion – Electronic fuel Injection systems –single point and multipoint injection.

UNIT II COMPRESSION IGNITION ENGINES: 7

Mechanical Injection System- Direct and indirect injection systems - Supercharging, Turbocharging

UNIT III COMBUSTION OF FUELS: 9

Combustion stoichiometry of petrol, diesel, alcohol and hydrogen fuels - Chemical energy and heating values - Chemical equilibrium and maximum temperature - SI engine combustion - - Stages of combustion - Normal and Abnormal combustion-Factors affecting knock - Combustion Chambers. Flame velocity and area of flame front - CI engine combustion - Combustion chambers – Fuel spray characteristics - droplet size, penetration and atomization.

UNIT IV ENGINE ELECTRONICS: 9

Engine Management system, Measurement of Speed, Pressure, Temperature, air flow, exhaust oxygen sensor.

RECENT TRENDS:

Learn Burn Engines - Stratified charge Engines – Low heat rejection engines- Gasoline Direct Injection Engine - Homogeneous charge compression Ignition

UNIT V ENGINE EMISSION AND THEIR CONTROL: . 10

Pollutant - Sources and types – HC emission- CO emission - formation of NOx - Particulate emissions – Aldehydes, sulphur, lead, phosphorus emission. Methods of controlling Emissions- Thermal converters, Catalytic converters and Particulate Traps, Exhaust Gas Recirculation (EGR), Charcoal Canister. Emission measurements techniques and Driving cycles

TOTAL : 45 PERIODS

OUTCOMES:

- able to describe the basic thermodynamics as applied to engine system
- ability to use mathematical knowledge to describe the combustion.
- ability to design engine systems
- ability to control engine emission

TEXT BOOKS:

1. John B. Heywood, " Internal Combustion Engine Fundamentals ", McGraw Hill, 1988.
2. Ganesan V, “Internal Combustion Engines”, Tata McGraw Hill, 2007.

REFERENCES:

1. Mathur R B and Sharma R P, " Internal Combustion Engines ", Dhanpat Rai publications, 2000.
2. Heinz Heisler, “Advanced Engine Technology”, SAE Interanmatinal , 1995.
3. Richard Stone, “Introduction to Internal Combustion Engines” , SAE International, 1999
4. Domkundwar and Domkundwar, “I. C. Engines”, Dhanpat Rai and Sons, 2010

GE6083 DISASTER MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXTBOOK:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

AT6071 MANUFACTURING OF AUTOMOTIVE COMPONENTS L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge on basic principle and production methods of automotive components.

UNIT I CASTED ENGINE COMPONENTS 9

Material selection and Manufacturing methods for Piston, Piston rings, Cylinder block, wet and dry liners, Engine head, Oil pan, Carburetors. Thermal barrier coating of Engine head and valves.

UNIT II FORGED ENGINE COMPONENTS 8

Material selection and Manufacturing methods for Crank shaft, Connecting rod, Cam shaft, valve, Piston pin, Push rod, Rocker arm, tappets, spark plug.

UNIT III TRANSMISSION SYSTEM 10

Material selection and Manufacturing methods for Clutch – Clutch lining – Gear Box – Gear – Propeller Shaft – Differential – Axle Shaft – Bearing – fasteners – Wheel drum.

Methods of Gear manufacture – Gear hobbing and gear shaping machines - gear generation - gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching.

UNIT IV VEHICLE CHASSIS 8

Material selection and manufacturing methods for chassis, dead axle, leaf spring, coil spring and shock absorbers – wheel housing – steering system, Brake shoes, wheel rim, Tyres. Heat treatment procedures.

UNIT V RECENT DEVELOPMENTS 10

Surface treatment – Plastics – Plastics in Automobile vehicles – Processing of plastics - Emission control system – catalytic converter – Hydro forming of exhaust manifold and lamp housing – stretch forming of Auto body panels – MMC liners –Selection of materials for Auto components. Use of Robots in Body weldment.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course the student can able to use the basic principle and production methods of automotive components

TEXT BOOK:

1. Heldt. P.M, High speed combustion engines, Oxford publishing Co., New York, 1990.

REFERENCES:

1. Kirpal Singh, Automobile Engineering, Vol. I & II, Standard Publishers, New Delhi, 1997.
2. Newton and steels, the motor vehicle, ELBS, 1990
3. Serope Kalpakjian and Steven R. Schmid, Manufacturing Processes for Engineering Materials, Fourth Edition, Pearson Education publications, 2003
4. Gupta K.M. Automobile Engineering Vol.I & II, Umesh Publishers, 2000.

MS6007 GAS DYANAMICS AND SPACE PROPULSION L T P C
3 0 0 3

OBJECTIVES:

- To apply the fundamentals of Gas dynamics and fluid dynamic in space propulsion
- To design propulsion systems in such as jet engines.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS : 9

Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone –Effect of Mach number on compressibility - Isentropic flow through variable area ducts - Nozzle and Diffusers –Use of Gas tables.

UNIT II FLOW THROUGH DUCTS: 9

Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - Variation of flow properties - Use of tables and charts - Generalised gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS: 9

Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl – Meyer relations - Use of table and charts - Applications.

UNIT IV JET PROPULSION : 9

Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines – Aircraft combustors.

UNIT V SPACE PROPULSION: 9

Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion – Performance study - Staging - Terminal and characteristic velocity - Applications - Space flights.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to utilise the knowledge the fluid dynamics, gas dynamics and mathematical knowledge in space propulsion design
- demonstrate their knowledge in designing propulsion system such as turbo-jet, turbo fan, ramjet and scanjets integrate various new space propulsion system in designing future vehicle.

TEXT BOOK:

1. Yahya S M " Fundamentals of Compressible Flow ", New Age International (P) Limited, New Delhi, 1996.

REFERENCES:

1. Hill P and Peterson C, "Mechanics and Thermodynamics of Propulsion", Addison Wesley Publishing Company, 1992.
2. Zucrow N J "Aircraft and Missile Propulsion, Vol. I and II ", John Wiley , 1975.
3. Zucrow N J "Principles of Jet Propulsion and Gas Turbines ", John Wiley, New York, 1970.
4. Cohen H , Rogers G E C and Saravanamuttoo, " Gas Turbine Theory ", Longman Group Ltd., 1980.
5. Sutton G P, "Rocket Propulsion Elements ", John Wiley, New York, 1986

6. Shapiro A H, "Dynamics and Thermodynamics of Compressible Fluid Flow Vol.kl ",John Wiley , New York, 1953
7. Ganesan V, "Gas Turbines ", Tata McGraw Hill Publishing Co., New Delhi, 1999.
8. Thomas E Vollman, Clay Whybark D, “Manufacturing Planning And Control For Supply Chain Management”, Tata McGraw-Hill,Fifth Edtition, 2005.
9. Edward B Magrab, Balakumar Balachandran,“Vibrations”, Thomson Learning, 2005.
10. Shridhara Bhat K, “World Class Manufacturing”, Himalaya Bublishing House, 2007
11. Hans Vanohain and Jack D Mattingly, ”Elements of Gas Turbine Propulsion”, TMH, 2006

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 CELLULAR LAYOUT 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

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 selection 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 BOOKS:

1. Peter scalon, "Process planning, Design/Manufacture interface", Elsevier science technology Books, Dec 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.

MS6008 MODELLING AND SIMULATION OF INTERNAL COMBUSTION ENGINES L T P C
3 0 0 3

OBJECTIVES:

- To introduce modeling and simulation concept to study the characteristics of IC Engines.
- To study the combustion in CI Engine and study the inflame of the different propagation on characteristics.
- To model and simulate the combution in IC engine and know the temperature pressure and develop spray models.

UNIT I INTRODUCTION: 9

First law and second law analysis, governing equation, conservation of mass, momentum and energy.
COMBUSTION IN SI ENGINES:
Combustion in premixed flames - stages of combustion, flame propagation, rate of pressure rise, cycle-to-cycle variation, abnormal combustion - theories, effect of engine operating variables on combustion.

UNIT II COMBUSTION IN CI ENGINES: 9

Combustion in diffusion flames - droplet and spray combustion theory, stages of combustion, delay period, peak pressure, heat release, gas temperature, diesel knock.

UNIT III MODELING OF IC ENGINES: 9

Heat of reaction - H_{rp} & U_{rp} calculations, adiabatic, constant volume combustion, constant pressure combustion, temperature drop due to fuel vaporization, adiabatic flame temperature, mean effective pressure, torque and thermal efficiency at full throttle, part throttle and supercharged conditions. Spray models, flow models and combustion models.

UNIT IV SIMULATION OF IC ENGINES: 9

SI & CI engine simulation – air standard cycle, fuel-air cycle, progressive combustion cycle and actual cycle simulation – part throttle, full throttle and supercharged conditions.

UNIT V SIMULATION OF NEW ENGINE CONCEPTS: 9

Dual fuel engine, **l**ow heat rejection engine, lean burn engine, variable compression ratio engine, homogeneously charged compression ignition engine, controlled auto ignition engine.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to develop mathematical model to simulation combustion in IC Engines and explain the characteristics.
- ability to design new engine using on simulation.

REFERENCES:

1. Ganesan V, “Internal Combustion Engineering”, Tata McGraw Hill Publishing Co., New Delhi, 2003.
2. Ganesan V, “Computer Simulation of Spark Ignition Engine Process“, Universities Press (I) Ltd, Hyderabad, 2001.
3. Heywood J B, “Internal Combustion Engine Fundamentals” McGraw Hill Book Co., USA, 2001.
4. Ganesan V, “Computer Simulation of Compression Ignition Engine Process”, University Press (I) Ltd, Hyderabad, 1996.
5. Ramoss A L, "Modeling of Internal Combustion Engines Processes", McGraw Hill Publishing Co., 1992.
6. Ashley Campbel, "Thermodynamic Analysis of Combustion Engines", John Wiley and Sons, New York, 1986.
7. Benson R S, whitehouse.N.D., "Internal Combustion Engines", Paragon Press, oxford, 1979.
8. Ashley S Campbell, “Thermodynamic Analysis of Combustion Engines”, John Wiley and sons, 1980.

MS6009 FAILURE ANALYSIS AND DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To introduce different failure Mechanisms and role of Materials and Design in failure
- To develop Mathematical model for different modes of fracture.
- To develop Mathematical model for dynamic fracture.
- To introduce different tools to analyse the fracture.

UNIT I MATERIALS AND DESIGN PROCESS: 9

Factors affecting the behavior of materials in components, effect of component geometry and shape factors, design for static strength, stiffness, designing with high strength and low toughness materials, designing for hostile environments, material processing and design, processes and their influence on design, process attributes, systematic process selection, screening, process selection diagrams, ranking, process cost.

UNIT II FRACTURE MECHANICS: 9

Ductile fracture, brittle fracture, Cleavage-fractography, ductile-brittle transition-Fracture mechanics approach to design-energy criterion, stress intensity approach, time dependent crack growth and damage

LINEAR ELASTIC FRACTURE MECHANICS:

Griffith theory, Energy release rate, instability and R-curve, stress analysis of cracks-stress intensity factor, K-threshold, crack growth instability analysis, crack tip stress analysis.

UNIT III ELASTIC PLASTIC FRACTURE MECHANICS: 9

Crack tip opening displacement (CTOD), J integral, relationship between J and CTOD,

DYNAMIC AND TIME-DEPENDENT FRACTURE:

Dynamic fracture, rapid loading of a stationary crack, rapid crack propagation, dynamic contour integral, Creep crack growth-C Integral, Visco elastic fracture mechanics, viscoelastic J integral

UNIT IV DETERMINATION OF FRACTURE TOUGHNESS VALUES: . **9**

Experimental determination of plane strain fracture toughness, K- R curve testing, J measurement, CTOD testing, effect of temperature, strain rate on fracture toughness

UNIT V FAILURE ANALYSIS TOOLS: **9**

Reliability concept and hazard function, life prediction, life extension, application of poisson, exponential and Weibull distribution for reliability, bath tub curve, parallel and series system, MTBF,MTTR, FMEA definition-Design FMEA, Process FMEA , analysis causes of failure, modes, ranks of failure modes, fault tree analysis, industrial case studies/projects on FMEA.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to carry out failure analysis and predict the root cause for the failure.
- ability to select suitable material for design.
- ability to use Mathematical knowledge to describe the different types of fracture.
- ability to use different characterization tools for failure analysis.

TEXT BOOKS:

1. John M Barsoom and Stanley T Rolte "Fracture and Fatigue Control in Structures", Prentice Hall, 1987.
2. ASM Metals Handbook, "Failure Analysis and Prevention", ASM Metals Park, Ohio, USA, Vol. 10, Tenth Edition, 1995.
3. Michael F Ashby, “Material Selection in Mechanical Design”, Butterworth – Heinemann, 1999.
4. Anderson T.L., Fracture Mechanics:Fundamentals and applications, third edition, 2004

REFERENCES:

1. Shigley and Mische, "Mechanical Engineering Design", McGraw Hill, 1992.
2. Mahmoud M Farag, “Material Selection for Engineering Design”, Prentice Hall, 1997.
3. Faculty of Mechanical Engineering, PSG College of Technology, “Design Data Book”, DPV Printers, 1993.

MS6010 DESIGN OF ROTATING EQUIPMENT **L T P C**
3 0 0 3

OBJECTIVES:

- To impart design concept to develop rotating equipments
- To train the students to design mixed flow impeller, propeller fans
- To train the students to study the performance of compressors.

UNIT I INTRODUCTION: **9**

Principles of fluid flow, Basic theory of rotating equipment.

PUMPS:

Different types of pump - characteristic curves. Theory of centrifugal pump impeller-vortex theory, design of impeller, volute and diffusers. Specific speed and design constants.

UNIT II DESIGN OF MIXED FLOW IMPELLERS: **10**

Geometric relationship, axial flow pumps, design. Use of aerofoil data for impeller design, guide vane, pump casing.
FANS:
Fan laws, performance coefficients, effect of change in fan speed, density, series and parallel operation, fan design losses, blade shape, casing.

UNIT III PROPELLER FANS: 9
Cross flow fans, principle of operation, applications, regulation of volume flow, sources of vibration in fans, noise attenuation testing.

BLOWERS:
Types, centrifugal blower - design procedure, selection, performance, special applications, control of volume flow.

UNIT IV PERFORMANCE ESTIMATION: 9
Instrumentation test rig layout, measurement of pressure, temperature, use of hot wire anemometer, boundary layer probes, measurement of sound, different types and characteristics. COMPRESSORS:
Different types of compressors - characteristic curves. Centrifugal compressor - multistage arrangement, blade design, types of diffusers, performance, series and parallel operation.

UNIT V AXIAL FLOW COMPRESSORS: 8
Cascade theory, efficiency, two dimensional cascade, velocity triangles and stage loading, stage reaction, losses, compressor-testing procedure.
DISC STRESSES AND CRITICAL SPEED:
Determination of disc stresses – sum and difference curves, Critical speeds of two bearing and three bearing shafts, torsional critical speeds

TOTAL : 45 PERIODS

OUTCOMES:
- ability to use mathematical skills and engineering principles to design rotating equipments like, mixed flow impeller, fans and compressors.

TEXT BOOKS:

1. Val S Lobanoff and Robert R Ross,"Centrifugal Pumps Design and Application", Jaico Publishing House, Madras.1996.
2. Allan Wallis R, "Axial Flow Fans and Ducts", John Wiley and Sons, New York, 1983.
3. Ronald P Lapina, "Estimating Centrifugal Compressor Performance", Gulf Publishing Company, 1982.
4. Church S Austin and Jagdish Lal, "Centrifugal pumps and blowers", Metropolitan Book Co. Pvt.Ltd, Delhi, 1973

IE6011 PRODUCT DESIGN AND DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:
- The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

UNIT I INTRODUCTION 5
Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding

customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II CONCEPT GENERATION AND SELECTION 5

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE 10

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV INDUSTRIAL DESIGN 10

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 15

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL: 45 PERIODS

OUTCOMES:

- The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

TEXT BOOK:

1. Kari T.Ulrich and Steven D.Eppinger,"Product Design and Development", McGraw-Hill International Edns. 1999.

REFERENCES:

1. Kemnneth Crow,"Concurrent Engg./Integrated Product Development", DRM Associates,26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh,"Tool Design – Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.

BM6602 **BIOMECHANICS** **L T P C**
3 0 0 3

OBJECTIVES

The student should be made to:

- Be exposed to principles of mechanics.
- Learn the mechanics of physiological systems.
- Be familiar with the mathematical models used in the analysis of biomechanical systems

UNIT I INTRODUCTION TO MECHANICS 9

Principles of Mechanics, Vector mechanics, Mechanics of motion - Newton's laws of motion, Kinetics, Kinematics of motion, Fluid mechanics – Euler equations and Navier Stoke's equations, Viscoelasticity, Constitutive equations, Stress transformations, Strain energy function.

UNIT II BIOFLUID MECHANICS 9

Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Couette flow and Hagen-poiseuille equation, turbulent flow. Cardiovascular system - biological and mechanical valves development, artificial heart valves testing of valves, Structure, functions, material properties and modeling of Blood vessels.

UNIT III BIOSOLID MECHANICS 9

Hard Tissues: Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models – anisotropy.

Soft Tissues: Structure, functions, material properties and modeling of Soft Tissues: Cartilage, Tendon, Ligament, Muscle.

UNIT IV BIOMECHANICS OF JOINTS AND IMPLANTS 9

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle.

Design of orthopedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants.

UNIT V MODELLING AND ERGONOMICS 9

Introduction to Finite Element Analysis, Analysis of bio mechanical systems using Finite element methods, Graphical design. Ergonomics- Gait analysis, Design of work station, Sports biomechanics, Injury mechanics.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the mechanics of physiological systems.
- Analyze the biomechanical systems.
- Design orthopaedic applications.

TEXT BOOKS:

1. Fung Y.C., "Bio-Mechanics- Mechanical Properties of Tissues", Springer-Verlag, 1998.
2. Duane Knudson, "Fundamentals of Biomechanics", 2007 Springer Science+Business Media, Second Edition
3. Marcelo Epstein, "The Elements of Continuum Biomechanics", 2012.

REFERENCES:

1. Jay D. Humphrey, Sherry De Lange, “An Introduction to Biomechanics: Solids and Fluids, Analysis and Design” , Springer Science+Business Media, 2004.
2. Shrawan Kumar, “Biomechanics in Ergonomics”, CRC Press Second Edition, 2007, .

ME6014 COMPUTATIONAL FLUID DYNAMICS L T P C
3 0 0 3

OBJECTIVES:

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 8

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 10

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT IV FLOW FIELD ANALYSIS 9

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V TURBULENCE MODELS AND MESH GENERATION 9

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able

- To create numerical modeling and its role in the field of fluid flow and heat transfer

- To use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The finite volume Method, Pearson Education Ltd.Second Edition, 2007.
2. Ghoshdastidar, P.S., Computer Simulation of flow and heat transfer, Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCES:

1. Patankar, S.V. Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, 2004.
2. Chung, T.J. Computational Fluid Dynamics, Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., Heat Transfer, Oxford University Press, 2005
4. Muralidhar, K., and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Narosa Publishing House, New Delhi, 1995.
5. ProdipNiyogi, Chakrabarty, S.K., Laha, M.K. Introduction to Computational Fluid Dynamics, Pearson Education, 2005.
6. Introduction to Computational Fluid Dynamics Anil W. Date Cambridge University Press, 2005.

ME6501 COMPUTER AIDED DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To provide an overview of how computers are being used in mechanical component design

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 9

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations-homogeneous coordinates - Line drawing -Clipping- viewing transformation

UNIT II GEOMETRIC MODELING 9

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep

UNIT III VISUAL REALISM 9

Hidden – Line-Surface-Solid removal algorithms – shading – colouring – computer animation.

UNIT IV ASSEMBLY OF PARTS 9

Assembly modelling – interferences of positions and orientation – tolerance analysis-massproperty calculations – mechanism simulation and interference checking.

UNIT V CAD STANDARDS 9

Standards for computer graphics- **Graphical Kernel System** (GKS) - standards for exchangeimages-**Open G**raphics Library **(OpenGL)** - Data exchange standards - IGES, STEP, CALSetc. - communication standards.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use computer and CAD software's for modeling of mechanical components

TEXT BOOKS:

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill Publishing Co.2007

REFERENCES:

1. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " Second Edition, Pearson Education, 1999.
2. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
3. Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc, 1992.
4. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education - 2003.

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.
5. Ganesan V. "Internal Combustion Engines", Third Edition, Tata Mcgraw-Hill, 2007.

MS6011 VALUE ANALYSIS AND VALUE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the student the concept of value engineering and methodology to evaluate cost identification.
- To understand the different techniques to analyse the value.
- To understand the different phases in value engineering.

UNIT I CONCEPTS: **9**

Introduction – status of VE in India and origin country – impact of VE application – types of values – types of function – function identification on product – function matrix – function analysis – elements of costs – calculation of costs – cost allocation to function – evaluation of worth in VE methodology.

UNIT II TECHNIQUES: **9**

General techniques: brain storming – godson feasibility ranking – morphological analysis – ABC analysis – probability approach – make or buy. Function – cost-worth analysis – function analysis – system techniques – function analysis matrix – customer oriented FAST diagram – fire alarm – Langrange plan – evaluation methods – matrix in evaluation – break even analysis.

UNIT III VALUE ENGINEERING IN JOB PLAN: **9**

Orientation phase – information phase – functional analysis – creative phase – evaluation phase – recommendation phase – implementation phase – audit phase.

UNIT IV REENGINEERING PRINCIPLES **9**

The 6R's of organizational transformation and reengineering – process reengineering – preparing the workforce – Methodology – PMI leadership expectation – Production and service improvement model – Process improvement.

UNIT V CASE STUDIES: **9**

Water treatment plant – engineering management, pump component, motor component, wet grinder, automobile, hospital.

TOTAL : 45 PERIODS

OUTCOMES:

- discuss the concept and associated terminology of value engineering
- To demonstrate the implementation of different techniques to analyse the value of product.
- To demonstrate the cost evaluation of different practical components / machineries.

TEXT BOOKS:

1. Mukhophadhyaya A K, "Value Engineering", Sage Publications Pvt. Ltd., New Delhi, 2003.
2. Richard J Park, "Value Engineering – A plan for inventions", St.Lucie Press, London, 1998.

REFERENCES:

1. Larry W Zimmesman. P E , "VE –A Practical approach for owners designers and contractors", CBS Publishers, Delhi, 1992
2. Arthus E Mudge, "Value Engineering", McGraw Hill book company, 1971

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.

MS6012 VIBRATION AND NOISE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the fundamentals of vibration and noise
- To explain single, two and multi degrees of freedom vibration systems and their characteristics equations.
- To explain vibration techniques and control methods.
- To introduce concept of sound isolation

UNIT I INTRODUCTION: 9

Relevance of and need for vibrational analysis. Mathematical modeling of vibrating systems-discrete and continuous systems-single-degree of freedom systems, free and forced vibrations, various damping models.

UNIT II TWO DEGREES OF FREEDOM SYSTEMS: 6

Generalized co-ordinates, principal co-ordinates, derivation of equations of motion, co-ordinate coupling, Lagrange's equation.

UNIT III MULTI DEGREES OF FREEDOM SYSTEMS: 12

Derivation of equations of motion, influence coefficients, orthogonality principle, calculation of natural frequencies by Raleigh, Stodala, Dunkerley, Holzer and matrix iteration methods, branched system, geared system.

TRANSIENT VIBRATION:

Impulse and arbitrary excitation, base excitation, Laplace transform formulation, response spectrum.

UNIT IV VIBRATION MEASUREMENT AND CONTROL: . 12

Measurement of vibration, FFT analyzer. Methods of vibration control - excitation reduction at source, balancing of rigid, flexible and variable mass rotors. Dynamic properties and selection of structural

materials-viscoelastic polymers, vibration absorbers- tuned absorber, tuned and damped absorber (qualitative treatment only), untuned viscous damper, vibration isolation

UNIT V NOISE: 6

Properties of sound – sound level meter. Sound isolation- machine enclosures, silencers and mufflers.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to develop mathematical mode for vibrating system with one, two and multi degrees of freedom
- ability to measure the vibration and control
- ability to explain the sound isolation and use of machine enclosures for noise suppression.

TEXT BOOKS:

1. Thomson W T, "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.
2. Ashok Kumar Mallik, “Principles of Vibration control”, Affiliated East-West Press (P) Ltd., New Delhi Press, 1990.
3. Lewis H Bell, “Industrial Noise Control Fundamentals and Applications”, Marcel Dekkev Incl., New York, 1982.

REFERENCES:

1. Rao S S, "Mechanical Vibrations", Addison Wesley, Longman, 1995.
2. Tse Morse and Hinkle, “Mechanical Vibration”, Prentice Hall of India Ltd., New Jersey,1987.
3. Grover G K, "Mechanical Vibrations ", New Chand and Brothers, Roorkey, 1989.
4. Seto, “Mechanical Vibrations ", Schaum Outline Series, McGraw Hill Book Company, New Delhi, 1990.
5. Kewal Pujara. and Pujara R.S., “Noise for Engineers”, Dhanpat Rai and Sons, New Delhi, 1984.

MS6013 MECHANICS OF COMPOSITE MATERIALS L T P C

3 0 0 3

OBJECTIVES:

- To introduce mechanics principle to composite materials and develop constitutive equations to predict properties.
- To discuss different processing techniques to develop components.
- To develop different micro mechanical models and study the stress – strain behaviour
- To introduce failure theories and develop macro mechanical theories for components.

UNIT I INTRODUCTION: 8

Modern materials in design, types, metals, polymers, ceramics, composites. Polymers-Classification, properties of thermo plastics, properties of thermo setting plastics, applications, merits and demerits. Classification of composites, Honey comb composites, advantages, applications. Matrix and their role, principal types of fibre and matrix materials.

UNIT II PROCESS AND CHARACTERISTICS OF COMPOSITES: **8**

Manufacture of polymer matrix composites-Lay up and curing, open and closed mould processes, bag moulding, filament winding, pultrusion, pulforming, thermoforming, advantages and limitations of different processes. Manufacture of metal matrix and ceramic matrix composites. Advantages,

limitations and characteristics of ceramic and metal matrix composites.

UNIT III CONCEPTS OF SOLID MECHANICS: 8

Stress and strain, Strain Energy, Plane stress and plane strain, Generalized Hook's Law for different types of materials, material symmetry, Engineering constants, coordinate transformation, thermal effects and moisture effects,

UNIT IV MICRO MECHANICAL BEHAVIOUR OF A LAMINA: . 7

Volume and mass fractions, density and void content, evaluation of elastic moduli, ultimate strengths of a unidirectional lamina, coefficients of thermal and moisture expansion

UNIT V MACRO MECHANICAL BEHAVIOUR OF A LAMINA: 14

Hook's Law for a two dimensional unidirectional lamina and angular lamina, evaluation of elastic moduli for unidirectional and angle lamina, engineering constants of unidirectional and angle lamina, strength failure theories.

MACRO MECHANICAL BEHAVIOUR OF A LAMINATE:

Laminate code, stress - strain behaviour in a laminate, Resultant forces and moments in a laminate, interlaminar stresses in laminates.

TOTAL : 45 PERIODS

OUTCOMES:

- ability to prepare composite
- ability to identify suitable material and reinforced for particular applilcations.
- ability to develop constitutive models to predict stress stains behaviour of lamination.
- ability to design composite structures.

TEXT BOOKS:

1. Autar K Kaw, "Mechanics of Composite Materials", CRC Press, NY, 1997.
2. Agarwal B D and Broutman L J, "Analysis and Performance of Fibre Composites", John Wiley and Sons Inc, 1990.
3. Matthews F L and Rawlings R D, "Composite Materials: Engineering and Science", Chapman and Hall, London, 1994.
4. Srinivasan, A.V. and Michael McFarland, "Smart Structures", Cambridge University Press, UK, 2001.
5. Kalyanmoy Deb, "Optimization for engineering design", Prentice-Hall India (Pvt) Ltd., New Delhi, 2000.

REFERENCES:

1. Ronald F Gibson, "Principles of Composite Material Mechanics", McGraw Hill Book Co, 1994.
2. Robert M Jones, "Mechanics of Composite Materials", McGraw Hill Book Co, 1970.
3. Terry Richardson, "Composites - A Design Guide", Industrial Press Inc, NY, 1987.
4. Sanjay K Mazumdar, "Composites Manufacturing", CRC Press, NY, 2003.