



B. TECH  
CURRICULUM  
AND  
SYLLABUS

**Semester I**

<b>Code</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
HSS101	English for Technical Communication I	2	0	0	2
MAT101	Mathematics I	3	0	0	3
PHY101	Physics I	3	0	0	3
CHY106	Chemistry	3	0	0	3
MEC101	Engineering Drawing	1	0	3	2
CIV101	Basic Civil and Mechanical Engineering	4	0	0	4
MEC181	Work Shop	0	0	3	1
CHY181	Chemistry Laboratory	0	0	3	1
	Total	16	0	9	19

**Semester II**

<b>Code</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
HSS102	English for Technical Communication II	2	0	0	2
MAT102	Mathematics II	3	0	0	3
PHY103	Physics II	3	0	0	3
EEE101	Basic Electrical and Electronics Engineering	4	0	0	4
CHY101	Environmental Sciences	2	0	0	2
CSE102	Programming Languages	2	0	0	2
MEC103	Engineering Mechanics (except BT, IT, CSE)	3	0	0	3
PHY181	Physics Laboratory	0	0	3	1

CSE181	Programming Language Laboratory	0	0	3	1
	Total	19	0	6	21

**Semester III**

Code	Subject	L	T	P	C
MAT201	Mathematics III	3	0	0	3
HSSxxx	Humanities Elective I	3	0	0	3
MEC201	Strength of Materials	3	1	0	4
EEE259	Electrical Drives and Controls	3	0	0	3
MEC202	Thermodynamics	3	1	0	4
MEC203	Fluid Mechanics and Machinery	3	1	0	4
MEC281	Strength of Materials / Fluid Mechanics Laboratory	0	0	3	2
EEE299	Electrical Sciences Laboratory	0	0	3	2
	Total	18	3	6	25

**Semester IV**

Code	Subject	L	T	P	C
MAT211	Numerical Methods	3	0	0	3
MEC204	Kinematics of Machinery	3	1	0	4
MEC205	Fluid Power Transmission Systems	3	1	0	4
MEC206	Material Science	3	0	0	3

MEC207	Manufacturing Technology	3	1	0	4
MEC208	Gas Dynamics and Propulsion	3	1	0	4
MEC282	Manufacturing Technology Laboratory	0	0	3	2
MEC283	Thermal Laboratory I	0	0	3	2
	Total	18	4	6	26

**Semester V**

Code	Subject	L	T	P	C
MECxxx	Department Elective I	3	0	0	3
	Minor Elective I	3	0	0	3
MEC301	Heat and Mass Transfer	3	1	0	4
MEC302	Machining and Metrology	3	0	0	3
MEC303	Design of Machine Elements	3	1	0	4
MEC304	Dynamics of Machinery	3	1	0	4
MEC381	Machine Drawing Practice Laboratory (Manual + Computer aided)	0	0	3	2
MEC382	Machine Tool and Metrology Laboratory	0	0	3	2
MEC383	Dynamics and Vibration Laboratory	0	0	3	2
	Total	18	3	9	27

**Semester VI**

<b>Code</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
MECxxx	Department Elective II	3	0	0	3
	Free Elective I	3	0	0	3
MEC305	Automobile Engineering	3	0	0	3
MEC306	Thermal Engineering	3	1	0	4
MEC307	Design of Transmission Systems	3	1	0	4
MEC308	Mechatronics	3	1	0	4
MEC384	CAD/CAM Laboratory	0	0	3	2
MEC385	Thermal Laboratory II	0	0	3	2
	Total	18	3	6	25

**Semester VII**

<b>Code</b>	<b>Subject</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
HSSxxx	Humanities Elective II	3	0	0	3
HSSxxx	Humanities–Elective III	3	0	0	3
	Free Elective II	3	0	0	3
MECxxx	Department Elective III	3	0	0	3
MECxxx	Department Elective IV	3	0	0	3
	Minor Elective II	3	0	0	3
MEC401	Power Plant Engineering	3	0	0	3
MEC481	Simulation Laboratory	0	0	3	2
	Total	21	0	3	23

**Semester VIII**

Code	Subject	L	T	P	C
MECxxx	Self Study Elective	3	0	0	3
MEC499	Project Work	0	0	24	8
	Total	3	0	24	11

**Total Credit (from 1<sup>st</sup> semester to 8<sup>th</sup> semester = 177)**

**MAJOR ELECTIVES**

Code	Subject	L	T	P	C
MEC309	Design of Jigs, Fixtures and Press Tools	3	0	0	3
MEC310	CNC Machining	3	0	0	3
MEC311	Non-Traditional Machining Techniques	3	0	0	3
MEC312	Internal Combustion Engines	3	0	0	3
MEC313	Turbo Machinery	3	0	0	3
MEC314	Energy Engineering and Management	3	0	0	3
MEC315	Design for Manufacture	3	0	0	3
MEC316	Theory of Metal Cutting	3	0	0	3
MEC317	Tribology	3	0	0	3
MEC318	Refrigeration and Air Conditioning	3	0	0	3
MEC319	Process Planning and Cost Estimation	3	0	0	3
MEC320	Finite Element Analysis	3	0	0	3
MEC321	Optimization Techniques	3	0	0	3

MEC322	Modern Manufacturing Processes	3	0	0	3
MEC323	Materials Management	3	0	0	3
MEC324	Plant Layout and Material Handling	3	0	0	3
MEC404	Robotics and Robot Applications	3	0	0	3
MEC405	Vibration Analysis and Noise Monitoring	3	0	0	3
MEC406	Renewable Energy Techniques	3	0	0	3
MEC407	Design of Heat Transfer Equipments	3	0	0	3
MEC408	Foundry Mechanization and Management	3	0	0	3
MEC409	Recent Trends in Welding Techniques	3	0	0	3
MEC410	Mechanical Behaviour of Materials	3	0	0	3
MEC411	Manufacturing System and Simulation	3	0	0	3
MEC412	Micro Electro Mechanical Systems	3	0	0	3
MEC413	Gear manufacturing and Inspection	3	0	0	3
MEC414	Sensors and Transducers	3	0	0	3
MEC415	Tooling for Production	3	0	0	3
MEC416	Industrial Safety	3	0	0	3
MEC417	Work Study	3	0	0	3
MEC418	Rapid Prototyping	3	0	0	3

MEC419	Production Planning and Control	3	0	0	3
MEC420	Industrial Engineering	3	0	0	3
MEC421	Non-destructive Examination	3	0	0	3
MEC422	Composite Materials Science	3	0	0	3
MEC423	Principles of Component Design	3	0	0	3
MEC424	Industrial Automation and Robotics	3	0	0	3

### MINOR ELECTIVES

Code	Subject	L	T	P	C
EEE306	Special Electrical Machines	3	0	0	3
EEE410	Neural Network And Fuzzy Logic	3	0	0	3
EIE310	Industrial Drives and Controls	3	0	0	3
EIE319	Piping and Instrumentation	3	0	0	3
CHE404	Computational Fluid Dynamics	3	0	0	3
CHE405	Computational Heat Transfer	3	0	0	3
CSE314	Digital Image Processing	3	0	0	3

### HUMANITIES ELECTIVES

Code	Subject	L	T	P	C
HSS001	Total Quality Management	3	0	0	3

HSS002	Engineering Management	3	0	0	3
HSS003	Indian Economic Development	3	0	0	3
HSS004	Industrial Psychology	3	0	0	3
HSS006	Professional Ethics	3	0	0	3
HSS008	Basics of Economics	3	0	0	3
HSS010	International Trade and Finance	3	0	0	3
HSS011	Information Systems for Managerial Decision Making	3	0	0	3
HSS013	Cost Analysis and Control	3	0	0	3
HSS014	Marketing Management	3	0	0	3
HSS015	Management Concepts and Techniques	3	0	0	3
HSS016	Organizational Psychology	3	0	0	3
HSS017	International Economics	3	0	0	3
HSS018	Communication Skills	3	0	0	3
HSS019	Operations Research	3	0	0	3
HSS020	Human Resource Management	3	0	0	3
HSS022	Banking Theory and Practice	3	0	0	3
HSS023	Entrepreneurship Development	3	0	0	3
HSS024	Industrial Psychology	3	0	0	3
HSS031	English Advance Level	3	0	0	3

**SEMESTER I**

<b>HSS101</b>	<b>ENGLISH FOR TECHNICAL COMMUNICATION I</b> (Common to all branches)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**FOCUS ON LANGUAGE**

Parts of speech - nominal compounds, noun phrases - relative pronoun - adjective - numerical, comparison and contrast, collocation and word combinations - verb - preposition and relative - conjunction- connectives, expressions of purpose and function, cause and effect - articles - adjectives - sentence pattern - tenses - voice - rewriting the sentences in impersonal/abbreviated passive grammatical structures - concord - sentence level verb noun agreement - gerund - rewriting infinitive into gerund - imperative - rewriting imperative into recommendation using should - word formation - varied grammatical function of the same word - affixes - prefix and suffix, number prefix, negative prefix - reported speech - editing strategies - conditional structures - real, unreal, no possibility, zero condition - writing formal definition - abbreviation and acronym - idioms and phrases - varieties of English - British versus American.

**LISTENING SKILLS**

Comprehension practice - vocabulary development - familiarity to varied types of spoken English and accents - developing ability to understand audio and video media - aiming at overcoming barriers to listening - listening to documentaries, radio news broadcasts, TV news telecasts - active listening in discussions and to lectures - taking notes while listening - extracting information from listening.

**SPEAKING SKILLS**

Oral practice - role play - interplay - seminar - transcoding visual into oral - participating in short and longer conversation - voice record, replay, correction of intonation, pronunciation and flow of speech - phonemes - vowels, consonants, stress, rhythm, intonation - group discussion - participative learning - acquiring proficiency, fluency, accuracy in oral communication - speaking practice - developing confidence - extempore speech - learning professional/conversational etiquette.

**READING SKILLS**

Vocabulary extension - improving vocabulary - intensive reading - reading strategies - identifying topic sentence - guessing meaning from content - picking out specific information - professional reading - reading practice - predicting the content, critical and analytical reading - reading articles in English newspapers, sports magazines, encyclopedias - reading aloud, use of stress and intonation - reading and comprehending technical materials - cloze reading.

**WRITING SKILLS**

Discourse cohesion - improving writing skills, avoiding common grammatical errors in academic writing - extending the hints - writing shorter sentences - punctuation - dialogue writing - paragraph writing, problems and solutions, achieving coherence, transition words, sequence words - essays of descriptive and argumentative - writing instructions, use of imperatives - jumbled sentences into sequential paragraph using linguistic clues - report writing - technical reports, industry visit reports, events reports - writing recommendations - letter writing - formal and informal letters - job application and resume, permission for in-plant training, business correspondence letters, calling for quotation, placing order, lodging complaint, persuasive letters - assignment writing - mini-project - transcoding - transferring of information from text to pictorial/graphical representation and vice versa.

**TEXT BOOK**

1. Rizvi M Ashraf, Effective Technical Communication, Tata McGraw-Hill, 2005.

**REFERENCES**

1. Daniel Jones, English Pronouncing Dictionary, Universal Book Stall, New Delhi, 17<sup>th</sup> Edition, 2000.
2. Geoffrey Leech, Fan Svartvik, A Communicative Grammar of English, Pearson Education Asia, 1994.
3. Hornby, AS, Oxford Advanced Learner's Dictionary of Current English, OUP, 7<sup>th</sup> Edition, 2005.
4. Manivannan G, English for Engineers - A Book on Scientific and Technical Writing, Govi Publications, 2005.
5. Martin Cutts, Plain English Guide - How to Write Clearly and Communicate Better, Oxford University Press, 1999.

<b>MAT101</b>	<b>MATHEMATICS I</b> (Common to all Branches)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**MATRICES**

Review of linear algebra - matrix operations - addition, scalar multiplication, multiplication, transpose, adjoint and their properties - special types of matrices - null, identity, diagonal, triangular, symmetric, skew - symmetric, Hermitian, skew - Hermitian, orthogonal, unitary, norma – rank - consistency of a system of linear equations - solution of the matrix equation  $Ax = b$  – row - reduced Echelon form.

**EIGEN VALUE PROBLEMS**

Eigen value and eigen vector of real matrix – properties of eigen values and eigen vectors – Cayley - Hamilton theorem – Orthogonal

transformation of a real symmetric matrix to diagonal form – reduction of quadratic form to canonical form by orthogonal transformation – index, signature and nature of quadratic form.

### **DIFFERENTIAL CALCULUS**

Review of limits - continuity and differentiability - curvature – Cartesian and Parametric Co-ordinates – centre and radius of curvature – circle of curvature - evolutes - involutes - envelopes - partial differentiation – Euler’s theorem for homogeneous functions - total differential – Taylor’s expansion (two variables) - Maxima / Minima for functions of two variables – Method of Lagrangian multiplier – Jacobians.

### **THREE DIMENSIONAL ANALYTICAL GEOMETRY**

Direction cosines and ratios – angle between two lines – equations of a plane – equations of straight line – coplanar lines – shortest distance between two skew lines – sphere – tangent plane – plane section of a sphere – orthogonal spheres.

### **ORDINARY DIFFERENTIAL EQUATIONS**

Solutions of second and higher order linear ODE with constant coefficients – Cauchy’s and Legendre’s linear equations - Simultaneous first order linear equations with constant coefficients - Method of variation of parameters.

### **TEXT BOOKS**

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 8<sup>th</sup> Edn., 2001.
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume I, Scitech Publications (India) Pvt. Ltd., Chennai, 2<sup>nd</sup> Edn., Reprint 2000, 1999.

**REFERENCES**

1. Grewal , B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37<sup>th</sup> Edn., 5<sup>th</sup> Reprint 2004, 2003.
2. Venkataraman, M. K., Engineering Mathematics First Year, The National Publishing Company, Chennai, 2<sup>nd</sup> Edn., Reprint 2001, 2000.

PHY 101	PHYSICS I (Common to all Branches)	L	P	T	C
		3	0	0	3

**ACOUSTICS AND STRUCTURE OF SOLIDS**

Classification of sound - reverberation, Sabine's formula, common acoustical defects and remedies - classification of solids- Crystal structures, X-ray diffraction, crystal growth, Crystal defects.

**LASER AND FIBRE OPTICS**

Interaction of radiation with matter – quantum mechanical view, three and four - level laser system, engineering and medical applications - introduction of fibre optics- classification of fibre, engineering and medical applications

**QUANTUM PHYSICS**

Inadequacy of classical mechanics – black body radiation, Plancks law, photoelectric effect, Compton effect, Einstein's photoelectric equation, Schrödinger wave equation, Particle in one, three dimensional box.

**NDT, NEW ENGG.MATERIALS**

Ultrasonics, Ultrasonics flaw detectors-X-ray photography-Fluoroscopy, Thermography-Gammaray-spectroscopy, chracterization

technique, Nanophase materials- Biomaterials, Non linear materials, polymer materials.

### **DIGITAL ELECTRONICS**

Introduction-Analog to Digital circuits-Conversion of numbers one's complement-2's complement-logic gates-Boolean algebra-DeMorgan's theorem- Karnaugh's maps.

### **TEXT BOOK**

1. Gaur R. K. and Gupta S. L., Engineering Physics, Dhanpat Rai Publishers, New Delhi, 2001.

### **REFERENCES**

1. Murthy V.S.R., Jena AK. Gupta K.P. and Murthy G.S., Structures and Properties of Engineering Materials, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Ali Omar. M, Elementary Solid State Physics, Pearson Education (Singapore), Indian Branch, New Delhi, First Edition, 2006.
3. William F. Smith., Foundations of materials science and Engineering, McGraw-Hill, New York, 3rd Edition, 2003.
4. Mathews. P.M., Venkatesan. K., Text Book of Quantum Mechanics, Tata McGraw Hill Company, Delhi, 2003.
5. Gupta S.L., Kumar.V., Hand book of Electronics, Pragati Prakashan, Meerut, 28<sup>th</sup> Edition, 2001.

<b>CHY106</b>	<b>CHEMISTRY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **WATER**

Water quality parameter (Industry and Drinking Water) - Hardness, Definition, Classifications, Expressions, Units of Hardness of Water with respect to  $\text{CaCO}_3$ , Problems -Estimation of Hardness by EDTA Method (Theory Only) - Definition of Alkalinity (Theory Only) - Boiler feed water - Requirements, Disadvantages of using hard water in boilers, Removal of boiler scales and sludges - Water Softening -

Zeolite Process, Demineralization (Ion – Exchange Process), Desalination

### **CORROSION SCIENCE AND CONTROL ENGINEERING**

Corrosion - definitions, electrode potential - Principles of Dry and Wet Corrosion, Factors Influencing rate of corrosion, Types of Corrosion - Corrosion Control – Impressed Current Cathodic Protection and Sacrificial Anodic Protection Method - Corrosion Inhibitors – Protective Coatings, Surface conversion coatings, organic coatings (paints)

### **POLYMERS**

Introduction, Classification, Difference Between Thermoplastic and Thermosetting Plastics - Properties of Plastic - Degree of Polymerization – Types of Polymerization (Mechanism) - Phenol Formaldehyde Resin, Epoxy Resin, polyurethanes, Teflon -Amino Resins (Urea Formaldehyde, Nylon.11, Nylon.66 and Nylon 6), PET, PVC – Composites - Definition, characteristics, Constituent. Types- Fibre reinforced plastics (FRP), Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMMC), Properties and Applications

### **INSTRUMENTAL METHODS OF ANALYSIS**

Electro Magnetic Radiation - Absorption of Radiation , Beer - Lambert's Law – UV-Visible spectroscopy – IR Spectroscopy - Principle and Instrumentation (Block Diagram Only) Estimation of Iron by Colorimetry – Flame Photometry, Principle and Instrumentation (Block Diagram Only), Estimation of Na by Flame Photometry - Atomic Absorption Spectroscopy, Principle and Instrumentation (Block Diagram Only), Quantitative Estimation of Nickel by Atomic Absorption Spectroscopy

### **BIOMOLECULES AND NANOTECHNOLOGY**

Carbohydrates - Classification, Synthesis, Structure and Properties of Glucose and Sucrose – Polysaccharides, Starch and Cellulose -

Amino Acids - Polypeptide linkages, Structure and Properties of DNA and RNA - Enzyme Catalysis - Kinetics and Mechanism – Nanotechnology - Introduction, Preparation, Characterization and Application

### TEXT BOOKS

1. Jain, P.C., Monika Jain, Engineering Chemistry, Dhanpat Rai Publishing company (P) Ltd., New Delhi, 14<sup>th</sup> Edition, 2002
2. Sharma, B.K., Industrial Chemistry, Goel Publishing House, Meerut, 12<sup>th</sup> Edition, 2001

### REFERENCES

1. Puri, B.R., Sharma, L.R., Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., Jalandhar, 40<sup>th</sup> Edition, 2003
2. Vogel, A.I., A text book of Quantitative Inorganic Analysis, ELBS, London, 3<sup>rd</sup> Edition, 2000
3. Mick Wilson and Kamali Kannangara, Nanotechnology: Basic science and emerging Technology, Overseas India Pvt. Ltd. Press, New Delhi, 1<sup>st</sup> Edition, 2005
4. Bandyopadhyay, A.K., Nano Materials, New Age International Publishers, New Delhi, 1<sup>st</sup> Edition, 2007

<b>MEC101</b>	<b>ENGINEERING DRAWING</b> (Common to all Branches)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>1</b>	<b>0</b>	<b>3</b>	<b>2</b>

### INTRODUCTION

Importance of graphics – use of drafting instruments – BIS conventions and specifications – size, layout and folding of drawing sheets – lettering dimensioning and scales - Orthographic principles - free hand sketching in first angle projection from pictorial views.

**PROJECTION OF POINTS, STRAIGHT LINES AND PLANES**

Projection of points, located in all quadrants - projection of straight lines located in the first quadrant, determination of true lengths and true inclinations, location of traces - projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes.

**PROJECTION AND SECTION OF SOLIDS**

Projection of solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method. Section of above solids in simple vertical position by cutting planes inclined to any one of the reference planes, obtaining true shape of section.

**DEVELOPMENT OF SURFACES**

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cones - development of lateral surfaces of combined solids – prism and cylinder, cylinder and cylinder with axes at right angles with no offset.

**ISOMETRIC AND PERSPECTIVE PROJECTION**

Principles of isometric projection – isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.

**TEXT BOOK**

1. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 46<sup>th</sup> Edition, 2003.

**REFERENCES**

1. Natarajan, K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2006.

2. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson Education, New Delhi, 2005.
3. Gopalakrishnana, K.R., Engineering Drawing (Vol. I and II), Subhas Publications, 1998.
4. Luzadder and Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt Ltd, New Delhi, XI Edition, 2001.
5. Venugopal, K., Engineering Graphics, New Age International (P) Limited, 2002.

<b>CIV101</b>	<b>BASIC CIVIL AND MECHANICAL ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	(Common to all Branches)	<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

### **CIVIL ENGINEERING BUILDINGS**

Characteristics of good building materials such as stones, bricks, plywood and ceramic tiles, timber, cement, aggregates and concrete - Basic functions of buildings – Major components of buildings – Foundations - Purpose of a foundation – Bearing capacity of soils – types of foundations. Proper methods of construction of Brick masonry – Stone masonry – Hollow Block masonry. Beams – Lintels – Columns – Flooring – Damp proof course – surface finishes – Doors and windows – Roofing.

### **TRANSPORTATION ENGINEERING**

Principles and Classification of surveying, Chain surveying, Compass surveying and leveling - Importance of roads – Classification of Highways –water bound macadam, bituminous and cement concrete roads –. Railways - Importance of railways – Gauges – Components of a permanent way. Bridges - Components of Culverts – Causeways, Slab Bridge, T-beam and slab bridge, Suspension bridge

**MECHANICAL ENGINEERING  
BOILERS AND TURBINES**

Boilers - boiler mountings and accessories – Cochran boiler, Locomotive boiler, Babcock and Wilcox boiler, fire and water tube boilers - Steam turbine - single stage impulse turbine, Parson's reaction turbine, difference between impulse and reaction turbines.

**POWER PLANTS AND INTERNAL COMBUSTION (IC) ENGINE**

Classification of power plants – steam, nuclear, diesel and hydro power plants - Alternate sources of energy - solar, wind, tidal, geothermal, ocean thermal energy conversion. – IC engine - components, working of four and two stroke petrol and diesel engines.

**PRODUCTION TECHNOLOGY**

Metal casting and forming process – patterns, moulding, melting of cast iron, casting – forging – rolling – extrusion – drawing - Metal joining process - welding – arc welding, gas welding, brazing and soldering - Metal machining – lathe, drilling machine, milling machine, shaping machine, planing machine, introduction to Computer Numerical Control machining.

**TEXT BOOK**

1. Shanmugam, G., and Palanichamy, M.S., Basic Civil and Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 1996.

**REFERENCES**

1. Khanna, K., Justo C E G, Highway Engineering, Khanna Publishers, Roorkee, 2001
2. Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, Dhanpat Rai and Sons, New Delhi, 1997.

3. Venugopal K., Basic Mechanical Engineering, Anuradha Publications, Kumbakonam, 2000.
4. Shanmugam G., Basic Mechanical Engineering, Tata McGraw Hill Publishing Co., New Delhi, 2001.

<b>MEC181</b>	<b>WORK SHOP</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1</b>

### **CARPENTRY**

Carpentry tools - practice in marking, sawing, planing and chiseling – making simple joints: lap joint, T-joint, dovetail joint, mortise and tenon joint.

### **FITTING**

Fitting tools - practice in marking, filing, punching, hacksawing - fitting to size and drilling - making of simple mating profiles: V, square, dovetail, half round joints.

### **SHEET METAL**

Study of press, die and tools - sheet metal layout - development of lateral surfaces - simple exercises: blanking, forming, bending and flanging.

### **DRILLING**

Drilling and tapping in drilling machines

#### **Demonstration on:**

- i) Welding operations like butt joint and lap joints in Arc welding
- ii) Foundry operations like mould preparation for split pattern
- iii) Smithy operations like the production of hexagonal bolt
- iv) Preparation of plumbing line sketches – basic pipe connections involving the fittings like valves, taps, couplings, unions, reducers, elbows and other components used in household fittings.

<b>CHY181</b>	<b>CHEMISTRY LABORATORY (Common to all branches)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>1</b>

1. Preparation of standard and buffer solutions.
2. Estimation of hardness of water sample by EDTA method
3. Determination of dissolved oxygen in a sample of water.
4. Estimation of chloride and fluoride ion in water sample.
5. Determination of alkalinity of water sample.
6. Estimation of hydrochloric acid by pH titration
7. Estimation of ferrous ion by potentiometric titration
8. Estimation of mixture of acid by conductometric titration
9. Estimation of iron by spectrophotometric method.
10. Flame photometry – Determination of Na and K

**SEMESTER – II**

<b>HSS102</b>	<b>ENGLISH FOR TECHNICAL COMMUNICATION II</b> (Common to all Branches)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**GRAMMAR AND VOCABULARY**

Grammar and vocabulary - introduction to grammatical models - proper use of tenses, concord, voice, articles, punctuation, and modal auxiliaries.

**RECEPTION SKILLS**

Listening and language development - improving listening skills - comprehension practice - comprehend classroom lectures, simple technically oriented passages - listening to news bulletins, pre-recorded talks, different speech styles, comprehending the essential meaning - physical and psychological barriers to listening - steps to overcome the barriers - practice in note-taking while listening.

**SPEAKING TECHNIQUES**

Speaking practice - improving conversing skills - improving self-expression - developing confidence and fluency in oral communication - physical and psychological barriers to speaking - steps to overcome the barriers - formal and public speaking practice - extemporaneous talk practice - speech process - fluency and accuracy in speech - developing persuasive speaking skills - conversation in a given milieu, social and cultural surroundings - practice in giving small talks on local topics for a minute or two - goal oriented group discussion - participating in seminars - independent and effective communication.

**READING STRATEGIES**

Reading comprehension - vocabulary extension methods - speed reading practice - technical and non-technical materials - practice in various reading techniques – skimming - scanning, eye reading -

looking for specific information - comprehending the given passages, technical information.

### **WRITTEN COMMUNICATION**

Basic grammatical structures - alphabet of other languages - paragraph writing - expressing the idea in writing - avoiding and correcting common errors - effective writing techniques - brevity, clarity, objectivity and simplicity - discourse writing - definition, description, instruction - note-making - proof reading - mechanics of writing - writing formal, informal letters, technical reports - reference skills - using dictionary better.

### **TEXT BOOKS**

1. Rizvi M Ashraf, Effective Technical Communication, Tata McGraw-Hill, 2005.
2. Rutherford Andrea J, Basic Communication Skills for Technology, Pearson Education, 2002.

### **REFERENCES**

1. Deborah C Andrews, Margaret D Bickle, Technical Writing - Principles and Forms, Macmillan, 1978.
2. Manivannan G, English for Engineers - A Book on Scientific and Technical Writing, Govi Publications, 2005.
3. Sarah Freeman, Written Communication in English, Orient Longman, 2000.
4. Thomson A J and AV Martinet, A Practical English Grammar, OUP, 4<sup>th</sup> Edition, 1986.
5. Tom Hutchinson, Alan Waters, English for Specific Purpose, Cambridge University Press, 1987.

<b>MAT102</b>	<b>MATHEMATICS II</b> (Common to all Branches)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **SEQUENCES AND SERIES**

Convergence and divergence of infinite series – series of positive terms – comparison, D’Alembert’s ratio, Raabe’s and Cauchy’s root tests – Convergence of alternating series – Leibnitz’s test (proof of theorems and tests not included) – elementary notions of absolute and conditional convergence - Power series – Taylor’s theorem (one variable).

### **ANALYTIC FUNCTION AND CONFORMAL MAPPING**

Function of a complex variable – Analytic function – Necessary conditions – Cauchy – Riemann equations – Sufficient conditions (excluding proof) – Properties of analytic function – Harmonic conjugate – Construction of Analytic functions - Conformal mapping -  $w = z+a$ ,  $az$ ,  $1/z$ ,  $e^z$ ,  $\sin z$ ,  $\cos z$  and bilinear transformation – fixed points – cross ratio.

### **COMPLEX INTEGRATION**

Statement and application of Cauchy’s integral theorem and integral formula – Taylor and Laurent expansions – Isolated singularities – Residues - Cauchy’s residue theorem - Contour integration over unit circle and semicircular contours (excluding poles on boundaries)- evaluation of real integrals using contour integration.

### **MULTIPLE INTEGRALS**

Review of Riemann integrals - Double integration – Cartesian and polar coordinates – change of order of integration – change of variable between Cartesian and polar – area as double integral – Triple integration in Cartesian, cylindrical and spherical polar coordinates – volume as triple integral.

**VECTOR CALCULUS**

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proof) – Simple applications.

**TEXT BOOKS**

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore , 8<sup>th</sup> Edn., 2001.
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume II, Scitech Publications (India) Pvt. Ltd., Chennai, 1<sup>st</sup> Edn., Reprint 2000, 1999.

**REFERENCES**

1. Grewal, B.S., Grewal, J.S., Higher Engineering mathematics, Khanna Publishers, New Delhi, 37<sup>th</sup> Edn., 5<sup>th</sup> Reprint 2004, 2003.
2. Venkataraman, M. K., Engineering Mathematics First Year, The National Publishing Company, Chennai, 2<sup>nd</sup> Edn., Reprint 2001, 2000.
3. Venkataraman, M. K., Engineering Mathematics –III A, The National Publishing Company, Chennai, 11<sup>th</sup> Edn., Reprint 2002, 1998.

PHY 103	PHYSICS – II (Common to Civil and Mechanical Engineering)	L	P	T	C
		3	0	0	3

**THERMAL AND NUCLEAR PHYSICS**

Mode of heat transfer - Thermal conductivity - Thermal diffusivity - Thermal insulations in buildings, application of heat transfer - Nuclear forces- Nuclear fission, Nuclear reactor uncontrolled chain reaction, Nuclear fusion .

**CONDUCTING MATERIALS**

Electron theory of solids – classical free electron theory, quantum free electron theory - Band theory of solids

**SEMI CONDUCTING AND SUPER CONDUCTING MATERIALS**

Semi conducting materials - Introduction, types of semi conducting materials, carrier concentration - Hall Effect –Determination of Hall coefficient - Superconducting Phenomena - Properties of superconductors, Type I and Type II superconductors, High T<sub>c</sub> Superconductors, Application of super conductors.

**MAGNETIC MATERIALS**

Classical theory of magnetism quantum theory of paramagnetism, Ferromagnetism, Ferrites, Applications of magnetic materials.

**DIELECTRIC MATERIALS AND OPTICAL MATERIALS**

Polarization - Electronic, Ionic, Orientational and space charge polarization , Internal field and deduction of Clausius -Mosotti relation - Dielectric materials – properties, classification, insulating materials - Optical properties of semiconductor- imperfection of crystals, Luminescence , Fluorescence and phosphorescence - Light Emitting Diode, Liquid crystal displays.

**TEXT BOOK**

1. William F.Smith, Foundations of Materials Science and Engineering, McGraw-Hill, New York, 3<sup>rd</sup> Edition, 2003.

**REFERENCES**

1. Aswani K.G., A Text book of Material Science, S.Chand & Co., Ltd., New Delhi, 2<sup>nd</sup> Edition, 2001.
2. Wahab M.A., Solid State Physics, Narosa Publishing House, New Delhi, Second edition, 1999.
3. Avadhanulu, M.N., Kshirsagar, P.G., A Text Book of Engineering Physics, S.Chand & Co. Ltd., New Delhi, 6th edition, 2003.

- 4 Pillai, S.O., Solid State Physics, 5th edition, New Age International Publication, New Delhi, 2003.
- 5 Ali Omar.M., Elementary Solid State Physics, Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2002.
- 6 Murthy, V.S.R., Jena, A.K., Gupta, K.P., and Murthy, G.S., Structure and Properties Of Engineering Materials, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2005.

<b>EEE101</b>	<b>BASIC ELECTRICAL AND ELECTRONICS ENGINEERING</b> (Common to all branches)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>4</b>	<b>0</b>	<b>0</b>	<b>4</b>

### **ELECTRICAL CIRCUITS**

Introduction to electric circuits – laws of electric circuits– Ohm’s Law, Kirchoff’s Laws– analysis of DC circuits–mesh, nodal – introduction to AC circuits– average Value, RMS value, power and power factor–analysis of 3 phase AC circuits – balanced and unbalanced circuits

### **ELECTRICAL MACHINES**

DC Machines –principle of operation–DC generators–emf equation, characteristics, types– DC motors–shunt, series, compound– single phase transformer – principle of operation, emf equation, phasor diagram –induction motors–single phase, three phase–alternators–principle of operation, emf equation , characteristics

### **ELECTRICAL MEASUREMENTS**

Moving coil –ammeter, voltmeter – moving iron instruments – ammeter, voltmeter – dynamometer – wattmeter, energy meter

### **BASIC ELECTRONICS**

Semiconductor devices – introduction, construction, types – pn junction diode –working principle, characteristics– zener diode–working principle, characteristics uni–junction transistor– operation,

characteristics –field effect transistor– operation, characteristics–bipolar junction transistor– operation, characteristics–applications–half wave and full wave rectifiers

### **DIGITAL ELECTRONICS**

Introduction to binary number system–logic gates –AND, OR, NOT, NAND, NOR, exclusive OR–boolean algebra– combinational circuits – half adder, full adder, half subtractor, full subtractor

### **INTEGRATED CIRCUITS**

Operational amplifier–introduction, DC characteristics, AC characteristics–types of operational amplifier–inverting, non–inverting– applications– scalar, adder, Subtractor, differentiator, and integrator

### **TEXT BOOKS**

1. Edward Hughes., Electrical & Electronics Technology, Pearson Education Ltd, 9<sup>th</sup> edition, 2005.
2. Kothari.D.P.,and.Nagrath.I.J., Basic Electrical Engineering, TataMcGraw Hill Second Edition.

### **REFERENCES**

1. Malvino,A P., Electronic Principles, TataMcGraw Hill International, 1998.
2. Vincent Del tora.,Electrical Engineering fundamentals, Prentice hall of India , 2<sup>nd</sup> edition 2003.
3. Muraleedharan.K.A., Muthusubramanian .R., and Salivahanan .S., Basic Electrical and Electronics and Computer Engineering, Tata McGraw Hill, 1997.

CHY101	ENVIRONMENTAL SCIENCES (Common to all branches)	L	P	T	C
		2	0	0	2

**NATURAL RESOURCES**

Definitions – scope of environmental sciences - forest resource – food resource – land resource – water – mineral resources - utilization of natural resource, impact on environment – conservation of natural resources.

**ECOSYSTEM AND BIODIVERSITY**

Concept – structure and function – energy flow in ecosystem – ecological succession – food chain – food web, ecological pyramids – biodiversity, definition, values, threats to biodiversity, conservation of biodiversity.

**ENVIRONMENTAL POLLUTION**

Definition, causes, effects and control measures of air, water and soil pollution – thermal and nuclear pollution.

**MANAGEMENT OF ENVIRONMENTAL POLLUTION**

Solid waste management – treatment methods adopted for municipal sewage and industrial effluent – hazardous and biomedical waste management.

**TOOLS FOR ENVIRONMENTAL MANAGEMENT**

Environment impact assessment – precautionary and polluter pay principle - constitutional provision – (air, water and forest) - waste minimization techniques, cleaner technology options, bioremediation.

**TEXT BOOK**

1.Dhameja, S.K., Environmental engineering and Management, S. K. Kataria and sons, New Delhi, 1<sup>st</sup> edition 2004.

**REFERENCES**

- 1.Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, 1<sup>st</sup> edition 2001.
- 2.Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. USA, 2<sup>nd</sup> edition 2004.

3. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media., New Delhi, 2<sup>nd</sup> edition 2004.
4. Masters, G. M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 2<sup>nd</sup> edition 1997
5. Henry, J. G. and Heike, G. W. Environmental Science and Engineering, Prentice Hall International Inc., New Jersey, 1<sup>st</sup> edition 2005.

<b>CSE102</b>	<b>PROGRAMMING LANGUAGES</b> (Common to all Branches)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

### **BASIC ELEMENTS OF C & CONTROL STATEMENTS**

Introduction to C- Structure of C language – Lexical elements of C- Operators and Expressions-Operator precedence and associativity of operators -Input and Output Functions-Library Functions –Header Files-Simple Computational problems. Decision Making: if statement - if-else statement - else-if ladder - switch statement – Looping Control Structure - the break statement - ? : operator - Continue statement - goto statement – Problems using Control Structures.

### **FUNCTIONS, PROGRAM STRUCTURES & ARRAYS**

Prototypes and Functions – Declaring, defining and accessing Functions- Parameter passing methods-Recursion - Storage Classes - Automatic Variables -External Variables – Static and Register Variables – Programs using functions. Defining and Processing an Array - Passing Arrays to Functions - Multidimensional Arrays - Arrays and Strings - Enumerated data types-Programs using sorting, searching and merging of arrays.

### **POINTERS, STRUCTURES & UNIONS**

Pointer Fundamentals - Pointer Declarations - Passing Pointers to Functions - Arrays and Pointers - Pointers and One-Dimensional

Arrays - Pointers and Multidimensional Arrays - Operations on Pointers - Pointers and Structures - Dynamic Memory Allocation – Command Line Arguments – Programs using Pointers with Functions, Arrays and Structures. Defining a Structure - Processing a Structure - User-Defined Data Types – Union – Nested structure - Structures and Pointers - Passing Structures to Functions - Self Referential Structures.

### **DATA FILES & DATA STRUCTURES**

Opening and Closing a Data File - Creating a Data File - High Level File Operations - Processing and Updation of Data Files - Unformatted Data Files - Low Level Programming – File Handling Programs. Linked List – Creation, Insertion and Deletion of elements - Stack and Queue implementation using Linked List.

### **UNIX BASICS & SHELL PROGRAMMING**

Shell Fundamentals - Shell Commands - Shell Decisions and Repetitions - Command line usage - Wildcard expansion - Redirection of I/O, pipes and filters. Shell Programming - Simple scripts - Specifying the interpreter - Shell variables - The Environment - Control flow; test, if, for, while, case - Command substitution - Signal catching - Shell functions - Aliases - Reading from the Standard I/P - Startup Files - basename and dirname - Expression evaluation.

### **TEXT BOOKS**

1. Byron S. Gottfried, Theory and Problems of Programming with C, Tata McGraw Hill, Second Edition, 1996.
2. Lowell Jay Arthur and Ted Burns, UNIX Shell Programming, John Wiley & Sons Canada, Ltd, Fourth Edition, 1997.
3. Deshpande P.S, Kakde O.G, C & Data Structures , Dreamtech Press, First edition, 2004

**REFERENCES**

1. Brian Kernighan W, Dennis Richie M, The C Programming language, Pearson Education, 2005.
2. Johnsonbaugh R. and Kalin M, Applications Programming in ANSI C, Pearson Education, Third Edition, 2003.
3. Behrouz A. Forouzan and Richard Gilberg F, A Structured Programming Approach Using C, Brooks - Cole Thompson Learning Publications, Second Edition, 2001.
4. Bruce Molay, Understanding UNIX / LINUX Programming: A Guide to Theory and Practice, Prentice Hall, First Edition, 2002.
5. Glass, G., Ables, K. UNIX for Programmers and Users, Prentice Hall, 1999.
6. Stephen Kochan and Patrick Wood, UNIX Shell Programming, Pearson Education, Third Edition, 2003.

<b>MEC103</b>	<b>ENGINEERING MECHANICS</b> (Expect BT, IT and CSE)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**STATICS OF PARTICLES**

Fundamental principles and concepts - vector algebra, Newton's laws, gravitation, force external and internal, transmissibility - velocity and acceleration - Couple- Moment about point and about axis - Varignon's theorem - resultant of concurrent and non-concurrent coplanar forces - static equilibrium, free body diagram, reactions - Problem formulation concept in 2-D and 3-D statics.

**TRUSSES AND FRAMES**

Trusses - assumptions, rigid and non-rigid trusses- simple trusses in plane and space- analysis by method of joints and by method of sections- compound trusses- statically determinate, rigid, and completely constrained - analysis of frames and machines.

**FRICTION**

Frictional forces- laws of friction- simple contact friction - rolling resistance - belt friction.

**PROPERTIES OF SURFACES AND SOLIDS**

Centroids of lines - areas, volumes, composite bodies - center of mass - area moment of Inertia - mass moment of inertia - principal moment of inertia.

**DYNAMICS OF PARTICLES**

Displacements, velocity and acceleration, their relationship – relative motion – Curvilinear motion – Newton’s law – work Energy equation of particles – impulse and momentum – impact of elastic bodies.

**TEXT BOOK**

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics, Tata McGraw Hill, New York, 2004.

**REFERENCES**

1. Merriam, J.L., Engineering Mechanics, Volume I – Statics, and Volume – II, Dynamics 2/e, Wiley International, 1998.
2. Irving , H., Shames, Engineering Mechanics, Statics and Dynamics, Third Edition, Prentice Hall of India Pvt. Ltd., 1993.

PHY 181	PHYSICS LABORATORY (Common to all Branches)	L	P	T	C
		0	0	3	1

1. To determine the acceleration due to gravity using Compound Pendulum
2. To determine the Rigidity Modulus of wire using Torsional Pendulum

3. To find thickness of the given two glass plates using single optic lever
4. To determine the thermal conductivity of a bad conductor – Lee’s disc method.
5. To determine the refractive index of the material of the prism
6. To find the prominent wave length of mercury spectrum using grating
7. To determine the particle size using Laser
8. To determine the coefficient of viscosity of the liquid by Poiseuille’s method
9. To determine the young’s modulus of given material using Uniform Bending
10. To Determine the thickness of a given material using Air wedge method
11. To determine the focal length of a biconvex lens using Newton’s Rings method
12. To determine the velocity of ultrasonic waves in the liquid using ultrasonic Interferometer

<b>CSE181</b>	<b>PROGRAMMING LANGUAGES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>LABORATORY</b> (Common to all Branches)	<b>0</b>	<b>0</b>	<b>3</b>	<b>1</b>

### **1. WORD PROCESSING, SPREADSHEET, POWERPOINT**

1. To create an advertisement in Word.
2. To illustrate the concept of mail merging in word.
3. To create a spread sheet to analyze the marks of the students of a class and also to create appropriate charts.
4. To create the presentation for the department using Power Point.

### **2. C PROGRAMMING**

5. To write a simple menu driven calculator program using switch statement
6. To write a program to print Pascal’s triangle.

7. To write a program for electricity bill preparation.
8. To write a program to print the sine and cosine series.
9. To print Fibonacci series up to N numbers.

### **3. ARRAYS AND FUNCTIONS**

10. To write a program to perform Matrix multiplication.
11. To write a program to sort a given set of numbers.
12. To write a program to perform string manipulation manipulations function like string concatenations, comparison, find the length and string copy without using library functions.
13. To write a program to arrange names in alphabetical order.
14. To write a C program to check whether a number is palindrome or not using functions.
15. To write a program to calculate the factorial of the given number using functions.

### **4. POINTERS, STRUCTURES AND FILES**

16. To print the mark sheet of n students using structures.
17. To write a program using pointers to access the elements of an array and count the number of occurrences of the given number in the array.
18. To write a program for find the average of numbers using files.
19. To write a program to merge the given two files arguments using command line arguments.

### **5. UNIX PROGRAMMING**

20. Study of Basic UNIX Commands.
21. Implement ls Command.
22. Write a shell script to determine the properties of a given file.
23. Implement grep function.
24. Write a shell script to find the factorial of given number.
25. Write a shell script to evaluate the given expression using switch-case.

**SEMESTER – III**

<b>MAT201</b>	<b>MATHEMATICS III</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	(Common to Bio-Technology, Chemical Engg., Civil Engg., CSE, EEE, EIE and Mechanical Engg.)	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**LAPLACE TRANSFORM**

Definition of Laplace Transform - Linearity property - condition for existence of Laplace Transform - First and Second Shifting properties - Laplace Transform of derivatives and integrals - Unit step functions - Dirac delta-function - Differentiation and Integration of transforms - Convolution Theorem - Inversion - Periodic functions - Evaluation of integrals by Laplace Transform - Solution of boundary value problems.

**PARTIAL DIFFERENTIAL EQUATIONS**

Formation of PDE – Solution of std types of first order PDE – Lagrange’s linear equation – Linear PDE of second and higher order with constant coefficients.

**FOURIER SERIES**

Dirichlet’s conditions – General Fourier series – odd and even functions – Half range sine and cosine series – complex form of Fourier series – Parseval’s identity – Harmonic analysis

**Z – TRANSFORM**

Z-transform – elementary properties – Inverse Z-transform – convolution theorem – formation of difference equation – solution of difference equation using Z-transform.

**FOURIER TRANSFORM**

Fourier Integral formula - Fourier Transform - Fourier sine and cosine transforms - Linearity, Scaling, frequency shifting and time

shifting properties - Self reciprocity of Fourier Transform -  
Convolution theorem -Application to boundary value problems.

### TEXT BOOKS

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore , 8<sup>th</sup> Edn., 2001.
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume II, Scitech Publications (India) Pvt. Ltd., Chennai, 1<sup>st</sup> Edn., Reprint 2000.

### REFERENCES

1. Grewal , B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37<sup>th</sup> Edn., 5<sup>th</sup> Reprint 2004.
2. Venkataraman, M. K., Engineering Mathematics –III A, The National Publishing Company, Chennai, 11<sup>th</sup> Edn., Reprint 2002.
3. Venkataraman, M. K., Engineering Mathematics - III B, The National Publishing Company, Chennai, 13<sup>th</sup> Edn., Reprint 1999.

<b>MEC201</b>	<b>STRENGTH OF MATERIALS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

### STRESS, STRAIN AND DEFORMATION IN SOLIDS

Tension, compression and shear stresses – Hook’s law – stress-ultimate stress and working stress – elastic constants and relationships between them – composite bars – temperature stresses – strain energy due to axial load – stress due to suddenly applied load and impact load.

### TWO DIMENSIONAL STATE OF STRESS

Two dimensional state of stress at a point – normal and shear stresses on any plane , principal planes and principal stresses – graphical method – two dimensional state of strains at a point, principal strains

and their directions – stresses and deformations in thin cylinders and spherical shells due to internal pressure.

### **BEAMS**

Types of beams and supports – shear force and bending moment at any cross section, sketching of shear force and bending moment diagrams for cantilever, simply supported and over hanging beams for any type of loading – relationship between rates of loading - shear force and bending moment.

### **STRESSES IN BEAMS**

Theory of simple bending – analysis for bending stresses – load carrying capacity of beams – proportioning sections – flitched beams – strain energy due to bending moment – shear stress distribution – strain energy due to transverse shear force.

### **STRESSES DUE TO TORSION**

Elastic theory of torsion – stresses and deformation in solid circular and hollow shafts – stepped shafts – composite shaft – stress due to combined bending and torsion– strain energy due to torsion- deformations and stresses in helical springs – design of buffer springs -leaf springs

### **TEXT BOOK**

1. Popov, E.P., Engineering Mechanics of solids, Prentice Hall of India, New Delhi, 1996.

### **REFERENCES**

1. Punmia, B. C., Strength of Materials, Laxmi Publications, 1992.
2. Kazimi, S. M. A., Solid Mechanics, Tata McGraw Hill Book Co Ltd., 1998.
3. Rajput, Strength of Materials, S. Chand Publications, 1999.
4. Bansal, R. K., Strength of Materials, Laxmi Publications, 2003.

5. Gere, Mechanics of Materials, Thomson Publications, 2006.
6. Junarkar, Mechanics of Structure, Vol.-I, Charator Publications, 2005.

<b>EEE259</b>	<b>ELECTRICAL DRIVES AND CONTROLS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and load variation factors

### **DRIVE MOTOR CHARACTERISTICS**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

### **STARTING METHODS**

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

### **CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

### **CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

**TEXT BOOK**

1. Vedam Subrahmaniam, Electric Drives (concepts and applications), Tata McGraw-Hill, 2001.

**REFERENCES**

1. Nagrath, I.J., and Kothari, D.P., "Electrical Machines, Tata McGraw-Hill, 1998.
2. Pillai, S.K., A first course on Electric drives, Wiley Eastern Limited, 1998.
3. Singh, M.D., Khanchandani, K.B., Power Electronics, Tata McGraw-Hill, 1998.
4. Partab, H., Art and Science and Utilisation of electrical energy, Dhanpat Rai and Sons, 1994.

<b>MEC202</b>	<b>THERMODYNAMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**BASIC CONCEPT, FIRST LAW AND SECOND LAW**

Classical approach - thermodynamic systems, first law of thermodynamics for open and closed systems, first law applied to a control volume, steady flow energy equation - second law of thermodynamics, Carnot cycle, Carnot theorem, Clausius inequality, concept of entropy - principle of increase of entropy.

**THERMODYNAMIC RELATIONS**

Basic thermodynamic relations - Helmholtz's and Gibb's functions, some mathematical theorems, Maxwell's relations - applications of Maxwell's relations to ideal and real gases, Joule -Thomson effect and co-efficient, Clausius- Claperyon equation.

**PROPERTIES OF PURE SUBSTANCE**

Properties of pure substances – thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T,

T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam.

### **IDEAL AND REAL GAS**

Mixture of gases -Dalton's law of partial pressures and Amagat's law of partial volumes for ideal gas mixtures - volumetric and gravimetric analysis -Principle of corresponding states, evaluation of ideal gas mixture properties and applications to various processes, properties of real gas mixtures, use of compressibility charts for real gas mixtures.

### **PSYCHROMETRY**

Psychrometry - atmospheric air and psychrometric properties - dry bulb temperature, wet bulb temperature, dew point temperature, partial pressures, specific and relative humidity, enthalpy and adiabatic saturation temperature - construction and use of psychrometric chart - analysis of various processes- heating, cooling, dehumidifying and humidifying- adiabatic mixing of stream, summer and winter air-conditioning - cooling load calculations.

### **TEXT BOOK**

1. Nag.P.K., Basic Thermodynamics, Tata McGraw-Hill, New Delhi, 2002.

### **REFERENCES**

1. Cengel, Thermodynamics- An Engineering Approach, Tata Mc Graw Hill, New Delhi, Third Edition, 2003.
2. Holman, J.P., Thermodynamics, McGraw-Hill, 3<sup>rd</sup> Edition, 1995.
3. Vanwylen and Sontag, Classical Thermodynamics, John Wiley, 2000.
4. Arora, C.P., Thermodynamics, Tata McGraw-Hill, New Delhi, 2003.
5. Merala C Pother, Craig W Somerton, Thermodynamics for Engineers, Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.

6. Sri Vastava, R.C., Saha, S.K., Jan, A.K., Thermodynamics, Prentice Hall of India, New Delhi, 2004.

<b>MEC203</b>	<b>FLUID MECHANICS AND MACHINERY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

### **BASIC CONCEPTS AND PROPERTIES**

Fluid – definition, distinction between solid and fluid - units and dimensions, properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - fluid statics - concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

### **FLUID KINEMATICS AND FLUID DYNAMICS**

Fluid kinematics - flow visualization, lines of flow, types of flow, velocity field and acceleration, continuity equation (one and three dimensional differential forms) - equation of streamline, stream function, velocity potential function, circulation, flow net, fluid dynamics - equations of motion, Euler's equation along a streamline, Bernoulli's equation, applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's  $\pi$  theorem-applications - similarity laws and models.

### **INCOMPRESSIBLE FLUID FLOW**

Viscous flow - Navier-Stoke's equation (Statement only) - shear stress, pressure gradient relationship - laminar flow between parallel plates, Laminar flow through circular tubes (Hagen Poiseulle's) - Hydraulic and energy gradient - flow through pipes - Darcy - Weisback's equation - pipe roughness -friction factor- Mody's diagram-minor losses - flow through pipes in series and in parallel - power transmission - boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

## **HYDRAULIC TURBINES**

Fluid machines-definition and classification - exchange of energy - Euler's equation for turbo machines - construction of velocity vector diagrams - head and specific work - components of energy transfer - degree of reaction. Hydro turbines- definition and classifications - Pelton wheel, Francis turbine, propeller turbine , Kaplan turbine - working principles - velocity triangles, work done, specific speed, efficiencies, performance curve for turbines.

## **HYDRAULIC PUMPS**

Pumps- definition and classifications - Centrifugal pump - classifications, working principle, velocity triangles, specific speed, efficiency and performance curves - reciprocating pump-classification, working principle, indicator diagram, work saved by air vessels and performance curves - cavitations in pumps - rotary pumps - working principles of gear and vane pumps, performance of positive displacement pump.

## **TEXT BOOK**

1. Streeter, V.L., and Wylie, E.B., Fluid Mechanics, McGraw-Hill, 1983.

## **REFERENCES**

1. Kumar, K.L., Engineering Fluid Mechanics, Eurasia Publishing House (P) Ltd, New Delhi, 7<sup>th</sup> edition, 2000.
2. Vasandani, V.P., Hydraulic Machines - Theory and Design, Khanna Publishers, 1992.
3. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi publications (P) Ltd, New Delhi, 5<sup>th</sup> edition, 1995.
4. White, F.M., Fluid Mechanics, Tata McGraw-Hill, c, 5<sup>th</sup> Edition, 2003.
5. Ramamirtham, S., Fluid Mechanics and Hydraulics and Fluid Machines, Dhanpat Rai and Sons, Delhi, 1998.

6. Som, S.K., and Biswas, G., Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill, New Delhi, 2<sup>nd</sup> Edition, 2004.

<b>MEC281</b>	<b>STRENGTH OF MATERIALS /</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>FLUID MECHANICS LABORATORY</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

### **Strength of Materials Laboratory**

1. Tension test on mild steel rod
2. Double shear test on Mild steel and Aluminum rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinell 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 Hardened samples and Hardened and tempered samples.

### **Fluid Mechanics Laboratory**

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturimeter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of Centrifugal pump / Submergible pump.

6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

<b>EEE299</b>	<b>ELECTRICAL SCIENCES LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. Load test on DC Shunt and DC Series motor
2. C.C and Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. S.C Test on a single phase transformer
6. Regulation of an alternator by EMF and MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Load test on single phase Induction Motor.
11. Study of DC and AC Starters

**SEMESTER IV**

<b>MAT211</b>	<b>NUMERICAL METHODS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	(Common to Civil, EEE, EIE and Mechanical Engg.)	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS**

Review of open end methods, bracketed end methods - the intermediate theorem (excluding proof) - iterative method - False position method - Newton – Raphson method for single variable and for simultaneous equations with two variables - Solutions of a linear system by Gaussian, Gauss-Jordan, Jacobi and Gauss – Seidel methods - Eigen value of a matrix by Power method.

**INTERPOLATION**

Newton forward and backward difference formulae - Newton's divided difference formulae - Lagrange's polynomials - Stirling's Central difference formulae.

**NUMERICAL DIFFERENTIATION AND INTEGRATION**

Numerical differentiation with interpolation polynomials - Numerical integration by Trapezoidal and Simpson's (both 1/3rd and 3/8th) rules - Two and Three point Gaussian quadrature formulae - Double integrals using Trapezoidal and Simpson's rule.

**INITIAL VALUE PROBLEMS**

Single step Methods – Taylor Series, Euler and Modified Euler, Runge – Kutta method of order four for first and second order differential equations - Multistep Methods-Milne's predictor and corrector method.

**BOUNDARY VALUE PROBLEMS**

Finite difference solution for the second order ordinary differential equations - Finite difference solution for one dimensional heat equation (both implicit and explicit) , One-dimensional wave equation and two-dimensional Laplace and Poisson equations.

Laboratory assignments for Numerical methods using **MATLAB / C / C++**.

**TEXT BOOKS**

1. Kreyszig, E, Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore , 8<sup>th</sup> Edn., 2001.
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Numerical Methods, Scitech Publications (India) Pvt. Ltd., Chennai, 2<sup>nd</sup> Edn., Reprint 2006, 2001.

**REFERENCES**

1. Jain, M.K., Iyengar, S.R.K., Jain, R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd., New Delhi, 4<sup>th</sup> Edn., 2003.
2. Francis Scheid, Theory and Problems of Numerical Analysis, Schaum's Outline Series, Singapore, 2<sup>nd</sup> Edn., 1989.

<b>MEC204</b>	<b>KINEMATICS OF MACHINERY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**BASICS OF MECHANISMS**

Kinematic inversions of four bar chain and slider crank - description of common mechanisms - single, double and offset slider crank mechanisms - quick return mechanisms - indexing mechanisms - rocking mechanisms - straight line generators - design of crank rocker mechanisms.

**KINEMATICS**

Displacement, velocity and acceleration analysis in simple mechanisms - instantaneous centre of velocity - complex algebra methods - vector approach- coincident points - Coriolis acceleration.

**CAM PROFILES**

Layout of plate cam profiles - derivatives of follower motion - high speed cams - circular arc and tangent cams - standard cam motion - pressure angle and undercutting.

**GEARS**

Spur gear - terminology and definitions – interchangeable gears - gear tooth action - interference and undercutting - non standard gear teeth - helical, bevel, worm, rack and pinion gears - gear trains - parallel axis gear trains – epicyclic gear trains - differentials - automotive transmission gear trains.

**FRICTION**

Sliding and rolling friction – friction in screws with square thread, v-threads - friction drives - friction clutches - belt and rope drives - friction aspects in brakes - friction in the propulsion and braking of vehicles - tractive resistance.

**TEXT BOOK**

1. Rattan, S.S., Theory of Machines, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998.

**REFERENCES**

1. Shigley, J.E., and Uicker, J.J., Theory of Machines and Mechanisms, McGraw-Hill, New Delhi, 1995.
2. Thomas Bevan, Theory of Machines, CBS Publishers and Distributors, 3<sup>rd</sup> Edition, London, 1984.
3. Ghosh, A., and Mallick, A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd., New Delhi, 1988.
4. Rao, J.S., and Dukkupati, R.V., Mechanism and Machine Theory, Wiley-Eastern Ltd., New Delhi, 1992.

<b>MEC205</b>	<b>FLUID POWER TRANSMISSION SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

### **INTRODUCTION**

Introduction to fluid power-advantages of fluid power - applications of fluid power system - types of fluid power systems - properties of hydraulic fluids - Pascal's law - energy, work, and power - transmission of forces through liquids - density and specific gravity

### **HYDRAULIC SYSTEM AND COMPONENTS**

Sources of hydraulic power- pumping theory – pump classification – gear pump, vane pump, piston pump - construction and working of pumps – pump performance – variable displacement pumps - fluid power actuators - linear actuators, rotary actuators – types of hydraulic cylinders – single acting, double acting cylinder – fluid motors - gear, vane and piston motors.

### **DESIGN OF HYDRAULIC CIRCUITS**

Construction of control components - direction control valve - shuttle valve – pressure control valve – pressure reducing valve, sequence valve - flow control valve – poppet valve, sliding spool valve, check valves, fixed and adjustable valves - electrical control solenoid valves - relays, ladder diagram - accumulators - types of accumulators, accumulators circuits, sizing of accumulators-intensifier – applications of intensifier, intensifier circuits - design of ram type hydraulic press - hydraulic tilting for electric arc furnace.

### **PNEUMATIC SYSTEMS AND COMPONENTS**

Pneumatic components - properties of air – compressors – filter, regulator, and lubricator unit – air control valves - quick exhaust valves- pneumatic actuators - fluid power circuit design - speed control circuits, synchronizing circuit, penumo hydraulic circuit - sequential circuit design for simple applications using cascade method.

**DESIGN OF PNEUMATIC CIRCUITS**

Servo systems – hydro mechanical servo systems - electro hydraulic servo systems and proportional valves - fluidics – introduction to fluidic devices, simple circuits - introduction to electro pneumatic logic circuits - ladder diagrams, PLC applications in fluid power control - fluid power circuits - failure and troubleshooting.

**TEXT BOOK**

1. Anthony Esposito, Fluid Power with Applications, Pearson Education, 5<sup>th</sup> Edition, New Delhi, 2000.

**REFERENCES**

1. Majumdar, S.R., Pneumatic systems – Principles and maintenance, Tata McGraw Hill, New Delhi, 2001.
2. Michael J Pinches John G Ashby, J. G., Power Hydraulics, Prentice Hall, 1989.
3. Majumdar, S.R., Oil Hydraulics, Tata McGraw-Hill, New Delhi, 2000.

<b>MEC206</b>	<b>MATERIAL SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**BASICS**

Types of bonds in solids, crystal structure of metals, defects in metallic structure, plastic deformation of metals, binary alloys - mechanism of plastic deformation, slip and twinning.

**CONSTITUTION OF ALLOYS AND PHASE DIAGRAM**

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.

**HEAT TREATMENT**

Annealing - full annealing, stress relief, recrystallisation and spheroidizing – normalizing - hardening and tempering of steel - isothermal transformation diagrams – cooling curves superimposed on I.T. diagram - hardenability, jominy end quench test – austempering, martempering – case hardening - carburising, nitriding, cyaniding, carbonitriding – flame and induction hardening.

**ALLOYS AND POLYMERS**

Copper and copper alloys – brass, bronze and cupronickel – aluminum and Al-Cu – precipitation strengthening treatment – bearing alloys - polymers, composites, ceramics, glasses- their fabrication, processing methods, engineering properties and applications- fiber and particulate reinforced composites.

**TESTING OF MATERIALS AND FRACTURE**

Mechanical properties of materials, testing of materials - surface modifications of metals for specific engineering application, tribological properties of metals and non-metals - types of fracture – testing of materials under tension, compression and shear loads – hardness tests (Brinell, Vickers and Rockwell), impact test- Izod and Charpy - fatigue and creep test.

**TEXT BOOK**

1. Kenneth G.Budinski and Micheal K.Budinski, Engineering Materials, Prentice-Hall of India Private Limited, 4<sup>th</sup> Indian Reprint 2002.

**REFERENCES**

1. William D Callister Jr., Material Science and Engineering, John Wiley and Sons, 6<sup>th</sup> Edition, Singapore, 2005.
2. Raghavan, V., Material Science and Engineering, Prentice Hall of India Pvt., Ltd., New Delhi, 1999.
3. Sydney H.Avner, Introduction to Physical Metallurgy, McGraw Hill Book Company, New York, 1994.

<b>MEC207</b>	<b>MANUFACTURING TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

### **METAL CASTING PROCESS**

Moulding sands - types and properties - patterns – types, selection of patterns, pattern allowances - classifications of castings according to mould materials and moulding methods - special casting techniques - fettling and finishing of castings - defects in castings.

### **FABRICATION PROCESS**

Classification of welding process - principle of gas welding - arc welding - resistance welding - solid state welding - thermo-chemical welding - radiant energy welding - brazing and soldering - thermal cutting of metals or alloys.

### **BULK DEFORMATION PROCESSES**

Forging - classification of forging processes, forging defects and inspection - rolling - classification of rolling processes, rolling mill, rolling of bars and shapes - extrusion - classification of extrusion processes, extrusion equipments.

### **SHEET METAL FORMING PROCESS**

High velocity forming - explosive forming, electro hydraulic forming - magnetic pulse forming - pneumatic - mechanical high velocity forming.

### **FORMING OF PLASTICS**

Plastics - types of plastics - plastic moulding processes, defects in plastics.

### **TEXT BOOK**

1. Jain, R.K., Production Technology, Khanna Publishers, 2002.

**REFERENCES**

1. Hajra Choudhry, Elements of Workshop Technology-Vol I, Dhanpat Rai and Sons, 1992.
2. HMT Production Technology, Tata Mc Graw-Hills Publishing Co. Ltd, 1994.
3. Chapman, W.A.J., Workshop Technology-Vol - II, Oxford and IBH Publishing.

<b>MEC208</b>	<b>GAS DYNAMICS AND PROPULSION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**INTRODUCTION**

Compressible flows - propagation of infinite pulse in a fluid, velocity of sound, disturbance propagation in subsonic and supersonic flows, mach cone, stagnation property.

**ISENTROPIC FLOW**

Isentropic flow in a variable area duct; Critical properties, choking in an isentropic flow, shapes of supersonic/subsonic nozzles and diffusers, variation of pressure and mach number with area ratio, C-D nozzle, Effect of back pressure.

**FANNO AND RAYLEIGH FLOW**

Adiabatic flow with friction (Fanno flow) - flow in constant area duct without friction and with heat transfer (Rayleigh flow).

**NORMAL SHOCKS**

Normal shocks - normal shock relations, numerical problems, introduction to oblique shocks and bow shocks.

**PROPULSION**

Propulsion – jet propulsion – types of jet engines, performance analysis - rocket propulsion – types of rocket engines, performance analysis.

**TEXT BOOK**

1. Yahya, S.M., Fundamental of compressible flow, New Age International (p) Ltd., New Delhi, 1996.

**REFERENCES**

1. Patrich H Oosthusien, William E Carscallen, Compressible fluid flow, McGraw-Hill, 1997
2. Cohen, H., Rogers, R.E.C., and Sravanamutoo, Gas turbine theory, Addison Wesley Ltd., 1987.
3. Ganesan, V., Gas Turbines, Tata McGraw-Hill, New Delhi, 1999.
4. Rathakrishnan, E., Gas Dynamics, Prentice Hall of India, New Delhi, 2001.

MEC282	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
		0	0	3	2

**MACHINING PRACTICE**

**Lathe:** Plain turning, step turning, taper turning, parting off, knurling, thread cutting, eccentric turning, Boring, Counter boring and counter sinking, cutting force measurement, special operations in capstan and turret lathe.

**Drilling:** Through hole, blind hole, reaming, tapping, cutting force measurement

**FOUNDRY PRACTICE**

Study of moulding tools, equipments, furnaces, preparation of moulding sand, exercise: flange, gland, bush, straight pipe, bend pipe, T - pipe and grooved pulley.

**SMITHY PRACTICE**

Study of forging tool - making a square out of round rod, making an L-bend, making a hook, square headed bolt, hexagonal headed bolt and V-clamp.

### **WELDING PRACTICE**

Study of welding tools, equipments, exercise in Arc welding and Gas welding: Lap joint, butt joint, V-joint and Tee joint

### **PLUMBING PRACTICE**

Study of plumbing tools – laying pipe connection to the suction side of a pump inlet and the delivery side of a pump outlet – practice in mixed pipe connections: metal, plastic and flexible pipes used in household appliances.

<b>MEC283</b>	<b>THERMAL LABORATORY – I</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

### **IC ENGINES LABORATORY**

1. Port and valve timing diagram
2. Performance test on four stroke diesel engine
3. Heat balance test on four stroke diesel engine
4. Performance test on four stroke petrol engine
5. Heat balance test on four stroke petrol engine
6. Retardation test to find frictional power of diesel engine
7. Performance test on blowers
8. Performance test on single / two stage air compressor

### **STEAM LABORATORY**

1. Performance and energy balance test on steam generator
2. Performance and energy balance test on steam turbine

### **FUELS LABORATORY**

1. Determination of flash point and fire point using open / closed cup apparatus
2. Determination of viscosity using Saybolt / Redwood viscometer.

**SEMESTER – V**

<b>MEC301</b>	<b>HEAT AND MASS TRANSFER</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**CONDUCTION**

Conduction – Fourier law of heat conduction, heat generation, pin fins, transient conduction, lumped capacitance model.

**CONVECTION**

Convection – introduction, governing equations, boundary layer concept, free convection - vertical plate, horizontal cylinder, horizontal plate - forced convection – laminar flow, turbulent flow, Reynolds analogy.

**CONVECTIVE PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**

Condensation and boiling – boiling modes, correlations, forced convection boiling, laminar film condensation on a vertical plate, turbulent film condensation - heat exchangers – LMTD and NTU analysis, fouling factor, effectiveness.

**RADIATION**

Radiation – laws of radiation, black body radiation, shape factor, radiation exchange between gray surfaces, radiosity, irradiation.

**MASS TRANSFER**

Mass transfer – Ficks law of diffusion, forced convective mass transfer, heat and mass transfer analogies.

**TEXT BOOK**

1. Sachdeva, R.C., Fundamentals of Engineering Heat and Mass Transfer, New Age International, 1995.

**REFERENCES**

1. Yadav, R., Heat and Mass Transfer, Central Publishing House, 1995.
2. Ozisik, M.N., Heat Transfer, McGraw-Hill Book Co., 1994.
3. Nag, P.K., Heat Transfer, Tata McGraw-Hill, New Delhi, 2002.
4. Holman, J.P., Heat and Mass Transfer, Tata McGraw-Hill, 2000.
5. Kothandaraman, C.P., Fundamentals of Heat and Mass Transfer, New Age International, New Delhi, 1998.
6. Frank, P., Incropera and David, P. D., Fundamentals of Heat and Mass Transfer, John Wiley and Sons, 1998.

<b>MEC302</b>	<b>MACHINING AND METROLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**MACHINE TOOLS**

Lathe - Capstan and Turret lathe - Drilling and Boring machine-classification, principles of working - work holding and tool holding devices.

**SPECIAL MACHINES**

Shaper, Planer and Slotting machines - classification, principles of working, work holding and tool holding devices - milling, hobbing, broaching and grinding machines - classification, principles of working, work holding and tool holding devices.

**NC AND CNC MACHINE TOOLS**

NC and CNC machine tools - manual part programming, computer aided part programming, APT- post processors, APT programming.

**QUALITY CONTROL AND INSPECTION**

Quality control, limits, fits and tolerances, statistical quality control, control charts, inspection system.

**MEASUREMENTS**

Errors in measurements - calibration - length measurement - angle measurement - surface finish - terminology - optical measurement.

**TEXT BOOK**

1. Khanna, O.P., and Lal, M., A Text Book of Production Technology - Vol. II, Dhanpat Rai and Sons, 1994.

**REFERENCES**

1. Yoram Koren, Computer Control of Manufacturing Systems, McGraw Hill, 1986.
2. Choudhry, S.K.H., Elements of Work Shop Technology-Vol II, MPP, 1994.
3. HMT, Production Technology, Tata McGraw Hill, New Delhi, 1994.
4. Gupta, I., Engineering Metrology, Dhanpat Rai and Sons, 2004.
5. Jain, R.K., Engineering Metrology, Khanna Publications, 2006.

<b>MEC303</b>	<b>DESIGN OF MACHINE ELEMENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**SIMPLE STRESSES**

Types of simple stresses - static and varying loading- theories of failures - allowable stress - factor of safety - stress concentration factor- stress intensity factor - fluctuating stresses- design for combined fatigue loading.

**DESIGN OF SCREWED FASTENERS AND JOINTS**

Screwed fasteners - design of welded joints, eccentric loading of welded and bolted joints - design of pin joints - riveted joints

**DESIGN OF SHAFTS, COUPLINGS AND BEARINGS**

Design principles of shafts - static, fatigue loading - design of couplings – design and selection of journal and antifriction bearings

**DESIGN OF ENGINE PARTS**

Design of basic elements in internal combustion engine - connecting rods, flywheels, crank shafts.

**DESIGN OF SPRINGS**

Design of helical springs - compression and tension – Torsion springs - Leaf springs –Belleville springs

**TEXT BOOK**

1. Shigley, J.E., and Mischke, C.R., Mechanical Engineering Design, McGraw-Hill International, Fifth Edition, 1989.

**REFERENCES**

1. Deutschman, D., Michels, W.J., and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
2. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
3. Spottes, M.F., Design of Machine Elements, Prentice-Hall India, 1994.
4. R.L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998.

<b>MEC304</b>	<b>DYNAMICS OF MACHINERY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**BASICS**

Applied and constraint forces - Static force analysis in simple mechanisms - Dynamic force analysis in reciprocating engines – gas forces - equivalent masses - bearing loads - fly wheels - engine shaking forces - cam dynamics

**BALANCING OF MASSES**

Static and dynamic balancing - balancing of rotating masses - balancing a single cylinder engine, balancing of multi cylinder engines - partial balancing in locomotive engines - balancing linkages - balancing machines

**VIBRATION ANALYSIS**

Free vibration - equations of motion , natural frequency - types of damping - damped vibration - critical speeds of shaft - Torsional systems - force transmissibility and amplitude transmissibility - vibration isolation.

**GOVERNORS**

Governors - types - centrifugal governors - gravity controlled, spring controlled centrifugal governors - characteristics - effect of friction - controlling force, other governor mechanisms.

**GYROSCOPE**

Gyroscopes - gyroscopic forces and torques, gyroscopic stabilization – effects on ship, aeroplane, automobiles – automatic control

**TEXT BOOK**

1. Rattan, S.S., Theory of Machines, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1994.

**REFERENCES**

1. Thomas Bevan, Theory of Machines, CBS Publishers and Distributors, 1984.
2. Ghosh, A., and Mallick, A.K., Theory of Mechanisms and Machines, Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
3. Shigley, J.E., and Uicker, J.J., Theory of Machines and Mechanisms, McGraw-Hill, Inc., 1995.
4. Rao, J.S., and Duggipati, R.V., Mechanism and Machine Theory, Wiley-Eastern Limited, New Delhi, 1992.

<b>MEC381</b>	<b>MACHINE DRAWING PRACTICE LABORATORY (MANUAL + COMPUTER AIDED)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

### **CONVENTIONAL REPRESENTATION OF MACHINE COMPONENTS AS PER IS CODE**

Screw threads, tapped holes, holes on circular pitch, bearing, knurling, splined shafts, springs, gears, tapers, chamfers, countersunk and counter bores, keys, welded joints, structural sections and their designations.

### **SCREWED FASTENERS**

Thread forms and their proportions - thread designations, single and multi start threads, right and left hand threads - types of screws, bolts and nuts,

### **LIMITS, FITS AND TOLERANCES**

ISO system of fits and tolerance - tolerance chart - hole basis and shaft basis system - types of fits with symbols and applications - conventional representation on parts drawings.

### **SURFACE ROUGHNESS**

Surface texture, machining symbols, roughness values (Ra) and roughness grade numbers, conventional representation on part drawings.

### **MANUAL DRAWING**

Assembly drawings of mechanical components like valves, boiler mounting, coupling, vices, pumps, engine sub assemblies, jigs and fixtures, lathe tail stock, tool posts, gear boxes, pulley blocks, revolving centre etc.

**COMPUTER AIDED DRAWING**

Assembly drawings of mechanical components by using software packages like Solidworks, PRO-E, IDEAS and AUTOCAD

<b>MEC382</b>	<b>MACHINE TOOL AND METROLOGY LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

**MACHINES LABORATORY**

1. **Shaping:** Rectangular block, V-Groove, Dovetail – Internal and External
2. **Planing:** Rectangular block, V-Groove, Dovetail– Internal and External
3. **Slotting:** Step-cutting, Keyway cutting
4. **Milling:** Plain, Hexagonal, Angular, T - Slot, Gang, Spur gear bevel gear and Cam
5. **Tool and Cutter Grinder:** V-tool and parting tool grinding
6. **Cylindrical and Surface Grinding:** Cylinder grinding, Tapered cylinder grinding, Rectangular surface grinding
7. **Gear Hobbing:** Spur, Worm and Helical gear generation

**METROLOGY LABORATORY**

1. Use of precision measuring instruments like micrometer, Vernier height and depth gauges, surface plate, etc.
2. Checking dimensions of a part using slip gauge
3. Use of sine bar for measuring angles and tapers
4. Calibration of plug and dial gauges, Micrometer

5. Measurement of tooth thickness by gear tooth Vernier
6. Testing squareness of a try square using slip gauges.
7. Checking straightness of a surface plate using auto-collimator
8. Measurement of thread parameters using floating carriage micrometer
9. Gear Inspection using profile projector
10. Use of Electronic and Mechanical comparator
11. Measurement of taper angle using tool makers microscope
12. Study and use of coordinate measuring machine

<b>MEC383</b>	<b>DYNAMICS AND VIBRATION LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

1. Moment of inertia on flywheel and connecting rod
2. Governor-Porter, Proell and Hartnell - determination of speed and sensitivity
3. Whirling speed of shaft – determination of critical speed
4. Transverse vibration – determination of deflection
5. Undamped free vibration spring mass system
6. Forced vibration system – single and multi degree of freedom
7. Vibration analyzer
8. Cam study - jump phenomenon –determination of critical speeds
9. Vibrating Table – determination of transmissibility ratio

10. Compound Pendulum – determination of torsional and natural frequencies – system with lumped moment of inertia.

**SEMESTER VI**

<b>MEC305</b>	<b>AUTOMOBILE ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**ENGINES**

General classification of vehicles, power unit, all components of power unit, steering systems- power steering, wheel and suspension systems.

**TRANSMISSION SYSTEMS**

Axles, differentials, mechanical, hydraulic and pneumatic brakes, power brakes, four wheel drive- clutches, couplings, gear boxes and torque converters.

**ENGINE AUXILIARY SYSTEMS**

Electronic fuel injection systems, CRDi system.

**ELECTRICAL SYSTEMS**

Electrical systems- construction, operation and maintenance of batteries, generators, relays, starter motors, lighting, ignition, electrical accessories- panel board instruments, automobile air conditioning, troubleshooting.

**ALTERNATE ENERGY SOURCES**

Electric and hybrid vehicles, fuel cells.

**TEXT BOOK**

1. Heitner, J., Automotive Mechanics Principle and Practice, Affiliated East-West Press Ltd., 2<sup>nd</sup> ed., 1974.

**REFERENCES**

1. Newton, K., Steeds, W., and Garrett, T.K., The Motor Vehicle, Butterworths, 1989.
2. Kirpal Singh, Automobile Engineering, Vol. I and II, Standards Publishers, New Delhi, 2000.

<b>MEC306</b>	<b>THERMAL ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**GAS POWER CYCLES**

Air standard cycles-Carnot, Otto, Diesel, dual and Stirling cycles, p-v and T-s diagrams, description, efficiencies and mean effective pressures, comparison of Otto and Diesel cycles, gas turbine (Brayton) cycle- description and analysis, regenerative gas turbine cycle, inter cooling and reheating in gas turbine cycles - Carnot vapour power cycle, drawbacks as a reference cycle, simple Rankine cycle- description, diagram, analysis for performance, comparison of Carnot and Rankine cycles, effect of pressure and temperature on Rankine cycle performance, actual vapour power cycles - ideal and practical regenerative Rankine cycles, open and closed feedwater heaters - reheat Rankine cycle.

**REFRIGERATION**

Vapour compression refrigeration system- description, analysis, refrigerating effect - capacity, power required, unit of refrigeration, COP, refrigerants and their desirable properties - air cycle refrigeration, reversed Carnot cycle, reversed Brayton cycle, vapour absorption refrigeration system, steam jet refrigeration.

**AIR COMPRESSOR**

Operation of a single stage reciprocating compressor, work input through p-v diagram and steady state steady flow analysis, effect of clearance and volumetric efficiency, adiabatic, isothermal and mechanical efficiencies, multistage compressor, saving in work,

optimum intermediate pressure, inter-cooling, minimum work for compression.

### **STEAM NOZZLE**

Flow of steam through nozzles, shape of nozzles, effect of friction, critical pressure ratio, supersaturated flow.

### **TURBINES**

Steam turbine- impulse and reaction principles, compounding, velocity diagrams for simple and multistage turbines, speed regulations and governors.

### **TEXT BOOK**

1. Rajput, R.K, Thermal Engineering, S.Chand publishers, 2000.

### **REFERENCES**

1. Rudramoorthy, R., Thermal Engineering, Tata McGraw-Hill, New Delhi, 2003.
2. Kothandaraman, C.P., Domkundwar, S., and Domkundwar, A.V., A course in Thermal Engineering, Dhanpat Rai and Sons, Fifth edition, 2002.
3. Holman, J.P., Thermodynamics, McGraw-Hill, 1985.
4. Rogers, Engineering Thermodynamics, ELBS, 1992.
5. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw-Hill, New Delhi, 1994.
6. Sarkar, B.K., Thermal Engineering, Tata McGraw-Hill, New Delhi, 1998.

<b>MEC307</b>	<b>DESIGN OF TRANSMISSION SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

### **DESIGN OF FLEXIBLE ELEMENTS**

V belts and pulleys - flat belts and pulleys - wire ropes and pulleys - link chains and pulleys – transmission chains and sprockets - silent chains - ribbed V belts.

### **SPUR GEAR**

Gear terminology – module – force analysis – Lewis and Buckingham design – limitations – dynamic effects.

### **BEVEL, WORM AND HELICAL GEARS**

Parallel helical gears - kinematics - force analysis in crossed helical gears - worm gearing - force analysis in straight bevel gears - kinematics bevel gear - force analysis in gear blank

### **DESIGN OF GEAR BOX**

Gear box-geometric progression, standard step ratio, Ray diagram, kinematics layout -design of sliding mesh gear box - constant mesh gear box.

### **DESIGN OF CLUTCHES AND BRAKES**

Clutches –internal expanding rim clutches- external contracting rim clutches - frictional contact axial clutches, cone clutches – brake-energy considerations - temperature rise - friction materials.

### **TEXT BOOK**

1. Bhandari, V.B., Design of Machine Elements, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1994.

### **REFERENCES**

1. Maitra, G.M., Prasad, L.V., Hand book of Mechanical Design, II Edition, Tata McGraw-Hill, 1985.

2. Shigley, J.E., and Mischke, C.R., Mechanical Engineering Design, McGraw-Hill International Editions, 1989.
3. Prabhu, T.J., Design of Transmission Elements, Mani Offset, Chennai, 2000,
4. Norton, R.L., Design of Machinery, McGraw-Hill Book Co Ltd, 2004.
5. Hamrock, B.J., Jacobson, B., Schmid, S.R., Fundamentals of Machine Elements, McGraw-Hill Book Co., 1999.
6. Khurmi, R.S. Machine design, S. Chand and Co., New Delhi, 2006

<b>MEC308</b>	<b>MECHATRONICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

### **INTRODUCTION TO MECHATRONICS**

Introduction to mechatronics systems - measurement systems-control systems.

### **SENSORS AND TRANSDUCERS**

Introduction-performance terminology-displacement, position and proximity-velocity and motion-fluid pressure-temperature sensors-light sensors-selection of sensors-signal processing.

### **8085 MICROPROCESSOR**

Introduction – architecture - pin configuration - instruction set - programming of microprocessors using 8085instructions-interfacing input and output devices-interfacing D/A converters and A/D converters-applications-temperature control-stepper motor control-traffic light controller.

### **PROGRAMMING LOGIC CONTROLLERS**

Introduction-basic structure-input / output processing-programming - mnemonics-timers, internal relays and counters-data handling-analog input/output-selection of a PLC.

**DESIGN OF MECHATRONIC SYSTEMS**

Stages in designing mechatronic systems - traditional and mechatronic design -possible design solutions-case studies of mechatronic systems - pick and place robot - automatic car park system -engine management system.

**LAB PRACTICE**

1. Addition of Two 8-bit numbers, Sum of 8-bits and 16bits.
2. Decimal addition of two 8-bit numbers Sum: 16 bits
3. Multi-byte Subtraction.
4. Analog to Digital Conversion.
5. Digital to Analog Conversion.
6. Stepper Motor Controller.

**TEXT BOOK**

1. Bolton, W., Mechatronics, Longman, Second Edition, 1999.

**REFERENCES**

1. Michael, B.H., and David, G.A., Introduction to Mechatronics and measurement systems, McGraw Hill International Editions, 1999.
2. Bradley, D.A., Dawson, D., Buru, N.C., and Loader, A.J., Mechatronics, Chapman and Hall, 1993.
3. Ram, K., Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, Fourth Revised Edition, 1999.

<b>MEC384</b>	<b>CAD/CAM LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

**A) Computer Aided Design (CAD)**

1. 3D Part modeling – protrusion, cut, sweep, draft, loft, blend, rib
2. Editing – Move, Pattern, Mirror, Round, Chamfer

3. Assembly – creating assembly from parts – assembly constraints
4. Conversion of 3D solid model to 2D drawing - different views, sections, isometric view and dimensioning
5. Introduction to Surface Modeling
6. Introduction to File Import, Export – DXF, IGES, STL, STEP
7. 3D modeling of machine elements like Flanged coupling, screw jack etc.

**Note:** Any one of the 3D modeling softwares like Pro/E, IDEAS, CATIA, UNIGRAPHICS, AutoCAD to be used.

**B) Computer Aided Manufacturing (CAM)**

1. Manual Part Programming (Using G And M Codes) in CNC Lathe
2. Part programming for Linear and Circular interpolation, Chamfering and Grooving
3. Part programming using standard canned cycles for Turning, Facing, Taper turning and Thread cutting

**C) Manual Part Programming (using G and M codes) in CNC milling**

1. Part programming for Linear and Circular interpolation and Contour motions.
2. Part programming involving canned cycles for Drilling, Peck drilling, and Boring.

**D) Simulation and NC Code Generation**

NC code generation using CAD / CAM softwares - Post processing for standard CNC Controls like FANUC etc.

**REFERENCES**

1. CAD / CAM, Ibrahim Zeid, Tata McGraw Hill, New Delhi, 2002.
2. CAD / CAM , Zimmer and Groover, Prentice Hall India, 2003.

<b>MEC385</b>	<b>THERMAL LABORATORY – II</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

**Heat Transfer Laboratory**

1. Determination of thermal conductivity-insulating powder, composite walls, guarded hot plate method.
2. Determination of heat transfer coefficient - free convection, forced convection, pin- fin.
3. Heat exchanger-double pipe heat exchanger- parallel flow and counter flow.
4. Emissivity measurement, Stefan Boltzman constant.

**Refrigeration and Air conditioning Laboratory**

1. Determination of COP of vapour compression refrigeration system
2. Performance test on air conditioning test rig

**SEMESTER VII**

<b>MEC401</b>	<b>POWER PLANT ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**THERMAL POWER PLANT**

Thermal power plant- boilers and cycles, high pressure boilers - coal and ash handling systems, fluidized bed combustion, condensers, cooling towers, electrostatic precipitator, pulverized fuel firing, burners

**NUCLEAR AND HYDEL POWER PLANT**

Principles of nuclear energy – nuclear power plant, fission and fusion reactions, reactor types – pressurized water reactor, boiling water reactor – hydro electric power plants – runoff storage and pumped storage type, draft tube, lay-out, selection of water turbine.

**GAS TURBINE AND DIESEL POWER PLANT**

Gas turbine power plant- Brayton cycle, types, selection of material, performance of gas turbines - diesel engine power plant – components and lay-out, selection of engine type, environmental hazards.

**OTHER POWER PLANTS**

Unconventional power plants – solar, wind, ocean thermal energy conversion, tidal and geothermal power plants, MHD concepts of energy conversion.

**PLANT ECONOMICS**

Load curve – definition – fixed and operating costs, comparison of economics of different types of power plants.

**TEXT BOOK**

1. Arora, S.C., and Domkundwar, S., A course in Power Plant Engineering, Dhanpatrai, 2001.

**REFERENCES**

1. EI- Wakil, M.M., Power Plant Technology, McGraw-Hill, 1984.
2. Nag, P.K., Power plant Engineering, Tata McGraw-Hill, 1998.
3. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 1998.
4. Ramalingam, K.K., Power Plant Engineering, Scitech Publications, 2002.
5. Rai, G.D., Introduction to Power Plant Technology, Khanna Publishers, 1995.
6. Rajput, R.K., Power Plant Engineering, Laxmi Publications, 1995.
7. Frank D.Graham, Power Plant Engineers Guide, D.B. Taraporevala Sons and Co, New Delhi, 1993.
8. Morse Frederick, T., Power Plant Engineering, Prentice Hall of India, 1998.
9. Culp, A.W., Principles of Energy Conversion, McGraw Hill, 2000.

<b>MEC481</b>	<b>SIMULATION LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

**A. SIMULATION**

1. Simulation of air conditioning system with condenser temperature and evaporator temperatures as input to get COP using C /MAT Laboratory.
2. Simulation of Hydraulic / Pneumatic cylinder using C / MAT Laboratory.
3. Simulation of cam and follower mechanism using C / MAT Laboratory.

**B. ANALYSIS (SIMPLE TREATMENT ONLY)**

1. Stress analysis of a plate with a circular hole.
2. Stress analysis of rectangular L - bracket
3. Stress analysis of an axi-symmetric component
4. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
5. Mode frequency analysis of a 2D component
6. Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
7. Harmonic analysis of a 2D component
8. Thermal stress analysis of a 2D component
9. Conductive heat transfer analysis of a 2D component
10. Convective heat transfer analysis of a 2D component

**MAJOR ELECTIVES**

<b>MEC309</b>	<b>DESIGN OF JIGS, FIXTURES AND PRESS TOOLS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**PURPOSE, TYPES AND FUNCTIONS OF JIGS AND FIXTURES**

Tool design objectives - production devices - inspection devices - materials used in jigs and fixtures – types of jigs - types of fixtures - mechanical actuation - pneumatic and hydraulic actuation-analysis of clamping force-tolerance and error analysis.

**JIGS**

Drill bushes – different types of jigs - plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs - automatic drill jigs - rack and pinion operated - air operated jigs components - design and development of jigs for given components.

**FIXTURES**

General principles of - boring, lathe, milling, broaching, grinding, planning and shaping fixtures - assembly - inspection and welding fixtures - modular fixtures - design and development of fixtures for given component.

**PRESS WORKING**

Press working terminology-presses and press accessories, computation of capacities and tonnage requirements, element of progressive combination and compound dies - die block - die shoe, bolster plate, punch plate, punch holder, guide pins and bushes – strippers knockouts - stops – pilots - selection of standard die sets strip lay out - strip lay out calculations.

**DESIGN AND DEVELOPMENT OF DIES**

Design and development of progressive and compound dies for blanking and piercing operations - bending dies – development of bending dies, forming and drawing dies -development of drawing dies.

**TEXT BOOK**

1. Edward, G., Hoffman, Jigs and Fixture Design, Thomson Delmar Learning, Singapore, 2004.

**REFERENCES**

1. Donaldson, C., Tool Design, Tata McGraw-Hill, New Delhi, 1986.
2. Kempster, Jigs and Fixtures Design, The English Language Book Society, 1978.
3. Joshi, P.H., Jigs and Fixtures, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition, 2004
4. Hiram E Grant, Jigs and Fixture, Tata McGraw-Hill, New Delhi, 2003.
5. Fundamentals of Tool Design, ASTME, CEEE Edition, 1983.
6. Design Data Handbook., PSG College of Technology, Coimbatore, 2006.

<b>MEC310</b>	<b>CNC MACHINING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INTRODUCTION**

Development of CNC technology - principles, features, advantages, economic benefits, applications - CNC, DNC concept - classification of CNC machine- types of control, CNC controllers, characteristics, interpolators.

**CNC MACHINES**

CNC machine building, structural details, configuration and design, guide ways - friction and antifriction and other types of guide ways - elements used to convert the rotary motion to a linear motion- screw and nut - re-circulating ball screw, planetary roller screw, re-circulating roller screw - rack and pinion - torque transmission elements- gears, timing belts, flexible - couplings and bearings.

**DRIVES**

Spindle drives- DC shunt motor, 3 phase AC induction motor - feed drives - stepper motor servo principle, DC and AC servo motors- open loop and closed loop control - axis measuring system - synchro, synchro revolver, gratings, moiré fringe gratings, encoders, inductosyn laser interferometer.

**COORDINATE SYSTEM**

Coordinate system - structure of a part program, G and M codes - manual part programming for Fanuc, Sinumeric control system – CAPP - APT part programming using CAD/CAM, parametric programming.

**CUTTING TOOL MATERIALS**

Cutting tool materials - carbide inserts classification - qualified, semi qualified and preset tooling, tooling system for machining centre and turning centre work holding devices -maintenance of CNC machines.

**TEXT BOOK**

1. HMT, Mechatronics, Tata McGraw –Hill Publishing company Ltd., New Delhi, 1998.

**REFERENCES**

1. James Madison, CNC Machining Hand book, Industrial Press inc., 1996.
2. Steve Krar, Arthur Gill, CNC Technology and Programming, Mc-Graw Hill International Editions, 1990.
3. Berry Leathan- Jones, Introduction to Computer Numerical control, Pitman, London, 1987.
4. Sadasivan, T. A., and Sarathy, D., Cutting tools for Productive Machining, Widia (India) Ltd., August, 1999.
5. Radhakrishnan, P., Computer Numerical Control Machines, New Central Book agency, 1992.

6. Peter Smid, CNC Programming Hand book, Industrial Press Inc., 2000.

<b>MEC311</b>	<b>NON-TRADITIONAL MACHINING TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **MECHANICAL ENERGY BASED MACHINING**

Overview, need, classification of non-conventional machining processes - Abrasive jet machining - introduction, principle, equipment, process parameters, process characteristics, advantages, limitations, applications - ultrasonic machining - principle, machining unit, tool materials, tool size, process characteristics, advantages, limitations, applications - water jet machining and abrasive flow machining - introduction, principle, equipment, process details, advantages, limitations, and applications.

### **ELECTRO CHEMICAL MACHINING**

Electro-chemical machining - introduction, principle, elements, machine, chemistry of process, metal removal rate, tool design, accuracy, surface finish, economics, advantages, limitations, applications - electrochemical grinding - electrochemical deburring, electrochemical honing, shaped tube electrolyte machining - chemical machining - introduction, advantages, limitations, applications.

### **ELECTRO THERMAL BASED MACHINING**

Electrical Discharge Machining - introduction, principle, machine dielectric fluid, spark erosion generators, EDM tools, electrode holders, tool design, flushing, process characteristics, applications, electrical discharge grinding, die sinking, wire cut EDM.

### **THERMAL PROCESS**

Plasma Arc Machining - introduction, principle, plasma, non-thermal generation of plasma, mechanism of metal removal, PAM parameters, equipment, safety precautions, advantages, limitations, applications - Electron Beam Machining, laser beam machining, Ion

Beam Machining - introduction, principle, equipment, parameters, characteristics, types of lasers.

### **HYBRID MACHINING**

Hybridisation of non-conventional processes and micro and nano-manufacturing ECDG, electrochemical spark machining, electrochemical micro machining, overview of micro and nano-manufacturing and applications.

### **TEXT BOOK**

1. Pandey, P.C., Shan, H.S., Modern Machining Processes, Tata McGraw Hill, New Delhi, 1980.

### **REFERENCES**

1. HMT Production Technology Handbook, 1994.
2. Ghosh Amitabh, Malik Ashok, Manufacturing Science, East West Press Pvt Ltd, 1985.
3. Lindberg Roy, A., Processes and Materials of Manufacture, Prentice Hall of India, New Delhi, 1990.

<b>MEC312</b>	<b>INTERNAL COMBUSTION ENGINES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **SPARK IGNITION ENGINE**

Spark ignition engine mixture requirements, feedback control, carburetors, fuel injection systems - monopoint and multipoint injection, stages of combustion - normal and abnormal combustion - factors affecting knock, combustion chambers - introduction to thermodynamic analysis of SI engine combustion.

### **COMPRESSION IGNITION ENGINE**

Stages of combustion in CI engine, direct and indirect injection systems, combustion chambers, fuel spray behaviour, spray structure, spray penetration and evaporation - air motion, turbocharging, introduction to thermodynamic analysis of CI engine combustion.

**POLLUTANTS**

Pollutants - sources and types, formation of NO<sub>x</sub>, hydrocarbon emission mechanism, carbon monoxide formation.

**EMISSION CONTROL**

Particulate emissions - methods of controlling emissions- catalytic converters and particulate traps, methods of measurements and driving cycles.

**FUELS**

Alcohol, hydrogen, natural gas and Liquefied Petroleum Gas - properties, suitability, engine modifications, merits and demerits as fuels, lean burn engines, stratified charge engines, gasoline direct injection engine, homogeneous charge compression ignition, plasma ignition, measurement techniques.

**TEXT BOOK**

1. John B Heywood, Internal Combustion Engine Fundamentals, McGraw Hill, 1988.

**REFERENCES**

1. Mathur, R.B., and Sharma, R.P., Internal Combustion Engines, Dhanpatrai, 2000.
2. Rowland S Benson and Whitehouse, N.D., Internal combustion Engines, Vol.I and II, Pergamon Press, 1983.
3. Duffy Smith, Auto fuel Systems, The Good Heart Willox Company, Inc., 1987.

<b>MEC313</b>	<b>TURBO MACHINERY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INTRODUCTION**

Stages of turbo machines – energy transfer between fluid and rotor, stage velocity triangles, thermal turbo machines, classification,

general energy equation, modified turbo machines, compression and expansion process.

### **FAN AND BLOWERS**

Fan, blowers – blade design, velocity triangles, stage parameters, flow analysis in impeller blades, design parameter, volute and diffusers, efficiencies and losses, fan noises, causes and remedial measures.

### **CENTRIFUGAL FLOW COMPRESSORS**

Centrifugal compressors - definition and classifications, stage parameters, performance characteristics - cascade of blades, cascade tunnel, blade geometry, cascade variables, energy transfer and loss in terms of lift and drag.

### **AXIAL FLOW COMPRESSORS**

Axial flow compressors - definition and classifications, constructional details, stage velocity triangles, stage work, stage pressure rise, H-S diagram, stage efficiencies and losses, degree of reaction, radial equilibrium, surging and stalling, performance characteristics.

### **AXIAL AND RADIAL FLOW TURBINES**

Axial and radial flow turbines - construction details, 90° IFR turbine, stage work, stage velocity triangles, stage pressure rise, impulse and reaction stage, effect of degree of reaction, H-S diagram, efficiencies and losses, performance characteristics.

### **TEXT BOOK**

1. Yahya, S.M., Turbines, Compressors and Fans, Tata McGraw-Hill Publishing Company, 1996.

### **REFERENCES**

1. Dixon S.L, Fluid Mechanics, Thermodynamics of turbo machines, Pergamon press, 2nd Edition, 1990.

2. Kadambi, V., and Manohar Prasad, An Introduction to energy conversion - Vol. III, Turbo machines- Wiley Eastern India Ltd, 1977.
3. Shepherd, D.H., Principles of Turbo-machinery, The Macmillan Company, 1969.

<b>MEC314</b>	<b>ENERGY ENGINEERING AND MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **BASICS**

Introduction - fossil fuels reserves, world energy consumption, green house effect, global warming, renewable energy sources, environmental aspects utilization, energy prizes, energy policies.

### **ENERGY CONSERVATION SCHEMES**

Energy conservation schemes - industrial energy use, energy surveying and auditing, energy index, energy cost, cost index, energy conservation in engineering and process industry, in thermal systems, in buildings and non-conventional energy resources schemes.

### **FUELS AND CONSUMPTION**

Fuels and consumption - boilers, furnaces, waste heat recovery systems, heat pumps and refrigerators, storage systems, insulated pipe work systems, heat exchangers.

### **ENERGY MANAGEMENT PRINCIPLES**

Energy management principles - energy resource management, energy management information systems, instrumentation and measurement, computerized energy management.

### **COSTING TECHNIQUES**

Costing techniques - cost optimization, optimal target investment schedule, financial appraisal and profitability, project management.

**TEXT BOOK**

1. Murphy, W.R., and Mc KAY, G., Energy Management Butterworths, London, 2000.

**REFERENCES**

1. Callaghn, P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.
2. David Merick and Richard Marshal, Energy, present and future options, Vol. I and II, John Wiley and Sons, 1981.
3. Chaigier, N.A., Energy Consumption and Environment, McGraw-Hill, 1981.
4. Ikken, P.A., Swart, R.J., and Zwerves, S., Climate and Energy, 1989.
5. Ray, D.A., Industrial Energy Conservation, Pergamaon Press, 1980.

<b>MEC315</b>	<b>DESIGN FOR MANUFACTURE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INTRODUCTION**

General design - principles for manufacturability, strength and mechanical factors, mechanisms selection, evaluation method - process capability - feature tolerances - geometric tolerances - assembly limits – datum features - tolerance stacks.

**FACTORS INFLUENCING FORM DESIGN**

Working principle - material, manufacture, design - possible solutions - materials choice- influence of materials on form design of welded members, forgings and castings.

**COMPONENT DESIGN –MACHINING CONSIDERATION**

Design features to facilitate machining - drills, milling cutters, keyways - doweling procedures - counter sunk screws - reduction of machined area - simplification by separation - simplification by amalgamation - design for machinability - design for economy -

design for clampability - design for accessibility - design for assembly.

### **COMPONENT DESIGN – CASTING CONSIDERATIONS**

Redesign of castings based on parting line considerations - minimizing core requirements, machined holes, redesign of cast members to obviate cores.

### **REDESIGN FOR MANUFACTURE AND CASE STUDIES**

Identification of uneconomical design - modifying the design - group technology - computer applications for DFMA.

### **TEXT BOOK**

1. Harry Peck, Design for Manufacture, Pittman Publication, 1983.

### **REFERENCES**

1. Robert Matousek, Engineering Design - A systematic approach, Blackie and sons Ltd., 1963.
2. James G. Bralla, Hand Book of Product Design for Manufacturing, McGraw Hill Co., 1986.
3. Swift, K.G., Knowledge based design for manufacture, Kogan Page Ltd., 1987.

<b>MEC316</b>	<b>THEORY OF METAL CUTTING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION**

Theory of metal cutting- chip formation - specific cutting energy - shear angle - theory of merchant, Lee and Shaffer - friction in metal cutting - temperatures in metal cutting - measurement of cutting temperature- Cutting fluids.

### **SINGLE POINT CUTTING TOOLS**

Cutting tool material, properties, insert and coated tools, tool wear, tool life - single point tools-nomenclature, type and styles- design

and manufacture of tools - HSS and carbides-brazed and clamped insert tools for turning, boring, shaping operations.

### **MULTIPOINT CUTTERS**

Multi-point cutters- nomenclature, classification and selection, construction methods, cutter setting, design and manufacture of drills, reamers, taps, milling cutters, grinding wheel specification, lapping ,dressing and truing.

### **JIGS AND FIXTURES**

Jigs - degrees of freedom - principles of location and clamping-principles of jig design -elements of jigs, classification of jigs - design of jigs for drilling – fixtures - principles of fixture design, locators and different types of clamps - elements of fixture, design of fixtures for milling, turning, boring and grinding operations.

### **PRESS TOOLS**

Press tools-design and manufacture for die sets for sheet metal components-simple, compound and progressive dies for punching and blanking operations - dies for drawing and bending operation-selection of presses and tools.

### **TEXT BOOK**

1. Sen, B.C., Battacharya, A., Principles of Metal Cutting, New central Book Agency, 1982.

### **REFERENCES**

1. Donaldson, C., Lecain, G.H., and Gold, V.C., Tool Design, Tata McGraw Hill of India Pvt Ltd., New Delhi,1978.
2. Arshinov, V., Alekseev, G., Metal cutting Theory and Cutting Tool Design, MIR Publishers, Moscow, 1976.
3. Geoffrey Boothroyd., Fundamentals of Metal machining and Machine tools, McGraw Hill International, 1985.
4. Hoffman, G., Fundamentals of Tool Design, SMF Publications, 1980.

5. SME, Manufacturing Engineers Hand Book, 1984.
6. Kempster, Principles of Jigs and Tools Design, ELBS, 1978.
7. Rodin, P., Design and Production of Metal cutting Tools, MIR Publishers, Moscow, 1968.

<b>MEC317</b>	<b>TRIBOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **SURFACE FRICTION AND WEAR**

Topography of the surfaces - surface features - surface interaction - theory of friction - sliding and rolling friction, friction properties of metallic and non-metallic materials, friction in extreme conditions - wear- types of wear - mechanism of wear - wear resistance materials - surface treatment - surface modifications - surface coatings.

### **LUBRICATION THEORY**

Lubricants-physical properties, lubricants standards, lubrication regimes - hydrodynamic lubrication - Reynolds equation - thermal, inertia and turbulent effects - elasto hydrodynamic, plasto hydrodynamic and magneto hydrodynamic lubrication - hydro static lubrication - gas lubrication.

### **DESIGN OF FLUID FILM BEARINGS**

Design and performance analysis of thrust and journal bearings - full, partial, fixed and pivoted journal bearings design - lubricant flow and delivery - power loss, heat and temperature, rotating loads and dynamic loads in journal bearings - special bearings - hydrostatic bearing design.

### **ROLLING ELEMENT BEARING**

Geometry and kinematics - materials and manufacturing processes - contact stresses - hertzian stress equation, load divisions - stresses and deflection - axial loads and rotational effects - bearing life capacity.

**TEXT BOOK**

1. Sahoo, Engineering Tribology, PHI, New Delhi, 2007.

**REFERENCES**

1. Kragelsky, I.V., and Alisin, V.V., Tribology- lubrication, wear and lubrication, Professional Engineering Publishing, 2001.
2. Basu, S.K., Senguta, S.N., Fundamentals of Tribology, PHI, New Delhi, 2006.
3. Cameron, A., Basic Lubrication Theory, Ellis Herward Ltd., UK, 1981.
4. Hulling, J., Principles of Tribology, MacMillan , 1984.
5. Williams, J.A., Engineering Tribology, Oxford Univ. Press, 1995.

<b>MEC318</b>	<b>REFRIGERATION AND AIR CONDITIONING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INTRODUCTION**

Review of thermodynamic principles of refrigeration, concept of aircraft refrigeration system, vapour compression refrigeration cycle, use of P-H charts, multistage and multiple evaporator systems, cascade system, COP comparison, vapour absorption refrigeration system, ammonia water and lithium bromide water systems, steam jet refrigeration system.

**REFRIGERANTS AND APPLICATIONS**

Refrigerants - properties - selection of refrigerants, alternate refrigerants, refrigeration plant controls - testing and charging of refrigeration units - applications to refrigeration systems.

**PSYCHROMETRY AND COOLING LOAD CALCULATION**

Psychrometric processes - use of psychrometric charts, grand and

room sensible heat factors, bypass factor, requirements of comfort air conditioning, comfort charts, factors governing optimum effective temperature, recommended design conditions and ventilation standards.

### **LOAD**

Types of load - design of space cooling load , heat transmission through building, Solar radiation , infiltration , internal heat sources (sensible and latent) , outside air and fresh air load , estimation of total load - domestic, commercial and industrial systems - central air conditioning systems.

### **AIR CONDITIONING EQUIPMENTS**

Air conditioning equipments – air cleaning and air filters, humidifiers, dehumidifiers, air washers, condenser , cooling tower and spray ponds, elementary treatment of duct design, air distribution system, Thermal insulation of air conditioning systems – applications - car, industry, stores, and public buildings

### **TEXT BOOK**

1. Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Ltd., 1983.

### **REFERENCES**

1. Arora, C.P., Refrigeration and Air Conditioning, Tata McGraw-Hill, New Delhi, 1988.
2. Roy.J Dossat, Principles of Refrigeration, Pearson Education, New Delhi, 1997.
3. Jordon and Prister, Refrigeration and Air Conditioning, Prentice Hall of India Pvt Ltd., New Delhi, 1985.
4. Stoecker, N.F., and Jones, Refrigeration and Air Conditioning, TMH, New Delhi, 1981.

<b>MEC319</b>	<b>PROCESS PLANNING AND COST ESTIMATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **PROCESS PLANNING**

Types of production - standardization, simplification - production design and selection - process planning, selection and analysis - steps involved in manual experience based planning and computer aided process planning - retrieval, generative - selection of processes analysis - breakeven analysis.

### **ESTIMATING AND COSTING**

Importance and aims of cost estimation - functions of estimation - costing - importance and aims of costing - difference between costing and estimation - importance of realistic estimates - estimation procedure.

### **ELEMENT OF COST**

Introduction - material cost - determination of material cost labour cost - determination of direct labour cost - expenses - cost of product (Ladder of cost) - illustrative examples - analysis of overhead expenses - factory expenses - depreciation - causes of depreciation - methods of depreciation - administrative expenses - selling and distributing expenses - allocation of overhead expenses.

### **PRODUCT COST ESTIMATION**

Estimation in forging shop - losses in forging - forging cost - illustrative examples - estimation in welding shop - gas cutting - electric welding - illustrative examples - estimation in foundry shop - estimation of pattern cost and casting cost - illustrative examples.

### **ESTIMATION OF MACHINING TIME**

Estimation of machining time for lathe operations - estimation of machining time for drilling, boring, shaping, planing, milling and grinding operations - illustrative examples.

**TEXT BOOK**

1. Adithan, M., and Pabla, B.S., Estimating and Costing, Konark Publishers Pvt. Ltd., 1989.

**REFERENCES**

1. Chitale, A.K., and Gupta, R.C., Product Design and Manufacturing, Prentice Hall Pvt. Ltd., New Delhi, 1997.
2. Nanua Singh, System approach to Computer Integrated Design and Manufacturing, John Wiley and Sons, Inc., 1996.
3. Joseph G Monks, Operations Management, Theory and Problems, McGraw Hill Book Company, 1982.
4. Narang, G.B.S., and Kumar, V., Production and Costing, Khanna Publishers, 1995.
5. Banga, T.R., and Sharma, S.C., Estimating and Costing, Khanna Publishers, 1986.

<b>MEC320</b>	<b>FINITE ELEMENT ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INTRODUCTION**

Historical background – matrix approach – application to the continuum – discretisation matrix algebra – Gaussian elimination – governing equations for continuum – classical techniques in FEM – weighted residual method – Ritz method.

**ONE DIMENSIONAL PROBLEMS**

Finite element modeling – coordinates and shapes functions-potential energy approach – Galarkin approach – assembly of stiffness matrix and load vector – finite element equations – quadratic shape functions – applications to plane trusses.

**TWO DIMENSIONAL CONTINUUM**

Introduction – finite element modeling – scalar valued problem – Poisson equation –laplace equation – triangular elements – element

stiffness matrix – force vector – Galarkin approach - stress calculation – temperature effects.

### **AXISYMMETRIC CONTINUUM**

Axisymmetric formulation – element stiffness matrix and force vector – Galarkin approach – body forces and temperature effects – stress calculations – boundary conditions – applications to cylinders under internal or external pressures – rotating discs.

### **ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL CONTINUUM**

The four node quadrilateral – shape functions – element stiffness matrix and force vector numerical integration - stiffness integration – stress calculations – four node quadrilateral for axisymmetric problems.

### **TEXT BOOK**

1. Chandrupatla, T.R., and Belegundu, A.D., Introduction to Finite Elements in Engineering, Pearson Education, New Delhi, 3<sup>rd</sup> Edition, 2002.

### **REFERENCES**

1. David V Hutton, Fundamentals of Finite Element Analysis, McGraw-Hill Int. Ed., 2004.
2. Rao, S.S., The Finite Element Method in Engineering”, Pergammon Press, 1989.
3. Logan, D.L., A First course in the Finite Element Method, Thomson Learning, Third Edition, 2002.
4. Robert D Cook., David.S, Malkucs Michael E Plesha, Concepts and Applications of Finite Element Analysis, Wiley, 4 Edition, 2003.
5. Reddy, J.N., An Introduction to Finite Element Method, McGraw-Hill International Student Edition, 1985.

6. Zienkiewicz, O.C., and Taylor, R.L., The Finite Element Methods, Vol.1, The basic formulation and linear problems, Vol.1, Butterworth Heineman, 5<sup>th</sup> Edition, 2000.

<b>MEC321</b>	<b>OPTIMIZATION TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION TO OPTIMIZATION**

Classification of optimization problems - applications of optimization - concepts of design vector- design constraints - constraint surface - objective function surfaces and multi -level optimization - quadratic programming- non-linear programming – unconstrained optimization techniques- basics of constrained optimization.

### **UNCONSTRAINED OPTIMIZATION**

Steepest-descent method-Newton methods - Quasi-Newton methods- linear/nonlinear conjugate gradient methods-interval reduction methods- line-search methods- trust-region methods-local and global convergence.

### **NONLINEAR EQUATIONS**

Newton's method - modified Newton's methods; Broyden's (quasi-Newton) method-Inexact Newton methods - the bisection method - line-search methods and merit functions- trust - region methods- local and global convergence.

### **CONSTRAINED OPTIMIZATION**

Lagrange multipliers- Karush - Kuhn-Tucker conditions - line-search methods and merit functions-active-set methods (for inequality constraints) - penalty function methods (for equality constraints) - reduced-gradient and gradient-projection methods - augmented Lagrangian and projected Lagrangian methods - Barrier methods (for inequality constraints) - interior-point methods (for inequality

constraints) - sequential linearly constrained programming-sequential quadratic programming.

### **RECENT TECHNIQUES IN OPTIMIZATION**

Convexity; linear programming and simplex method- quadratic programming- duality-nonlinear least-squares problems-variational calculus- nonsmooth optimization-dynamic optimization and the maximum principle of pontryagin- dynamic programming and the hamilton-Jacobi-Bellman equation-neural networks and the backpropagation algorithm- stochastic optimization- simulated annealing- genetic algorithms- neural network based optimization- optimization of fuzzy systems.

### **TEXT BOOK**

1. Edwin, K. P., Chong, and Stanislaw, Zak, H., An Introduction to Optimization, Wiley-Interscience, 2nd Edition, 2001.

### **REFERENCES**

1. Jorge Nocedal and Stephen Wright, Numerical optimization, Springer, New York, Springer Series in Operations Research and Financial Engineering, Second edition, 2006.
2. Numerical methods for unconstrained optimization and nonlinear equations by John E. Dennis and Robert B. Schnabel, Prentice Hall, Englewood Cliffs, NJ, 1988, reprinted by SIAM publications, 1993.
3. Fletcher, R., Practical methods of optimization, John Wiley and Sons, Chichester, New-York, Second edition, 1987.
4. Philip, E Gill., Walter Murray and Margaret, H, Wright, Practical optimization by Academic Press, New York, 1981.
5. David G. Luenberger, Linear and nonlinear programming by, Addison-Wesley Publ. Comp., Reading, Second edition, 1984.
6. Frederic Bonnans, J., Jean Charles Gilbert, Claude Lemarechal, Claudia, A., Sagastizbal Numerical

Optimization: Theoretical and Practical Aspects, Springer Series, Universitext, Second edition 2006.

<b>MEC322</b>	<b>MODERN MANUFACTURING PROCESSES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **POWDER METALLURGY**

Processing of powder metals, ceramics, glass and super conductors- introduction -production of metal powders - compaction of metal powders-sintering-secondary and finishing operations-design considerations of powder metallurgy - process capabilities -shaping ceramics - forming and shaping of glass - design consideration for ceramics and glass - metal injection moulding.

### **NC MACHINES AND ROBOTICS**

Numerical control and robotics - background of numerical control - basics of numerical control - motion control- point to point and contouring - linear interpolation and circular interpolation - contouring control - positioning system - absolute and incremental - control loops - open and closed loop control - cartesian coordinate conventions - left and right hand-programming numerically controlled machines - G and M codes - basic concepts of robotics - programming of robots - initial robot specification - introduction to rapid prototyping.

### **SUPER CONDUCTORS**

Processing of superconductors-forming and shaping plastics and composite materials – introduction – extrusion – injection moulding – blow moulding – casting – processing of reinforced plastics – processing metal-matrix composites – processing ceramic composites – design consideration and economics of forging and shaping plastics.

**ADVANCED MACHINING**

Advanced machining processes and nanofabrication – introduction - chemical machining - electrochemical machining - electrical discharge machining - wire EDM - laser beam machining - water jet machining-abrasive jet machining - nano fabrication -micro machining-the economics of advanced machining processes.

**MICRO ELECTRIC DEVICES**

Fabrication of microelectronic devices – introduction - semiconductors and silicon - crystal growing and wafer preparation-film deposition-oxidation-lithography - etching - diffusion and ion implantation, metallization and testing - bonding and packaging - yield and reliability - printed circuit boards.

**TEXT BOOK**

1. Serope Kalpakjian, and Steven R Schmid, Manufacturing Engineering and Technology, Pearson Education, Fourth Edition, 2002.

**REFERENCES**

1. Benjamin W Niebel, Alan B Draper, Richard A Wysk, Modern Manufacturing Process Engineering, Mc Graw Hill, International edition, 1989.
2. Hajra Choudhry, S. K., Bose, S. K., Elements of Work Shop Technology, Vol II, 1995
3. Machine tools, Media Promoters and Publishers ( P ) Ltd., Bombay, 10<sup>th</sup> Edition, 2000.
4. HMT, Production Technology, Tata McGraw-Hill, New Delhi, 1996.

<b>MEC323</b>	<b>MATERIALS MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **FUNCTIONS OF MATERIALS MANAGEMENT**

Introduction - objectives - organizations - functions - administration  
- integrated approach - relationship with other department.

### **PURCHASING MANAGEMENT**

Purchasing policies and procedures - legal aspects - selection of sources of supply - forms and records - methods of purchasing - capital purchasing ethics.

### **STORES MANAGEMENT**

Store function - location - layout - materials handling and movement  
-stock taking-procedures and records – ABC and VED system of stock control.

### **INVENTORY MANAGEMENT**

EOQ - inventory systems - periodic - deterministic and probabilistic models - static inventory model – reorder point – lead time analysis – safety stocks

### **VALUE ANALYSIS**

Standardization - variety reduction - JIT - MRP I, MRP II - vender evaluation and rating - inventory audit and information systems.

### **TEXT BOOK**

1. Lamer Lee and Donald W Dobler, Purchasing and Materials Management, Tata McGraw-Hill, New Delhi, 1996.

### **REFERENCES**

1. Gopalakrishnan, P., Purchasing and Materials Management, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1996.

2. Gopalakrishnan, P., Handbook of Materials Management, Prentice Hall of India, New Delhi, 1996.
3. Starr and Miller, Inventory Control Theory and Practice, Prentice Hall of India, New Delhi, 1989.
4. Ahuja, K.K., Material Management, CBS Pub., New Delhi, 1992.
5. Spencer B.S., Computer Based Production and Inventory Control, Prentice Hall, 2002.
6. Joseph S.M., Production and Operations Management, John Wiley and Sons, 1999.
7. Datta, A.K., Integrated Materials Management: A Functional Approach, Prentice Hall of India Ltd., New Delhi, 1998.

<b>MEC324</b>	<b>PLANT LAYOUT AND MATERIAL HANDLING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION TO FACILITY DESIGN**

Facilities requirements- need for layout study – types of layout- facilities design - sources of information for facilities design - process design - flow analysis techniques

### **PLANT LAYOUT- WORKSTATION DESIGN**

Site selection- plant location analysis – factors- costs - location decisions – auxiliary -plant cost – land – building and production – equipment - material cost - services requirement- employee services- space requirements- activity relationship analysis.

### **SPACE REQUIREMENTS**

Office layout techniques and space requirements - area allocation - application of computer simulation and modeling - simple problems in single facility location models - network location problems.

### **PRODUCTION FLOW DESIGN**

Organization chart - activity relationship chart - production routing sheets - flow process chart - worksheet for activity relationship chart-

nodal diagram- operation chart - assembly chart for product - package design unit load design - departmental layout - production flow analysis (PFA) - line balancing - financial analysis - design cycle – SLP procedure manpower - machinery requirements – computer algorithms – ALDAP, CORELAP, CRAFT.

### **MACHINES AND MATERIAL HANDLING**

Computations of machine requirements - area and cost of production equipments - unit load concept - material handling system design - handling equipment types - selection and specification - containers and packaging - receiving and shipping areas - storage analysis - plant services - total space requirements.

### **TEXT BOOK**

1. Meyers, Fred, E., and Stephens, Matthew, P., Manufacturing Facilities Design and Material Handling, Prentice-Hall, Inc., Second Edition, 2000.

### **REFERENCES**

1. James Apple, M., Plant layout and Material Handling, John Wiley, 1977.
2. Tompkins, J.A., and White, J.A., Facilities and Planning, John Wiley, 1984.
3. Richard Francis, L., and John, A., White, Facilities Layout and Location - an Analytical Approach, Prentice Hall Inc. New Delhi, 1984.

<b>MEC404</b>	<b>ROBOTICS AND ROBOT APPLICATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION**

Fundamentals of Robotics- robot anatomy, robot classification.

**ROBOT KINEMATICS**

General characteristics - classification - special purpose tools - assembly fixtures - Typical designs, compliance in wrists - end effectors multiple end effectors systems.

**ROBOT PROGRAMMING**

Robot programming and languages - robot language development, language classification.

**ROBOT CELL DESIGN**

Robot applications - robot applications in manufacturing: material transfer and machine loading / unloading - processing operations like welding and painting - assembly operations - inspection automation-robot cell design and control.

**ROBOT DEVELOPMENTS**

Recent developments in advanced robotics - special applications of robotics - nuclear industry, surgery, food manufacturing - miniature and micro robotics: technologies and applications.

**TEXT BOOK**

1. Harry Colestock, Industrial Robotics, McGraw Hill Book Co., New Delhi, 2005.

**REFERENCES**

1. Aggrawel, Robotics, Khanna Publishers, 2001.
2. Groover, M.P., Industrial Robotics, McGraw Hill Book Co., Singapore, 1986.
3. Deb, S.R., Robotics Technology and Flexible automation, Tata McGraw Hill Pub., New Delhi, 1994.

<b>MEC405</b>	<b>VIBRATION ANALYSIS AND NOISE MONITORING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **FUNDAMENTALS OF VIBRATION**

Introduction - classification of vibration - free and forced vibration, undamped and damped vibration, linear and non linear vibration - response of damped and undamped systems under harmonic force-analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

### **BASICS OF NOISE**

Introduction - amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation -measurement and analysis of noise - measurement environment -equipment, frequency analysis, tracking analysis, sound quality analysis.

### **AUTOMOTIVE NOISE SOURCES**

Noise Characteristics of engines - engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

### **CONTROL TECHNIQUES**

Vibration isolation - tuned absorbers, untuned viscous dampers, damping treatments- application of dynamic forces generated by IC engines - engine isolation - crank shaft damping - modal analysis of the mass elastic model shock absorbers.

### **SOURCE OF NOISE AND CONTROL**

Methods for control of engine noise - combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures - automotive noise control principles -sound in enclosures, sound energy absorption, sound transmission through barriers

**TEXT BOOK**

1. Singiresu S.Rao, Mechanical Vibrations, Pearson Education, New Delhi, 2004.

**REFERENCES**

1. Kewal Pujara, Vibrations and Noise for Engineers, Dhanpat Rai and Sons, 1992.
2. Bernard Challen and Rodica Baranescu, Diesel Engine Reference Book, SAE International, Second edition, 1999.
3. Julian Happian and Smith, An Introduction to Modern Vehicle Design, Butterworth - Heinemann, 2004.
4. John Fenton, Handbook of Automotive body Construction and Design Analysis - Professional Engineering Publishing, 1998.

<b>MEC406</b>	<b>RENEWABLE ENERGY TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INTRODUCTION**

World energy use – reserves of energy resources, environmental aspects of energy utilization, renewable energy scenario in India.

**SOLAR ENERGY**

Solar – flat plate and concentrating collectors, solar heating and cooling techniques, solar desalination, solar pond, solar cooker, solar thermal power plant, solar photo voltaic conversion, solar cells, PV applications.

**WIND ENERGY**

Wind data and energy estimation – types of wind energy systems, performance, details of wind turbine generator, safety and environmental aspects.

**BIO MASS**

Biomass direct combustion – biomass gasifier, biogas plant, ethanol production, bio diesel, cogeneration, biomass applications.

**OTHER ENERGY TECHNIQUES**

Tidal energy, open and closed OTEC cycles, geothermal energy – fuel cell systems.

**TEXT BOOK**

1. Rai, G.D., Non Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.

**REFERENCES**

1. Sukhatme, S.P., Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.
3. Twidell, J.W., and Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
4. Tiwari, G.N., Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.
5. Freris, L.L., Wind Energy Conversion systems, Prentice Hall, UK, 1990.
6. Johnson Gary, L., Wind Energy Systems, Prentice Hall, New York, 1985.

<b>MEC407</b>	<b>DESIGN OF HEAT TRANSFER EQUIPMENTS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**HEAT EXCHANGERS**

Types, shell and tube heat exchangers, regenerators and recuperators, industrial applications, temperature distribution and its implications, LMTD, effectiveness.

**FRICION FACTOR**

Effect of turbulence, friction factor, pressure loss, channel divergence, thermal stress in tubes, types of failures.

**HEAT TRANSFER AND PRESSURE LOSS**

Heat transfer and pressure loss, flow configuration, effect of baffles, effect of deviations from ideality, design of typical liquid, gas-liquid heat exchangers, plate heat exchangers.

**CONDENSORS**

Design of surface and evaporative condensors, design of shell and tube, plate type evaporators.

**ACCESSORIES**

Packings, spray design, selection of pumps, fans and pipes, testing and maintenance, experimental methods.

**TEXT BOOK**

1. Kern, D.Q., Process Heat Transfer, Tata McGraw Hill, New Delhi, 1997.

**REFERENCES**

1. Arthur P Frass, Heat Exchanger Design, John Wiley and Sons, New York, Second Edition, 1996.
2. Taborek, T., Hewitt, G.F., and Afgan, N., Heat Exchangers, Theory and Practice, McGraw Hill Book Co., 1980.
3. Walker, Industrial Heat Exchangers - A Basic Guide, McGraw Hill Book Co., 1980.
4. Nicholas Chermisioff, Cooling Tower, Ann Arber Science pub., 1981.

<b>MEC408</b>	<b>FOUNDRY MECHANIZATION AND MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION**

Introduction to casting and foundry industry- basic principles of casting processes-sequence in foundry operations- patterns-moulding practice- ingredients of moulding sand and core sand-sand testing- different moulding processes.

### **FURNACES**

Types of furnaces used in foundry-furnaces for melting, melting practice for steel, cast iron, aluminium alloys, copper alloys and magnesium alloys- safety considerations- fluxing, degassing and inoculation

### **SPECIAL CASTING TECHNIQUE**

Sand casting- permanent mould casting, die casting, centrifugal casting, plaster mould casting, investment casting, continuous casting, squeeze casting, full mould process, strip casting.

### **CASTING PROCESS**

Overview of pouring and solidification- concept of shrinkage-Chvorinov's rule- chilling-gating systems- functions of riser- types of riser- bottom pouring and top pouring -yield calculations-visualization of mould filling (modeling).

### **SOLIDIFICATION**

Concepts of solidification, directional solidification- role of chilling-filtration of liquid metals, consumables- details of inoculation and modification – with respect to cast irons and Al-Si system- casting defects- soundness of casting and its assessment.

### **TEXT BOOK**

1. Foundry Manual, Fredonia Books, 2006.

**REFERENCES**

1. Heine, R. W., Loper, C. R., Rosenthal, P. C., Principles of Metal Casting, Tata McGraw Hill Publishers, 2<sup>nd</sup> Edition, 1985
2. Wulff, B., Taylor, H. F., Fleming, M. C., Foundry Engineering, Wiley Eastern, 1959.
3. Jain, P. L., Principles of Foundry Technology, Tata McGraw Hill, New Delhi, 3<sup>rd</sup> Edition, 1995.
4. Srinivasan, N. K., Foundry Technology, Khanna Publications, 1986

<b>MEC409</b>	<b>RECENT TRENDS IN WELDING TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**FUSION WELDING**

Classification of welding processes- heat sources and shielding methods -fusion welding processes- oxy - acetylene welding, arc welding processes, electroslag and electrogas welding, resistance welding

**PRESSURE WELDING**

Cold and hot pressure welding-friction, friction stir, ultrasonic, induction pressure, explosive and diffusion welding

**NEWER WELDING TECHNIQUES**

Electron beam, plasma arc and laser beam welding principles, advantages, limitations and applications of the electron beam, plasma arc and laser beam welding processes

**SOLDERING AND BRAZING**

Soldering- soldering materials, applications of soldering- brazing

**WELDING METALLURGY**

Weld thermal cycles and their effects- structural changes in different materials- effects of pre and post heat treatments- concept of

weldability and its assessment - Welding of different materials- defects in welds, their causes and remedies

### TEXT BOOK

1. William A Bowditch, Welding Technology Fundamentals, Good Heart Willcox Publishers, 2006.

### REFERENCES

1. Houldcroft, P. T., Submerged Arc Welding, Abington Publishing, 1988.
2. Linnert, G. E., Welding Metallurgy, Volume 1 and 2, American Welding Society, 4<sup>th</sup> Edition, 1994
3. Jackson, M. D., Welding Methods and Metallurgy, Griffin, London, 1967.
4. Lancaster, L.F., The Physics of Welding, Pergamon Press, 1984.

<b>MEC410</b>	<b>MECHANICAL BEHAVIOUR OF MATERIALS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### DEFORMATION

Elastic and plastic deformation -Stress-strain relationship, plastic deformation of metallic materials - Mohr's circle - Yielding criterion - Von Mises and maximum shear stress, tresca yielding criterion - Failure criteria under combined stresses

### THEORY OF PLASTICITY

Elements of theory of plasticity - dislocation theory, properties of dislocation, stress fields around dislocations, elementary dislocation interactions - application of dislocation theory to work hardening and strengthening mechanisms.

### TENSILE PROPERTIES

Engineering stress-strain curve - true stress- strain curve - instability in tension, stress distribution at the neck, ductility measurement,

effect of strain rate and temperature on flow properties, testing machines - tensile properties of important materials.

### **HARDNESS TESTING**

Introduction - Brinell, Vickers, Rock well and Meyer hardness test, analysis of indentation by an indenter - Relationship between hardness and the flow curve – micro hardness tests- hardness conversion, hardness at elevated temperatures.

### **TORSION**

Introduction - mechanical properties in torsion, torsional stresses for large plastic strains- types of torsion failures - torsion test vs. tension test - hot torsion testing.

### **TEXT BOOK**

1. Thomas H. Courtney, Mechanical Behavior of Materials, Waveland Pr Inc; 2nd edition, 2005.

### **REFERENCES**

1. Dieter, G. E., Mechanical Metallurgy, McGraw Hill Publications, 3<sup>rd</sup> Edition, 1988.
2. Suryanarayana, Testing of Metallic Materials, Prentice Hall India, New Delhi, 1979.
3. Rose, R.M., Shepard, L.A., Wulff, J., Structure and Properties of Materials, Volume III, John Wiley, 4<sup>th</sup> Edition, 1984.
4. Honeycombe, R.W.K., Plastic Deformation of Materials, Edward Arnold Publishers, 1984.

<b>MEC411</b>	<b>MANUFACTURING SYSTEM AND SIMULATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COMPUTER MODELING AND SIMULATION SYSTEMS**

Monte carlo simulation-nature of computer modelling and simulation - limitations of simulation, areas of application - components of a

system - discrete and continuous systems. models of a system - a variety of modeling approaches.

### **RANDOM NUMBER GENERATION**

Techniques for generating random numbers - mid square method-the mid product method-constant multiplier technique - additive congruential method linear congruential method-tests for random numbers-the Kolmogorov-Smirnov test-the Chi-Square test.

### **RANDOM VARIABLE GENERATION**

Inverse transform technique-exponential distribution-uniform distribution - Weibull distribution - empirical continuous distribution - generate approximate normal variates - Erlang distribution.

### **DISTRIBUTION AND EVALUATION OF EXPERIMENTS**

Discrete uniform distribution - poisson distribution - geometric distribution - acceptance rejection technique for poisson distribution - gamma distribution - simulation experiments - variance reduction techniques - antithetic variables - verification and validation of simulation models.

### **DISCRETE EVENT SIMULATION**

Concepts in discrete event simulation, manual simulation using event scheduling, single channel queue, two server queue simulation of inventory problems - programming for discrete event systems in GPSS-Case studies.

### **TEXT BOOK**

1. Jerry Banks and John S Carson, Discrete – Event System Simulation, Prentice Hall Inc, New Delhi, 1984

**REFERENCES**

1. Gordon, G., Systems simulation, Prentice Hall of India Ltd, New Delhi, 1991.
2. Narsing deo, Systems simulation with digital computer, Prentice Hall of India Ltd, New Delhi, 1991.
3. Francis Neelamkovil, Computer Simulation and Modeling, John Wiley and Sons, 1987.
4. Ruth, M.D., and Keefe, M.O., Simulation and Modeling with Pascal”, Prentice Hall Inc., New Delhi, 1984.

<b>MEC412</b>	<b>MICRO ELECTRO MECHANICAL SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**FUNDAMENTALS OF MEMS**

Introduction, history, development and need of micro-electro - mechanical systems -overview of MEMS technology.

**MATERIALS AND FABRICATION PROCESSES**

Different electro-physical processes used for machining - dealing with MEMS materials - relevant non - conventional processes - IC fabrication processes used for MEMS - MEMS sensors and actuators.

**MICRO MACHINING**

Mechanical process techniques and process models for micro-machining- Fabrication processes and design of the process sequences

**DESIGN CONSIDERATION**

Design consideration –process design-mechanical design –design of silicon die-design of micro fluidic net work systems-capillary electrophoresis network system.

**RELIABILITY AND PROCESS CONTROL**

Reliability and process control of micro manufacturing processes.

**TEXT BOOK**

1. Tai Ran Hsu, MEMS and MICRO SYSTEMS Design and Manufacture, TMH, New Delhi, 2001.

**REFERENCES**

1. Vijay K Varadan, Micro Sensors, MEMS, and Smart Devices, John Wiley and sons, 2001.
2. Marc Madou, Fundamentals of micro Fabrication, CRC Press,1997.

<b>MEC413</b>	<b>GEAR MANUFACTURING AND INSPECTION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**GEAR GEOMETRY**

Principles of gear tooth action, geometry of spur and helical gears.

**GEAR MANUFACTURING**

Gear manufacturing – types – forming gear teeth by milling – gear generation by planning, shaping and hopping process – applications.

**GEAR INSPECTION**

Parkinson gear testing, Gleason gear testing, sources of errors in manufacturing gears, gear measurements, measurement of individual element, rolling test, composite method of gear checking.

**DESIGN AND ANALYSIS**

Design considerations, materials treatments and methodology - gear tooth failure mode analysis, stresses and load calculation.

**BEVEL AND WORM GEARS**

Principles of geometry and design of bevel and worm gearing.

**TEXT BOOK**

1. Merritt, H.E., Gear Engineering, A. H. Wheeler and Co. Pvt. Ltd.,
2. H.M.T Production Technology, Tata McGraw Hill, 2002.
3. R.L. Norton, Machine Design, Tata McGraw Hill, 2005.

**REFERENCES**

1. Maitra, G.L., Hand Book of Gear Design, Tata McGraw-Hill, 2nd ed., 2005.
2. Jain, R.K., Engineering Metrology, Khanna Publishers, Delhi, 2006.
3. P.S.G. Tech, Design Data, Kalaikathir Publishers, 2006.

<b>MEC414</b>	<b>SENSORS AND TRANSDUCERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**BASICS OF INSTRUMENTS**

Measurement systems – significance of measurements- methods of measurements – direct and indirect methods - classification of instruments – deflection and null type - generalized measurement system - characteristics of instruments – static and dynamic- types of errors - error analysis- units and standards.

**TRANSDUCERS**

Transducer – definition - classification of transducer – analog and digital transducer - primary and secondary transducer - active and passive transducer-inverse transducer - characteristics and choice of transducer - factors influencing choice of transducer - resistance transducer - basic principle.

**POTENTIOMETER AND THERMOCOUPLE**

Potentiometer – loading effects- resolution- linearity- non-linear potentiometer- noise in potentiometer - resistance strain gauge – types- resistance thermometer - thermistors – characteristics - thermocouple – compensation circuits – junction and lead –

compensation - merits and demerits. inductance transducer - basic principle- linear variable differential transformer - RVDT- synchro - induction potentiometer- variable reluctance accelerometer - microsyn.

### **CAPACITANCE AND PIEZOELECTRIC CRYSTALS**

Capacitance transducer – basic principle- transducers using change in - area of plates - distance between plates - variation of dielectric constants- frequency response - merits - demerits and uses - piezoelectric transducer - basic principle - mode of operation - properties of piezoelectric crystals - loading effects - frequency response and impulse response uses.

### **ROBOT SENSORS**

Pressure sensors – bourdon tube- bellows- and diaphragm - digital transducer – shaft encoder - optical encoder - digital speed transducer - hall effect transducer - sound sensors - vibration sensors – seismic transducer - chemical sensor – ph sensor - velocity transducer- introduction to smart sensors.

### **TEXT BOOK**

1. Sawhney, A.K., A Course in Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai and Co., (Pvt) Ltd., 2000.

### **REFERENCES**

1. Renganathan, S., Transducer Engineering, Allied publishers Limited, 1999.
2. Ernest O Doebelin, Measurement Systems – Application and Design, McGraw – Hill Publishing company, 1990.
3. Woolvert, G.A., Transducer in Digital Systems, Peter Peregrinus Ltd., England, 1998.

4. Patranabis, D., Principles of Industrial Instrumentation, Tata McGraw – Hill Publishing Company Limited, New Delhi, 1996.

<b>MEC415</b>	<b>TOOLING FOR PRODUCTION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **CUTTING TOOLS**

Geometry of cutting tools and tool nomenclature - single point and multiple point cutting tools and used for turning – milling - drilling and broaching - cutting tool materials and their properties - grinding wheels and their selections.

### **METAL CUTTING**

Mechanics of chip formation - types of chips - mechanism of orthogonal cutting - velocity relationship - cutting forces - factors affecting cutting forces - tool dynamometers - cutting force and power analysis – turning - drilling - milling and broaching - thermal aspects of machining- cutting fluids and their selection.

### **MACHINABILITY AND TOOL LIFE**

Tool wear and tool life- tool life equations - tool life specification and criteria - tool life testing - effect of machining parameters on tool life – machinability - variables affecting machinability - machinability index - economics of machining - selection of optimal machining conditions - productivity of machine tools.

### **JIGS AND FIXTURES**

Basic principle - elements of jigs and fixtures - location and clamping - 3-2-1 method of location- principles of pin location - radial location - V-location - cavity location - types of clamps - strap - cam - screw - latch – wedge and toggle clamps- hydraulic and pneumatic clamps - design considerations common to jigs and fixtures - drill jigs – leaf – box - plate and indexing jigs - milling fixtures.

**PRESS WORKING**

Different types of presses - principles of operation and selection - computation of capacities and tonnage requirements - shear action in die cutting operations - blanking and piercing - clearances - die block design - punch dimensions- punch support - stops and strippers - design of compound and progressive dies - bending and drawing dies - bending allowances - bending methods - spring back - calculation of blank size and press tonnage for drawing.

**TEXT BOOK**

1. Boothroyd, Fundamentals of Metal Machining and Machine Tools, McGraw Hill publications, 2001.

**REFERENCES**

1. Sen and Bhattacharya, Metal cutting Theory and Practice, New central book agency, Calcutta, 2000.
2. HMT, Production Technology, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2000.
3. Black, Theory of metal cutting, McGraw Hill publications.
4. Ranganath, B.J., Metal Cutting and Tool Design, Vikas Publishing House.
5. Sharma, P.C., A TEXT BOOK of Production Engineering, S Chand and Co, New Delhi.
6. Pandey and Shah, Modern machining processes, Tata McGraw – Hill Publishing Company Limited, New Delhi
7. Koenigberg, Machining Science and their application, Pergamon Press.
8. Donaldson, Tool Design, Mc Graw Hill publications.

<b>MEC416</b>	<b>INDUSTRIAL SAFETY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **ACCIDENT PREVENTION**

Definitions - history of safety movement - ILO – NSC – BSC – LPA - theories and principles of accident causation - cost of accidents - accident reporting and investigation - safety committee - safety suggestion scheme - safety education and training -safety management techniques.

### **SAFETY MANAGEMENT**

Safety systems - safety information system – safety control system - hazard and risk analysis – risk assessment methodologies - Fault Tree Analysis (FTA) and Event Tree Analysis (ETA) - total loss control - risk management.

### **HUMAN FACTORS ENGINEERING**

Man machine system- human behaviour- principles of ergonomics- factors impeding safety and personal protective equipment.

### **OCCUPATIONAL HEALTH AND HYGIENE**

Physical hazards - chemical hazards – recognition of hazards – evaluation – control measures - occupational health – concept and spectrum of health – industrial toxicology – definitions – hazard – toxicity – local and systemic effect – routes of entry

### **SAFETY REGULATION**

History of legislations related to safety - factories act and rules - workmen compensation act - OSHA standards.

### **TEXT BOOKS**

1. John V Grimaldi and Rollin H Simonds, Safety management, All India Travelers book seller, New delhi,1989.
2. Occupational Safety manual, BHEL, 2002.

**REFERENCES**

1. Accident Prevention Manual for Industrial Operations, NSC, Chicago, 1982.
2. Brown, D.B., System Analysis and Design for Safety, Prentice Hall Inc., New Jersey, 1976.
3. Encyclopedia of Occupational Health and Safety, Vol. I and II, International Labour Organisation, Geneva, 1985.
4. Handbook of Occupational Health and Safety, NSC Chicago, 1982.
5. Heinrich, H.W., Industrial Accident Prevention, McGraw-Hill, 1980.
6. Lees, F.P., Loss Prevention in Process Industries, Butterworths, New Delhi, 1986.
7. McCormick, E.J., and Sanders, M.S., Human Factors in Engineering and Design, Tata McGraw-Hill, 1982.

<b>MEC417</b>	<b>WORK STUDY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INTRODUCTION**

History of work study - productivity and living standards - productivity measurement - work design and the organization- work content and time.

**OPERATIONS STUDY**

Total time for a job or operation - total work content and ineffective time - methods and motions - graphic tools.

**PROCESS AND TIME STUDY**

Process analysis - process and activity charts - operation analysis - basic procedure- micro motion study - principles of motion economy - work measurement - stop watch time study - standard data - methods time measurement (MTM) - development of production standards- learning effect - work sampling - rating and allowances -

setting standard times for jobs - standard data - and predetermined time standards.

### **JOB EVALUATION**

Basic concepts - objective and subjective methods - compensation schemes - relationship of work study to incentive schemes- wage incentive plans.

### **ERGONOMICS**

Fundamental concepts- issues in design of systems - human performance in physical work - measuring work by physiological means- work posture - fatigue measurement and evaluation - environmental factors and work systems- industrial product design.

### **TEXT BOOK**

1. Introduction to work study, International Labor Organization, Geneva, 4th edition, 1992.

### **REFERENCES**

1. Curri and Faraday, Work Study, ELBS, 4th edition, 1978.
2. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., Seventh Edition, 1982.
3. Barnes, R.M., Motion and Time Study, John Wiley, 1980.
4. Stephen Konz., Work Design, Publishing Horizon Inc., Second Edition, 1979.
5. Bridger, R.S., Introduction to Ergonomics, McGraw-Hill, 1995.

<b>MEC418</b>	<b>RAPID PROTOTYPING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION**

Introduction - basic concept - overview of existing technologies of proto type tooling - need for speed design to market operations.

### **BASICS OF TOOLING**

Product development - state of the technology- conceptual design - prototype tooling - engineering pilot - limitations.

### **DEVELOPMENT OF DATA REPRESENTATION**

CAD Processes - data requirements for solid modeling - data representation - part orientation and support - STL format - slicing – post processing.

### **RPT PROCESS**

Rapid prototyping systems - selective laser sintering - working principles - advantages and limitations - sterolithography - working principles - applications, advantages and limitations.

### **OTHER SYSTEMS**

Laminated object modeling - waving principles, applications - advantages and limitations – fused deposition, modeling - direct shell production casting - applications.

### **TEXT BOOK**

1. Soenen, R., and Olling, Advanced CAD/ CAM Systems, Narosa Publishing house, 1995.

### **REFERENCES**

1. Duvvent, W. R, The Lithography Hand book, Narosa Publishing house, 1995.
2. Rapind News, University of Warwick, UK, 1995.

<b>MEC419</b>	<b>PRODUCTION PLANNING AND CONTROL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**BASICS**

Objectives - types of production - product development and design - standardization- simplification and specialization - break even analysis – forecasting - need and its use - market share - sales trend analysis - use of indicators and correlation analysis - effects - accuracy of forecasts.

**PRODUCT PLANNING**

Extending the original product information - value analysis - process planning and routing - steps in process planning.

**PRODUCT DATA MANAGEMENT**

Product data management (PDM) - Enterprise application integration (EAI).

**INVENTORY CONTROL**

Material and tool control - physical control - record keeping - two-bin material control system - the super market concept - procurement and control of tools - inventory control - determination of economic order quantity and economic lot size- ABC analysis - reorder point and lead time - MRP I and II - JIT and KANBAN.

**SCHEDULING AND DISPATCHING**

Loading and scheduling information rearranging for loading and scheduling - master scheduling - perceptual loading - order scheduling devices – dispatching - progress reporting and expediting.

**TEXT BOOK**

1. Samuel Eilon, Elements of Production Planning and control, Universal Book Corp., 1984.

**REFERENCES**

1. Buffa, E.S., Modern Production/Operations Management, John Wiley sons, 7th edition, 1983.
2. Scheele, Principles and Design of Production Control Systems, Prentice Hall Inc., New Delhi, 2000.
3. Jain, K.C., and Aggarwal, L.N., Production planning control and Industrial Management, Khanna Publishers, 1997.
4. Martand Telsang, Industrial Engineering and Production Management, S. Chand and Company, 1st edition, 2000.
5. Jain, K.C., and Aggarwal, L.N., Production Planning Control and Industrial Management, Khanna Publishers, 1990.
6. Hajra Choudhury, S.K., Nirjhar Roy and Hajra Choudhury, A.K., Production Management, Media Promoters and Publishers Pvt. Ltd., 1998.
7. Chary, S.N., Theory and Problems in Production and Operations Management, Tata McGraw Hill, New Delhi, 1995.

<b>MEC420</b>	<b>INDUSTRIAL ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**PLANT LAYOUT AND MATERIALS HANDLING**

Plant location, - classification of layout – layout design procedures - CRAFT, ALDEP, CORELAP - materials handling systems – principles - classification of materials handling equipments - production and operation decisions.

**PRODUCTIVITY MANAGEMENT AND WORK STUDY**

Introduction, productivity models, organizational transformation, re-engineering, process improvement models, re-engineering tools and implementation, reverse engineering - work study - time study - method study - tools – methods.

**RELIABILITY ENGINEERING**

Reliability concept - reliability data analysis - prediction models - reliability management - risk assessment.

**ERGONOMICS OF MANUFACTURING**

Introduction - human performance - work space design - design of equipments - design of environment.

**PROJECT MANAGEMENT**

Phases of project management – network constructions – CPM – PERT – crashing – resource leveling - resource allocation.

**TEXT BOOKS**

1. ILO, Introduction to work study, Geneva, 1974.
2. Richard Francis L. and John A.White, Facilities layout and location an analytical approach, Prentice Hall Inc,1984.

**REFERENCES**

1. Barnes, Raeph.M, Motion and time study -design and measurement work, John wiley, Newyork, 1990
2. Khanna, O.P., Industrial Engineering and Management, Dhanpatrai Publication, 2004.
3. Gopalakrishnan, P., and Banerji, A.K., Maintenance and Spare Parts Management, Prentice Hall Of India, New Delhi, 1991.
4. Edosomwan, J.A., Organisational Transformation and Process Re-engineering, British Library Cataloging In Pub. Data, 1996.
5. Rastogi, P.N., Re-Engineering and Re-Inventing the Enterprise, Wheeler Publications, New Delhi, 1995.
6. Fiegenbarum, A.V., Total Quality Control, Mcgraw-Hill, Inc., 1991.
7. Modarres, Reliability and Risk Analysis, Maral Dekker Inc., 1993.
8. James Apple, M., Plant Layout and Material Handling, John Wiley, 1977.

9. Lee J Krajewski, Larry P Ritaman, Operations Managements, Addison-Wesley, 2000.
10. Prasannachandra, Project management, Tata Mcgraw Hill, 1986.

<b>MEC421</b>	<b>NON-DESTRUCTIVE EXAMINATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION NON-DESTRUCTIVE TESTING**

Basic Principles of non-destructive testing – technical backgrounds – destructive and non-destructive testing comparisons-statistical measures and tools - process capability - theory of probability - sampling - ABC standard

### **LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS**

Characteristics of liquid penetrants - different washable systems - developers - applications - methods of production of magnetic fields - principles of operation of magnetic particle test - applications - advantages and limitations.

### **RADIO GRAPHY**

Sources of ray - X-ray production - properties of X-rays - film characteristics - exposure charts - contrasts - operational characteristics of X-ray equipment - applications.

### **ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES**

Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - principles of acoustic emission techniques - advantages and limitations - instrumentation - applications.

### **ADVANCES IN NDT AND EQUIPMENTS**

Inspection management - conventional non destructive testing - pre and post weld - heat treatment - pressure testing - vessel inspection - sub-sea inspection - long range ultrasonics - tube inspection-

personnel resourcing ultrasonic immersion inspection systems - analytical equipment - lab scanners, profilometers, gas analyzers and leak detectors - industrial X-ray systems, exposure cabinets, X-ray tubes - magnetic particle and fluorescent penetrant inspection - optical inspection systems - mass spectrometers - UV inspection.

### TEXT BOOK

1. Barry Hull and Vernon John, Non Destructive Testing, MacMillan, 1988.

### REFERENCES

1. American Society for Metals, Metals Hand Book, Vol.II, 1976.
2. Progress in Acoustic Emission, Proceedings of 10th International Acoustic Emission Symposium, Japanese Society for NDI, 1990.

MEC422	COMPOSITE MATERIALS SCIENCE	L	T	P	C
		3	0	0	3

### INTRODUCTION TO COMPOSITE MATERIALS

Introduction to material science - conventional materials - limitations of conventional materials - definition of composite materials - types and characteristics - applications.

### METAL MATRIX COMPOSITES (MMC) AND POLYMER MATRIX COMPOSITES (PMC)

MMC – Introduction – processing - microstructure characterization - micromechanics and mechanics of deformation – applications – PMC – introduction – types – fillers – manufacturing processes – applications.

**FABRICATION PROCESSES**

Fundamentals - bag moulding - compression moulding pultrusion-filament winding - other manufacturing process - quality inspection and non-destructive testing.

**TESTING OF COMPOSITES**

Introduction to micro-mechanics-unidirectional lamina - laminates – inter-laminar stresses - static mechanical properties - fatigue properties - impact properties - environmental effects - fracture mechanics and toughening mechanisms, damage prediction, failure modes.

**FAILURE PREDICTIONS**

Failure predictions - design considerations - joint design - codes - design examples - optimization of laminated composites - application of FEM for design and analysis of laminated composites.

**TEXT BOOK**

1. Ronald Gibson, Principles of Composite Material Mechanics, Tata McGraw Hill, New Delhi, 1994.

**REFERENCES**

1. Micael hyer, Stress Analysis of Fiber - Reinforced Composite Materials, Tata McGraw Hill, New Delhi, 1998.
2. Mallicak, P.K., Fiber-reinforced composites, Monal Deklar Inc., New York, 1988.
3. Agarwal, B.D., and Broutman, L.J., Analysis and Performance of Fiber Composites, John Wiley and Sons, New York, 1980.

<b>MEC423</b>	<b>PRINCIPLES OF COMPONENT DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**PRODUCT DESIGN PROCESS**

The design process - morphology of design - design drawings - computer aided engineering - designing of standards - concurrent

engineering – product life cycle - technological forecasting – market identification competition bench marking - systems engineering - life cycle engineering - human factors in design industrial design.

### **CONCEPTUAL DESIGN**

Creativity and problem solving - product design specifications - conceptual design - decision theory embodiment design - detail design.

### **MODELLING AND OPIMIZATION**

Mathematical modeling - simulation - geometric modeling - finite element modeling - optimization - search methods - geometric programming - structural and shape optimization.

### **MATERIAL SELECTION AND DESIGN FOR ASSEMBLY**

Material selection process - economics - cost Vs performance - weighted property index - value analysis role of processing and design - classification of manufacturing processes - design for manufacture - design for assembly - design for castings, forging, metal forming, machining and welding - residual stresses – fatigue.

### **QUALITY IN DESIGN**

Total quality concept - quality assurance - statistics process control - Taguchi methods - robust design - failure model effect analysis.

### **TEXT BOOK**

1. Dieter George, E., Engineering Design - A Materials and Processing Approach, McGraw Hill, International Edition Mechanical Engg. Series, 1991.

### **REFERENCES**

1. Karl, T., Ulrich and Steven, Product Design and Development ,McGraw Hill, 2000.
2. Palh, G., and Beitz, W., Engineering Design, Springer -

Verlag , New York, 1985.

3. Ray, M.S., Elements of Engineering Design, Prentice Hall Inc, 1985.
4. Suh, N.P., The Principle of Design, Oxford University Press, New York, 1990.

<b>MEC424</b>	<b>INDUSTRIAL AUTOMATION AND ROBOTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION TO AUTOMATION**

Classification of Manufacturing Industries – Types of Production – Functions in Manufacturing – Organization and Information processing in Manufacturing – production concepts and mathematical models – concepts, definition, objective, arguments and strategies of automation

### **AUTOMATED FLOW LINES AND ASSEMBLY SYSTEMS**

General terminology – analysis of transfer lines with and without storage buffers – partial automation – computer simulation of automated flow lines – assembly systems and line balancing – methods of line balancing – computerized line balancing methods.

### **AUTOMATED MATERIALS HANDLING AND STORAGE SYSTEMS**

Functions – types of equipment, analysis and design of conveyor systems and automated guided vehicle systems, automated storage/retrieval systems, carousel storage systems, work-in-progress storage, interfacing handling and storage with manufacturing - Inspection - Principles and methods – sensor technologies – coordinate measuring machines, contact and non-contact inspection methods – machine vision.

**FLEXIBLE MANUFACTURING SYSTEMS**

Definitions – classifications – flexibility – typical configurations – computer control systems – planning the FMS – analysis methods for flexible manufacturing systems – applications and benefits.

**ROBOTICS**

Robot – Definition – Robot Anatomy – drives and end effectors – Robot programming - Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effector commands, and Simple programs - RGVS, AGV; Implementation of Robots in Industries

**TEXT BOOK**

1. Mikell. P. Groover, Automation Production Systems, and Computer Integrated Manufacturing, Prentice Hall of India Ltd., New Delhi, 1998.

**REFERENCES**

1. D. M. Considine and G. D. Considine, Standard Hand Book of Industrial Automation, Chapman and Hall, NJ, 1986.
2. Radhakrishnan and S. Subramaniyan, CAD/CAM/CIM, New Age International (P) Limited, New Delhi, 1998.
3. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi, (1994) 1996.

**MINOR ELECTIVES**

<b>EEE306</b>	<b>SPECIAL ELECTRICAL MACHINES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**SYNCHRONOUS RELUCTANCE MOTORS**

Constructional features – types – axial and radial air gap motors – operating principle – reluctance – Phasor diagram - characteristics – Vernier motor.

**STEPPING MOTORS**

Constructional features – principle of operation – variable reluctance motor – hybrid motor – single and multi stack configurations – theory of torque predictions – linear and non-linear analysis – characteristics – drive circuits.

**SWITCHED RELUCTANCE MOTORS**

Constructional features – principle of operation – torque prediction – power controllers – non-linear analysis – microprocessor based control - characteristics – computer control.

**PERMANENT MAGNET BRUSHLESS D.C. MOTORS AND INDUCTION MACHINES**

Principle of operation – types – magnetic circuit analysis – EMF and torque equations – power controllers – motor characteristics and control - Induction voltage regulator -Synchronous induction motor - power selsyn - position selsyn - linear motors.

**PERMANENT MAGNET SYNCHRONOUS MOTORS**

Principle of operation – EMF and torque equations – reactance – Phasor diagram – power controllers - converter - volt-ampere requirements – torque speed characteristics - microprocessor based control.

**TEXT BOOK**

1. Miller T.J.E., Brushless Permanent Magnet and Reluctance Motor Drives, Clarendon Press, Oxford, 1989.
2. Aearnley P., Stepping Motors – A Guide to Motor Theory and Practice, Peter Perengrinus, London, 1982.

**REFERENCES**

1. Kenjo, T., Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 1984.
2. Kenjo,T., and Nagamori,S., Permanent Magnet and Brushless DC Motors, Clarendon Press, London, 1988.

<b>EEE410</b>	<b>NEURAL NETWORK AND FUZZY LOGIC</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INTRODUCTION TO NEURAL NETWORKS**

Overview of biological Neuro-system - mathematical models of neurons - learning rules - learning paradigms – supervised - unsupervised and reinforcement learning.

**FEEDFORWARD AND FEEDBACK NETWORKS**

Perceptron networks - training rules – multilayer perceptron - back propagation algorithm - associative memories - Hopfield networks - Boltzman machine – self organizing map.

**FUZZY LOGIC**

Overview of classical sets - introduction to fuzzy logic - membership function - fuzzy rule generation - operations on fuzzy sets – compliment – intersections – unions - combinations of operations- fuzzy if-then rule - fuzzy inferencing – Mamdani, TSK – defuzzification.

**NEURO FUZZY SYSTEM**

Adaptive Neuro Fuzzy Inference Systems (ANFIS) – architecture - hybrid learning algorithm - Parameter identification-Rule base

structure identification – input selection -input space partitioning – Neuro-Fuzzy control.

### APPLICATIONS

Applications of neural network – pattern recognition - fuzzy logic control – inverted pendulum – image processing – home heating system – biomedical applications – applications of neuro-fuzzy system - character recognition - channel equalization-noise cancellation.

### TEXT BOOKS

1. Jang .J.S.R., Sun. C.T., E. Mizutani, Neuro-Fuzzy and Soft Computing, Prentice Hall of India Pvt. Ltd, New Delhi,2005
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill, 1997.

### REFERENCES

1. Laurance Fausett, Englewood cliffs, N.J., Fundamentals of Neural Networks, Pearson Education, 1992.
2. Zimmermann .H.J., Fuzzy Set Theory and its Applications, Allied Publication Ltd., 1996.
3. John Yen and Reza Langari, Fuzzy Logic – Intelligence Control and Information, Pearson Education, New Delhi, 2003.

<b>EIE310</b>	<b>INDUSTRIAL DRIVES AND CONTROLS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### INTRODUCTION

Basic elements – types of electric drives – factors influencing the choice of electrical drives – heating and cooling curves – loading conditions and classes of duty – selection of power rating for drive motors with regard to thermal overloading and load variation factors

**DRIVE MOTOR CHARACTERISTICS**

Mechanical characteristics – speed - torque characteristics of various types of load and drive motors – braking of electrical motors – DC motors - shunt, series and compound - single phase and three phase induction motors.

**STARTING METHODS**

Types of D.C motor starters – typical control circuits for shunt and series motors – three phase squirrel cage and slip ring induction motors.

**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C DRIVES**

Speed control of DC series and shunt motors – armature and field control, ward - Leonard control system - using controlled rectifiers and DC choppers – applications.

**CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES**

Speed control of three phase induction motor – voltage control, voltage / frequency control, slip power recovery scheme – using inverters and AC voltage regulators – IGBT - applications

**TEXT BOOKS**

1. Vedam Subrahmaniam, Electric Drives, Tata Mcgraw-Hill, New Delhi, 2001
2. Nagrath. I. J. and Kothari. D. P, Electrical Machines, Tata Mcgraw-Hill, New Delhi, 1998.
3. Pillai. S.K , A first course on Electric Drives, Wiley Eastern Limited, 1998

**REFERENCES**

1. M. D. Singh, K. B. Khanchandani, Power Electronics, Tata Mcgraw-hill, 1998
2. H. partab, Art and Science and Utilisation of electrical energy, Dhanpat rai and Sons, 1994.

3. Power Electronics, Circuits, Devices and Applications Rashid (Muhammad H), Pearson Education Private Limited, II Edition., 1995.

<b>EIE313</b>	<b>POWER PLANT INSTRUMENTATION AND CONTROL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **OVERVIEW OF POWER GENERATION**

Brief survey of methods of power generation-hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants – building blocks – details of boiler processes  $\dot{U}$ P and I diagram of boiler – cogeneration.

### **MEASUREMENTS IN POWER PLANTS**

Electrical measurements – current, voltage, power, frequency, power-factor, non-electrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature-drum level measurement – radiation detector – smoke density measurement – dust monitor.

### **ANALYZERS IN POWER PLANTS**

Flue gas oxygen analyser – analysis of impurities in feed water and steam – dissolved oxygen analyser – chromatography – PH meter-fuel analyser – pollution monitoring instruments.

### **CONTROL LOOPS IN BOILER**

Combustion control – air/fuel ratio control – furnace draft control – drum level control – main steam and reheat steam temperature control – super heater control – attemperator – deaerator control – distributed control system in power plants-interlocks in boiler operation.

### **TURBINE-MONITORING AND CONTROL**

Speed, vibration, shell temperature monitoring and control-steam pressure control – lubricant oil temperature control – cooling system.

**TEXT BOOKS**

1. Sam G. Dukelow, The control of Boilers, Instrument Society of America, 1991.
2. Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.

**REFERENCES**

1. Elonka, S.M.and Kohal A.L. Standard Boiler Operations, McGraw Hill, New Delhi, 1994.
2. R.K.Jain, Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 1995.

<b>ICE319</b>	<b>PIPING AND INSTRUMENTATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**FLOW SHEET DESIGN**

Types of flowsheets, flow sheet presentation, flow sheet symbols, line symbols and designation, process flow diagram, synthesis of steady state flowsheet, flowsheeting software.

**PIPING AND INSTRUMENTATION DIAGRAM EVALUATION AND PREPARATION**

P and I D symbols, line numbering, line schedule, P and I D development, various stages of P and ID - P and ID for pumps, compressors process vessels, absorber, evaporator.

**CONTROL SYSTEMS AND INTERLOCKS FOR PROCESS OPERATION**

Introduction and description, need of interlock, types of interlocks, interlock for pumps, compressor, heater-control system for heater, distillation column, expander.

**INSTRUMENT LINE DIAGRAM**

Line diagram symbols, logic gates, representation of line diagram.

**APPLICATION OF P ID'S**

Applications of P and ID in design state, construction stage, commissioning state, operating stage revamping state, applications of P and ID in HAZAPS and risk analysis.

**TEXT BOOKS**

1. Ernest E.Ludwig, Applied Process Design for Chemical and Petrochemical Plants Vol-I, Gulf Publishing Company, Houston, 1989.
2. Max. S. Peters and K.D. Timmerhaus, Plant Design and Economics for Chemical Engineers, 4<sup>th</sup> Edition, McGraw Hill Inc., New York, 1991.

**REFERENCES**

1. Anil Kumar, Chemical Process Synthesis and Engineering Design, Tata McGraw Hill, New Delhi, 1982.
2. A.N Westerberg et al., Process Flow sheeting, Cambridge University Press, New Delhi, 1979.

<b>CHE404</b>	<b>COMPUTATIONAL FLUID DYNAMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**CLASSIFICATION OF PARTIAL DIFFERENTIAL EQUATIONS**

Classification of partial differential equations - Discretization methods, finite difference and finite volume formulations – classification of PDES.

**NUMERICAL SOLUTION OF ELLIPTICAL EQUATIONS**

Numerical solution of elliptical equations - linear system of algebraic equations – iterative solution of system of linear equation.

**MODEL EQUATIONS**

Model equations – wave equations, numerical solution of parabolic equations, stability analysis – advanced shock capturing schemes.

**DIFFUSION EQUATION**

Solutions of convection, diffusion equation – conservative and non-conservative schemes – concept of artificial viscosity and numerical diffusion.

**NAVIER, STOKES EQUATIONS AND ALGORITHMS**

Navier, Stokes equations and algorithms - basics of grid generation, numerical solution of hyperbolic equations, burgers equation generation.

**TEXT BOOKS**

1. Anderson Jr., Computational Fluid Dynamics, John Wiley, Singapore, 1995.
2. Chow,C.Y., Introduction to computational fluid dynamics , John Wiley, Singapore 1979.
3. Hirsch,A.A., Introduction to computational fluid dynamics, McGraw Hill, New York, 1989.

**REFERENCES**

1. Wirz, H.J, Smeldern, J.J., Numerical methods in fluid dynamics, McGraw-Hill and Co.,New York,1978.
2. Ferziger,J.H,Milovan Peric , Computational Methods for fluid dynamics, Springer Verlag ,London, 2<sup>nd</sup> Edition,1997.
3. Pozrikidis,C., Introduction to Theoretical and Computational Fluid Dynamics, Oxford University Press,London, 1997.
4. Bose,T.K., Computation Fluid Dynamics , Wiley Eastern Ltd, Singapore, 1988.

<b>CHE405</b>	<b>COMPUTATIONAL HEAT TRANSFER</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION**

Physical phenomena governing differential equation, energy equation, momentum equation, nature of coordinates, Discretization methods.

### **PARABOLIC EQUATIONS**

Parabolic equations - explicit, implicit and Crank Nicholson Methods - Cartesian and Polar Coordinates - mixed boundary condition - Jacobi - Gauss, sieidel and SOR Methods.

### **HEAT CONDITION AND CONVECTION**

Heat condition and convection - control volume approach - steady and unsteady one dimensional conduction - two and three dimensional - power law scheme - simpler algorithm.

### **GENERAL APPLICABILITY OF THE METHOD**

General applicability of the method - approximate analytical solution - Raleigh's Method- Galerkin Method, solution methods.

### **CONDUCTION AND DIFFUSION EQUATIONS**

Isoparametric element formulations conduction and diffusion equations, heat transfer Packages, Heat 2, HEATAX, RADIAT, ANSYS.

### **TEXT BOOKS**

1. Muralidhar, K., Sundararajan, T., Computational fluid flow and heat transfer ,Narosa publishing house, New Delhi,2<sup>nd</sup> edition,2003.
2. Anderson,D.A., Tannehill,J.C and Pletcher,R.H., Computational fluid mechanics and heat transfer, Hemisphere publishing corporation ,New York,1984.

**REFERENCES**

1. Mitchell,A.R,Grifths,D.F., Finite Difference Method in Partial Differential Equations , John Wiley and Sons,Singapore,1980.
2. Suhas Patankar., Numerical Heat Transfer and Fluid Flow, (Hemisphere Series on Computational Methods in Mechanics and Thermal Science), Taylor and Francis,1<sup>st</sup> Edition ,1980.
3. Jaluria and Torrance, Computational Heat Transfer, Hemisphere Publishing Corporation, New York, 1986.

<b>CSE314</b>	<b>DIGITAL IMAGE PROCESSING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**REVIEW OF IMAGE FUNDAMENTALS**

The fast Fourier transform - other separable image transforms. Image Enhancement: Background - Enhancement by point processing - spatial filtering - Enhancement in the frequency Domain - generation of spatial masks from frequency domain specifications - color image processing.

**IMAGE RESTORATION**

Degradation model - Diagonalisation of circulant and Block Circulant Matrices - Algebraic approach to Restoration - Inverse filtering Least mean square filter - Constrained Least Squares Restoration - Interactive Restoration - Restoration in the spatial domain - Geometric Transformation.

**IMAGE COMPRESSION**

Fundamentals - Image Compression Models - Elements of Information theory - Error Free Compression - Lossy Compression - Compression Standards.

**IMAGE SEGMENTATION**

Detection of Discontinuities - Edge linking and Boundary Detection - Threshold - Region Oriented segmentation - The use of motion in segmentation.

### **IMAGE REPRESENTATION AND DESCRIPTION REPRESENTATION SCHEMES**

Boundary Descriptors - Regional Descriptors - Morphology - Relational Descriptors Recognition and Interpretation - Elements of Image Analysis - Patterns and Pattern Classes - Decision - Theoretic Methods - Structural Methods - Interpretation.

### **TEXT BOOK**

1. Rafael C., Gonzalez and Richard. E., Woods, Digital Image Processing, Addison Wesley, 1992.

### **REFERENCNS**

1. Pratt, Digital Image Processing, Tata McGraw Hill, 1991.
2. Anil K. Jain, Fundamentals of Digital Image processing, Prentice Hall of India, 1<sup>st</sup> Edition, 1998.

**HUMANITIES ELECTIVES**

<b>HSS001</b>	<b>TOTAL QUALITY MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

**INTRODUCTION TO QUALITY MANAGEMEME**

Definitions – TOM framework, benefits, awareness and obstacles - Quality – vision, mission and policy statements - Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

**PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT**

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart - Concepts of Quality circle, Japanese 5S principles and 8D methodology.

**STATISTICAL PROCESS CONTROL AND PROCESS CAPABILITY**

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed - Process capability – meaning, significance and measurement – Six sigma concepts of process capability - Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve - Business process re-engineering (BPR) – principles, applications, reengineering process, benefits and limitations.

**TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT**

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements

of reliability, failure rate, FMEA stages, design, process and documentation.

### **TAGUCHI TECHNIQUES**

Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio - Seven old (statistical) tools - Seven new management tools - Bench marking and POKA YOKE.

### **REFERENCES**

1. Dale H.Besterfield et al, Total Quality Management, Perarson Education, Thrid edition, (First Indian Reprints 2004).
2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition, 2002.
3. William J.Kolarii, Creating quality, Mcgraw Hill, 1995
4. Poornima M.Charantimath., Total quality management, Pearson Education, First Indian Reprint, 2003.

<b>HSS002</b>	<b>ENGINEERING MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

### **INTRODUCTION**

Demand and Revenue Analysis - Demand Forecasting - Production Analysis - Cost and Supply Analysis, Price and output Determination - Investment Analysis - Plant Location - Economic Optimization.

### **FORMS OF BUSINESS AND FUNCTIONS**

Types of Business Organisation, Forms - Planning - Organizing - Designing effective organisations – Coordination

### **HUMAN RESOURCE DEVELOPMENT**

Motivating individuals and workgroups - Leadership for Managerial Effectiveness - Team working and Creativity - Managerial Communication - Personal Management – Time Management - Stores Management - Career Planning.

**FINANCIAL MANAGEMENT**

Product development - Management techniques in product development - Nature of controlling - Operations Management - Just-in-Time.

**GLOBAL ENVIRONMENT**

Managing World Economic Change - The global environment - Multinational Strategies - Economic Cycles and Director Investment - Change and Organisation Development - Managerial Ethics and Social responsibilities.

**REFERENCES**

1. Harold Koontz& Heinz Weihrich, Essentials of Management, Tata McGraw Hill publishing company Ltd.
2. Koontz, Weihrich& Aryasri, Principles of Management, Tata McGraw Hill publishing company Ltd.
3. Tripathi& Reddy, Principles of Management, Tata McGraw Hill publishing company Ltd.
4. Hampton, Management, Tata McGraw Hill publishing company Ltd.
5. L.M.Prasad, Principles of Management.

<b>HSS003</b>	<b>INDIAN ECONOMIC DEVELOPMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INDIAN ECONOMIC SCENARIO**

Indian economy before and after Independence - National income trends and compositions. Sources of capital formation and savings - Sectoral growth. Demographic trends in India and its effect on economic development - Occupational structure of the labour force.

**ECONOMIC PLANNING AND POLICY**

Indian Economic Planning, fiscal policy, Monetary Policy, Unemployment in India and other economic policies

**INDUSTRIAL DEVELOPMENT**

Industry: Industrial development during the planning period - Industrial policies Industrial licensing policy – MRTP Act, FERA and FEMA - Growth and problems of small-scale industries - Role of Public sector enterprises in India's industrialization. Impact of economic reforms on Indian industrial sector after 1991.

**FOREIGN TRADE**

External Sector - Role of foreign trade. Trends in exports and imports - Composition and direction of India's foreign trade - Balance of payments crisis and the New Economic Reforms – Export promotion measures and the new trade policies - Foreign capital – FDI, aid: Multinational corporations in India

**ISSUES**

Important Areas of Concern - Poverty and inequality. Unemployment. Rising prices. Industrial relations. Industrial structure and causes of industrial backwardness.

**REFERENCES**

1. Agrawal, A.N. Indian Economy. Problems of Developmental Planning, Wiley Eastern Ltd., Calcutta, latest edition.
2. Ahluwalia, I.J. and I.M.D. Little (eds.), India's Economic Reforms and Development, Essays in honour of Manmohan Singh, Oxford University Press, New Delhi, 1999.
3. Alam, K., Agricultural Development in North East India: Constraints and Prospects, Deep & Deep Publications, New Delhi, 1993.
4. Choudhuri, Primit. Aspects of Indian Economic Development, Lord George Allen & Unwin Ltd., London, 1975.
5. Dutt, R.C., The Economic History of India Under Early British Rule, Low Price Publications, Delhi, 1950.
6. Dutt, Ruddar and K.P.M. Sundaram, Indian Economy, S. Chand & Co. Ltd., New Delhi, 2001.

<b>HSS004</b>	<b>INDUSTRIAL PSYCHOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION**

The role of the psychologist in industry, the field of occupational Psychology - Study of behaviour in work situation and applications of Psychological principles to problems of selection, Placement, Counseling and training

### **DESIGN OF WORK ENVIRONMENTS,**

Human engineering and physical environment techniques of job analysis, Social environment- Group dynamics in Industry Personal psychology - Selection, training, placement, promotion, counseling, job motivations, job satisfaction .Special Study of problem of fatigue, boredom and accidents,

### **UNDERSTANDING CONSUMER BEHAVIOUR**

Consumer behaviour; study of consumer preference, effects of advertising, Industrial morale - the nature and scope of engineering psychology, its application to industry

### **WORK METHODS**

Efficiency at work, the concept of efficiency, the work curve, its characteristics - The work methods; hours of work, nature of work, fatigue and boredom, rest pauses. The personal factors; age abilities, interest, job satisfaction The working environment - noise, illumination, atmospheric conditions - Increasing efficiency at work; improving the work methods, Time and motion study, its contribution and failure resistance to time and motion studies, need for allowances in time and motion study.

### **WORK AND EQUIPMENT DESIGN**

Criteria in evaluation of job-related factor, job design, human factors, Engineering information, input processes, mediation

processes, action processes, methods design, work space and its arrangement, human factors in job design. Accident and Safety - The human and economic costs of accidents, accident record and statistics, the causes of accidents situational and individual factors related to accident reduction

### REFERENCES

1. Tiffin,J and McCormic E.J., Industrial Psychology, Prentice Hall, 6th Edn., 1975.
2. McCormic E.J., Human Factors engineering and design, McGraw Hill, 4th Edn.,1976. Mair, N.R.F., Principles of Human relations
3. Gilmer, Industrial Psychology
4. Ghiselli & Brown, Personnel and Industrial Psychology.
5. Myer, Industrial Psychology.
6. Dunnete, M.D., Handbook of Industrial and Organizational Psychology.
7. Blum & Taylor, Industrial Psychology.

<b>HSS006</b>	<b>PROFESSIONAL ETHICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### ENGINEERING ETHICS

Functions of Being a Manager – Stock holder and stakeholder management - Ethical treatment of employees - ethical treatment of customers- supply chain management and other issues.

### ENGINEERING AS SOCIAL EXPERIMENTATION

Senses of Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas - Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Professions and Professionalism – Professional ideals and virtues – Theories about right action – Self-interest – Customs and religion – Use of Ethical Theories.

**ENGINEER RESPONSIBILITY FOR SAFETY**

Corporate social responsibility - Collegiality and loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Discrimination.

**RESPONSIBILITY AND RIGHTS**

Moral imagination, stake holder theory and systems thinking - One approach to management Decision – making Leadership.

**GLOBAL ISSUES**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample code of conduct.

**REFERENCES**

1. Mike Martin and Roland Schinzinger, Ethics in Engineering, McGraw Hill, New York, 1996.
2. Charles D Fledderman, Engineering Ethics, Prentice Hall, New Mexico, 1999.
3. Laura Schlesinger, How Could You Do That: The Abdication of Character, Courage, and Conscience, Harper Collins, New York, 1996.
4. Stephen Carter, Integrity, Basic Books, New York, 1996.
5. Tom Rusk, The Power of Ethical Persuasion: From Conflict to Partnership at Work and in Private Life, Viking, New York, 1993.

<b>HSS008</b>	<b>BASICS OF ECONOMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **DEFINITION AND SCOPE OF ECONOMICS**

Definitions by A. Smith, A. Marshal and L. Robbins, P.Samuelson and their critical examination - Nature and scope of Economics - Micro-economics in relation to other branches of Economics.

### **LAW OF DEMAND**

Elasticity of demand - price, income and cross, concepts and measurement - Marshallian theory of consumers' behaviour and its critical examination - Indifference curve analysis - Price, income and substitution effects - Giffen goods- Engel curve.

### **MARKET STRUCTURE**

Definition of market. Concepts of product and factor markets. Different types of market: perfect competition, monopoly, imperfect competition, monopolistic, competition and oligopoly. Demand and Supply schedules. Price determination under perfect competition in long and short run. Price determination under monopoly. Discriminating monopoly.

### **MACRO-ECONOMICS**

Meaning, Macro-economic Policy and Its Objectives and Instruments - National Income and Social Accounting - Concepts, components, and measurement - Basic circular flow of income model, Unemployment, trade cycle, Inflation - causes, types, effects and control.

### **COMMERCIAL AND CENTRAL BANKS**

Credit creation, monetary policy and tools - Balance of payments - Items in the balance of payments account, equilibrium in the balance of payments.

**REFERENCES**

1. Ackley, G., Macroeconomics: Theory and Policy, Macmillan Publishing Company, New York, 1978.
2. Gupta, S.B., Monetary Economics, S. Chand & Co., New Delhi, 1994.
3. Ruddar Datt and K.P.M.Sundharam, Indian Economy, S.Chand & Company Ltd., New Delhi, 2003.
4. Kindleberger, C.P., R.D. Irwin, International Economics, Home Wood, 1973.
5. Lewis, M.K. and P.D. Mizan, Monetary Economics, Oxford University Press, New Delhi, 2000.
6. Ahuja H.L., Economic Environment of Business, Macroeconomic analysis, S.Chand & Company Ltd., New Delhi, 2005.
7. Gupta, G.S. Macroeconomics, Theory and Applications, Tata McGraw-Hill publishing company Ltd., New Delhi, 2001.
8. D.N.Dewedi, Macro economic – Theory and policy, Tata McGraw-Hill publishing company Ltd., New Delhi, 2001.

<b>HSS010</b>	<b>INTERNATIONAL TRADE AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>FINANCE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INTERNATIONAL TRADE**

International Trade – Meaning and Benefits – Basis of International Trade – Foreign Trade and Economic Growth – Balance of Trade – Balance of Payment – Current Trends in India – Barriers to International Trade – WTO – Indian EXIM Policy.

**EXPORT AND IMPORT FINANCE**

Special need for Finance in International Trade – INCO Terms (FOB, CIF, etc.) – Payment Terms – Letters of Credit – Pre Shipment and Post Shipment Finance – Forfeiting – Deferred Payment Terms – EXIM Bank – ECGC and its schemes – Import Licensing – Financing methods for import of Capital goods.

**FOREX MANAGEMENT**

Foreign Exchange Markets – Spot Prices and Forward Prices – Factors influencing Exchange rates – The effects of Exchange rates in Foreign Trade – Tools for hedging against Exchange rate variations – Forward, Futures and Currency options – FEMA – Determination of Foreign Exchange rate and Forecasting.

**DOCUMENTATION IN INTERNATIONAL TRADE**

Export Trade Documents - Financial Documents – Bill of Exchange-Type- Commercial Documents - Performa, Commercial, Consular, Customs, Legalized Invoice, Certification of Origin Certificate Value, Packing List, Weight Certificate, Certificate of Analysis and Quality, Certificate of Inspection, Health certificate. Transport Documents - Bill of Landing, Airway Bill, Postal Receipt, Multimodal Transport Document. Risk Covering Document: Insurance Policy, Insurance Cover Note. Official Document: Export Declaration Forms, GR Form, PP Form, COD Form, Softer Forms, Export Certification, Certification of Origin, GSPS – UPCDC Norms

**EXPORT PROMOTION SCHEMES**

Government Organizations Promoting Exports – Export Incentives : Duty Exemption – IT Concession – Marketing Assistance – EPCG, DEPB – Advance License – Other efforts I Export Promotion – EPZ – EQU – SEZ and Export House.

**REFERENCES**

1. Apte P.G., International Financial Management, Tata McGraw Hill.
2. Larceny & Bhattacharya, International Marketing, Sultan Chand & Sons.
3. B.M.Wali and AB Kalkumdrikas, Export Management, Sterling Publishers Pvt., Ltd.
4. Websites of WTO, World Bank, IMF, Ministry of Commerce, ECGC and EXIM Bank.

<b>HSS011</b>	<b>INFORMATION SYSTEMS FOR MANAGERIAL DECISION MAKING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**INTRODUCTION**

Information system – establishing the framework – business model – information system architecture – evolution of information systems.

**INFORMATION SYSTEM**

Functional areas, Finance, marketing, production, personnel – levels, Concepts of DSS, EIS, ES – comparison, concepts and knowledge representation – managing international information system.

**SYSTEM DEVELOPMENT**

Modern information system – system development life cycle – structured methodologies – designing computer based method, procedures control, designing structured programs.

**IMPLEMENTATION AND CONTROL**

Testing security – coding techniques – detection of error – validation – cost benefits analysis – assessing the value and risk information systems.

**SOFTWARE ENGINEERING**

Software engineering qualities – design, production, service, software specification, software metrics, and software quality assurance – software life cycle models – verification and validation.

**REFERENCES**

1. Kenneth C. Laudon and Jane Price Laudon, Management Information systems Managing the digital firm, Pearson Education, Asia.
2. Gordon B.Davis, Management Information system: Conceptual Foundations, Structure and Development, McGraw Hill, 1974.

3. Joyce J. Elam, Case series for Management Information System, Silmon and Schuster, Custom Publishing, 1996.
4. Steven Alter, Information system – A Management Perspective, AddisonWesley, 1999.
5. James AN O’ Brein, Management Information Systems, Tata McGraw Hill, New Delhi, 1999.
6. Turban Mc Lean, Wetherbe, Information Technology Management making connection for strategic advantage, John Wiley, 1999.
7. Ralph M.Stair and George W.Reynolds, Principles of Information Systems – A Managerial Approach Learning, 2001.

<b>HSS013</b>	<b>COST ANALYSIS AND CONTROL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **INTRODUCTION TO COSTING**

Costing, Elements of costing, Types of cost, Preparation of cost sheet.

### **COST ANALYSIS**

Marginal costing, Cost - volume – Profit analysis, Break-Even-Analysis, Break – Even-Chart, Applications.

### **CONTROL TECHNIQUES**

Budgeting and Budgetary control, Types of Budgets , Preparation of purchase Budget, Flexible budgets, Cash Budget, Sales Budget, Materials Budget, Master Budget, Zero based Budgeting.

### **STANDARD COSTING**

Types of Standards, Setting up of standards, Advantages and Criticism of Standard Costing – Control through variances.

### **ACTIVITY BASED COSTING**

Transfer Pricing, Target costing, Life Style Costing, Activity Based Costing (only theory).

**REFERENCES**

1. K.Saxena & C.D. Vashist, Advanced Cost Accounting and Cost Systems, V.Sultan Chand & Sons Publishers.
2. S.P. Jain & K. L. Narang, Advances Cost Accounting Kalyani Publishers.
3. Cost Management, The Institute of Chartered Accountants of India.
4. J. Blocher, K. H. Chen, G. Cokins and T. W. Lin., Cost Management: A Strategic Emphasis, Irwin/McGraw-Hill, 3d edition, 2005
5. J. Sha, Cases in Cost Management: a Strategic Emphasis by Second Edition. South-Western, 2001
6. Bhabatosh Bangerjee, Financial Policy & management ,Prentice Hall
7. Anthony.Dearden & Vancil, Management Control Systems, Irwin

<b>HSS014</b>	<b>MARKETING MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

**MARKETING**

Meaning - concept - functions - marketing Planning & implementation marketing Programmes - Marketing environment – Market Segmentation and consumer behaviour – Influencing factors, Decision process – Marketing mix – Marketing department.

**PRODUCT**

Meaning - Product planning - policies - positioning - New product development Product life cycle – BCG Matrix-branding. Packing, labeling.

**PRICING**

Pricing objectives – Setting and modifying the price – Different pricing method Product line pricing and new product pricing

**DISTRIBUTION**

Nature of Marketing channels - Types of Channel flows - Channel functions - Channel co-operation, conflict and competition - Direct Marketing Telemarketing, Internet shopping.

**PROMOTION**

Promotion Mix - Advertisement - Message - copy writing - Advertisement - budgeting - Measuring advertisement effectiveness - Media strategy - sales promotion - Personal selling, publicity and direct marketing.

**REFERENCES**

1. Philip Kotler, Marketing Management- Analysis Planning and Control, Prentice Hall of India, New Delhi.
2. Cundiff, Still & Govoni, Fundamentals of Modern Marketing, Prentice Hall of India, New Delhi.
3. Ramaswamy. V S & Namakumari. S, Marketing Management- Planning Implementation and Control, Macmillan Business Books, 2002.
4. Jobber, Principles and Practice of Marketing, McGraw-Hill.

<b>HSS015</b>	<b>MANAGEMENT CONCEPTS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>TECHNIQUES</b>	3	0	0	3

**DEVELOPMENT OF MANAGEMENT THOUGHT**

Scientific Management Movement, Administrative Movement, Human- Relations Movement, Decision-Science Movement, Behavioral Movement, Systems Movement, Contingency Movement

**ESSENTIALS OF PLANNING**

Objectives, goals, Programmed Decisions and Un programmed Decisions; Decision-Making, Creativity in Decision-Making, Forecasting and Strategy to Formulation.

**EFFECTIVE ORGANIZING**

Span of Control, Departmentation, Authority; Responsibility, Bureaucracy and Adhocracy; Group Dynamics

**REALITIES OF ORGANIZATIONAL LIFE**

Organizational Politics, Organizational Power, Organizational Conflict

**COMMUNICATION & CONTROL**

Communication Process Evaluation, Control Process, Qualities of a Good Control System, Management Audit, Human – Offset Accounting, Cost Benefit Analysis.

**REFERENCES**

1. Harold Koontz & Heinz Weihrich, Essentials of Management, Tata McGraw Hill publishing company Ltd.
2. Koontz, Weihrich & Aryasri, Principles of Management, Tata McGraw Hill publishing company Ltd.
3. Tripathi & Reddy, Principles of Management, Tata McGraw Hill publishing company Ltd.
4. Hampton, Management, Tata McGraw Hill publishing company Ltd.
5. L.M.Prasad, Principles of Management.

<b>HSS016</b>	<b>ORGANIZATIONAL PSYCHOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

**FOCUS AND PURPOSE**

Definition, need and importance of organizational Behaviour – nature and scope – frame work.

**INDIVIDUAL BEHAVIOUR**

Personality – types – factors influencing personality – theories – learning – types of learners – learning theories – organizational Behaviour modification. Attitudes – characteristics – components – formation – measurement. Perceptions – importance – factors influencing perception – interpersonal perception.

**GROUP BEHAVIOUR**

Organization structure – formation – groups in organizations – influence – group dynamics – emergence of informal leaders and working norms – group decision making techniques – interpersonal relations – communication – control.

**POWER**

Leadership styles – theories – leaders Vs managers – sources of power – power centers – power and politics.

**DYNAMICS OF ORGANIZATIONAL BEHAVIOURS**

Organizational climate – factors affecting organizational climate – importance. Job satisfaction – determinants – measurements – influence on behavior. Organizational change – importance – stability Vs change – proactive Vs reaction change – the change process – resistance to change – managing change. Organizational development – characteristics – objectives – team building. Organizational effectiveness – perspective – effectiveness Vs efficiency – approaches – the time dimension – achieving organizational effectiveness.

**REFERENCES**

1. Stephen P. Robins, Organisational Behavior, Prentice Hall of India, 9th edition, 2001.
2. Hellriegel, Slocum and Woodman, Organisational Behavior, South-Western, Thomson Learning, 9th edition, 2001.
3. Schermerhorn, hunt and Osborn, Organisational behavior, John Wiley, 7th edition, 2001.

4. Jit S.Chand, Organisational Behavior, Vikas publishing House Pvt. Ltd. 2nd edition, 2001.
5. Fred Luthans, Organisational Behavior, McGraw Hill Book Co., 1998.
6. New Strom & Davis, Organisational behaviour, McGraw Hill, 2001.
7. Jaffa Harris and Sandra Hartman, Organisational Behaviour, Jaico, 2002.

<b>HSS017</b>	<b>INTERNATIONAL ECONOMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

### **INTRODUCTION**

The Traditional Theory of International Trade, The Basic Trade Model, Heckscher-Ohlin-Samuelson Model, Effects of Tariffs & Quotas, Theory of Factor Movements - New Theories of International Trade and Industrial Policies.

### **EXCHANGE RATE & BALANCE OF PAYMENT**

The Balance of Payments and National Accounts, Determinants of Exchange Rates The Exchange-Rate Regime Choice and a Common Currency Area, International Debt and Currency Crises.

### **INTERNATIONAL REGULATORY AUTHORITY**

Political Economy of Trade Disputes, the FTA and the WTO - The role of the IMF and other International Financial Organizations.

Reasons for Protection World Trade, International Movements of Capital - The Balance of Trade and Other Measures of International Transactions. Export and import policies.

### **INTERNATIONAL MACROECONOMICS**

European Monetary Unification and the Euro - Preferential Trading Arrangements and the NAFTA International Policies for Economic Development, Trade Outsourcing and Off shoring

**REFERENCES**

1. Bhagwati N., A. Panagariya and T. N. Srinivasan, Lectures on International Trade, MIT Press, 2<sup>nd</sup> edition, 1998.
2. Obstfeld M., and K. Rogoff, Foundation of International Macroeconomics, McGraw-Hill, 1996.
3. Romer, D., Advanced Macroeconomics, McGraw Hill, 1996.

<b>HSS018</b>	<b>COMMUNICATION SKILLS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

**COMMUNICATION IN BUSINESS**

Systems approach, forms of business communication, management and communication, factors facilitating communication.

**COMMUNICATION PROCESS**

Interpersonal perception, selective attention, feedback, variables, listening barriers to listening, persuasion, attending and conducting interviews, participating in discussions, debates and conferences, presentation skills, paralinguistic features, oral fluency development.

**BUSINESS CORRESPONDENCE**

Business letter. Memos, minutes, agendas, enquiries, orders, sales letters, notice, tenders, letters of application, letter of complaints.

**TECHNICAL REPORTS**

Format, Choice of vocabulary, coherence and cohesion, paragraph writing, organization.

**PROJECT REPORTS**

Project proposal, project reports, and appraisal reports.

**REFERENCES**

1. Sharan J.Genrson and Steven M.Gerson, Technical Writing - Process and Product, Pearson Education, 2000.

2. Raymond V.Lesikar, John D. Pettit and Mary E.Flatley, Lesikass Basic Communication, Tata McGraw Will, 8th Edition, 1999.
3. Stevel. E. Pauley, Daniel G.Riordan, Technical Report Writing Today, AITBS Publishing & Distributors, India 5th edition, 2000.
4. Robert L.Shurter, Effective letters in business, Third Ed., 1983.
5. McGraith, Basic Managerial Skills for all Prentice Hall of India, 6th Edition, 2002.
6. Halliday, M.A.Ky R.Hasan, Cohesion in English, Longman, London, 1976.

<b>HSS019</b>	<b>OPERATIONS RESEARCH</b>	L	T	P	C
		3	0	0	3

### **INTRODUCTION TO LINEAR PROGRAMMING**

Introduction to applications of operations research in functional areas of management - Linear Programming - formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase), Special cases - Dual simplex method.

### **TRANSPORTATION MODELS AND ASSIGNMENT MODELS**

Transportation Models (Minimising and Maximising Cases) – Balanced and unbalanced cases – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel’s approximation methods - Check for optimality - Solution by MODI / Stepping Stone method - Cases of degeneracy - Transshipment Models - Assignment Models (Minimising and Maximising Cases) – Balanced and Unbalanced Cases - Solution by Hungarian and Branch and Bound Algorithms - Travelling Salesman problem - Crew Assignment Models.

### **INTEGER LINEAR PROGRAMMING AND GAME THEORY**

Solution to pure and mixed integer programming problem by Branch and Bound and cutting plane algorithms - Game Theory - Two person Zero sum games - Saddle point, Dominance Rule, graphical and LP solutions.

### **REPLACEMENT MODELS AND DECISION THEORY**

Replacement Models-Individuals replacement Models (With and without time value of money) – Group Replacement Models - Decision making under risk – Decision trees – Decision making under uncertainty.

### **PROJECT MANAGEMENT METHOD AND SIMULATION**

PERT / CPM – Drawing the network, computation of processing time, floats and critical path. Resource leveling techniques - Application of simulation techniques for decision making.

### **REFERENCES**

1. Kalavathy S, Operations Research, Vikas Publishing House, Second Edition, third Reprint 2004.
2. Paneerselvam R., Operations Research, Prentice Hall of India, Fourth Print, August 2003.
3. Tulsian P.C, Vishal Pandey, Quantitative Techniques (Theory and Problems), Pearson Education, Asia, First Indian Reprint 2002.

<b>HSS020</b>	<b>HUMAN RESOURCE MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

### **INTRODUCTION**

Functions of a human resources manager - recruitment and selection processes interview methods.

### **HR- EVALUATION AND DEVELOPMENT**

Performance appraisal, Training and development, disciplinary procedures, collective bargaining and employee welfare.

### **TRENDS IN HRM**

The recent methods and trends in HRM with a few case studies in the context of globalization.

## **STRATEGIC ROLE OF HUMAN RESOURCE MANAGEMENT**

Job analysis Personnel planning and recruiting Employee testing and selection, interviewing candidates, Appraising performance.

## **CAREER AND COMPENSATION**

Managing careers Compensation Benefits and services Labor relations and collective bargaining Employee safety and health

## **REFERENCES**

1. Decenzo and Robbins, Human Resource Management, Wiley, 6<sup>th</sup> edition, 2001.
2. Biswajeet Pattanayak, Human Resource Management, Prentice Hall of India, 2001.
3. Eugene McKenna and Nic Beach, Human Resource Management, Pearson Education.
4. Dessler, Human Resource Management, Pearson Education Limited, 2002.
5. Mamoria C.B and Mamoria S., Personnel Management, Himalaya Publishing.
6. Wayne Cascio, Managing Human Resources, McGraw-Hill, 1998.
7. Ivancevich, Human Resource Management, McGraw-Hill, 2002.

<b>HSS022</b>	<b>BANKING THEORY AND PRACTICE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

## **EVOLUTION OF BANKING SYSTEM**

Central Banking functions, Reserve Bank control over banks.

## **BANKER - CUSTOMER RELATIONSHIP**

Bank as borrowers, customer accounts, duties of paying and collecting bankers.

**LENDING BY BANKS**

RBI control over loans and advances, Securities for loans.

**AGENCY SERVICES BY BANKS**

Banker as bailee, safe deposit vaults, credit cards.

**CONSUMERS OF BANKING SERVICES**

Protection against deficiency in banking services.

**REFERENCES**

1. M.L.Tannan, Tannan's Banking Law and Practice in India, India Law House, New Delhi, 1997.
2. S.N.Gupta, The Banking Law in theory and Practice Vol. I & II, Universal Law Publishing Co., 1999.
3. M.S.Parthasarathy, Banking Law-Leading Indian Cases, N.M.Tripathi, 1985.
4. L.C.Goyle, Law of Banking and Bankers, Eastern Law House, 1995.

<b>HSS023</b>	<b>ENTREPRENEURSHIP DEVELOPMENT</b>	L	T	P	C
		3	0	0	3

**ENTREPRENEURIAL COMPETENCE**

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneur – Personality Characteristics of Successful Entrepreneur – Knowledge and Skills Required for an Entrepreneur.

**ENTREPRENEURIAL ENVIRONMENT**

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organisational Services - Central and State Government Industrial Policies and Regulations - International Business.

**BUSINESS PLAN PREPARATION**

Sources of Product for Business – Pre-feasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

**LAUNCHING OF SMALL BUSINESS**

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching.

**MANAGEMENT OF SMALL BUSINESS**

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units - Effective Management of small Business.

**REFERENCES**

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.
2. P. Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai, 1997.
3. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001.
4. Prasama Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, 1996.
5. P.C.Jain (ed.), Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi, 1999.
6. Staff College for Technical Education, Manila and Centre for Research and Industrial Staff Performance, Bhopal, Entrepreneurship Development, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998.

<b>HSS024</b>	<b>INDUSTRIAL PSYCHOLOGY</b>	L	T	P	C
		3	0	0	3

A Perspective of Industrial Economics  
 The Analysis of Markets and Market Structure  
 Goals of Firms/Industry and Market Performance  
 Vertical Integration and Diversification  
 Technical Progress and Issues of Public Policy

### REFERENCES

1. Gupta, G.S. Macroeconomics, Theory and Applications, Tata McGraw-Hill publishing company Ltd., New Delhi, 2001.
2. Samuelson, Paul A., and Nordhaus, W.D., Economics, Tata McGraw-Hill publishing company Ltd., New Delhi 2004.
3. D.N.Dewedi, Macro economic – Theory and policy, Tata McGraw-Hill publishing company Ltd., New Delhi, 2001.
4. K.P.M.Sundaram, Money Banking and international Trade, Himalaya Publishing House.

<b>HSS031</b>	<b>English Advance Level</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
---------------	------------------------------	----------	----------	----------	----------

Course Objectives : Acquisition of higher order Language skills: Style, Idiom, Nuance.  
 Literature Appreciation.

Course Content : Writing: Essays, Reports,  
 Reading: Select Literary Texts: Prose,  
 Poetry, Drama, Short Stories,  
 Book Review, Oral Skills : Presentations; Discussions

### REFERENCES:

1. Cambridge Advanced Learners' Dictionary 2005.
2. Palgrave's Golden Treasury: Ed. Palgrave, Frances Taylor London: Oxford University Press, 1861.
3. 20<sup>th</sup> Century English Literature, London: Penquin 1992.

4. The Garden of Forking Paths and other stories : Harris, V.C.  
New Delhi: Oxford University Press, 2002.
5. Discussion Materials: Film / News Clippings, Plays etc.