
B.Tech- MECHANICAL
CURRICULUM and SYLLABUS
(Regulation 2014)

Department of Mechanical Engineering



KALASALINGAM UNIVERSITY
(Kalasalingam Academy of Research and Education)
(Under sec.3 of UGC Ac,1956)
Anand Nagar, Krishnankoil-626126,
Srivilliputtur (via), Virudhunagar (Dt) Tamilnadu,India.
(www.kalasalingam.ac.in)

**B. TECH - MECHANICAL
CURRICULUM
AND
SYLLABUS**

KALASALINGAM UNIVERSITY
Anand Nagar, Krishnankoil - 626 190
Department of Mechanical Engineering
Curriculum and Syllabi

Semester I

Course Code	Course Name	L	T	P	C
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

Course Code	Course Name	L	T	P	C
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
HSS036	Soft Skills – I*				1
	Total	19	0	6	22

* Except SHIP – Mechanical

Semester III

Course Code	Course Name	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
HSS037	Soft Skills – II*				1
	Total	18	3	6	26

* Except SHIP – Mechanical

Semester IV

Course Code	Course Name	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
MEC209	Thermal Engineering	3	1	0	4
MEC282	Manufacturing Technology Laboratory	0	0	3	2
MEC283	Thermal Laboratory I	0	0	3	2
HSS038	Soft Skills – III*				1
	Total	18	4	6	27

* Except SHIP – Mechanical

Semester V

Course Code	Course Name	L	T	P	C
MECxxx	Major Elective I	3	0	0	3
	Minor Elective I	3	0	0	3
MEC328	Advanced Machine Tools And Metrology	3	0	0	3
MEC303	Design of Machine Elements	3	1	0	4
MEC304	Dynamics of Machinery	3	1	0	4
MEC329	Gas Dynamics and Jet Propulsion	3	1	0	4
MEC387	Machine Drawing Practice Laboratory	1	0	3	2
MEC382	Machine Tool and Metrology Laboratory	0	0	3	2
MEC383	Dynamics and Vibration Laboratory	0	0	3	2
MEC391	Community Service Project – Phase I			2	1
	Total	19	3	9	28

Semester VI

Course Code	Course Name	L	T	P	C
HSSxxx	Humanities Elective II	3	0	0	3
MECxxx	Major Elective II	3	0	0	3
	Free Elective I	3	0	0	3
MECxxx	Major Elective III	3	0	0	3
MEC307	Design of Transmission Systems	3	1	0	4
MEC327	Heat and Mass Transfer	3	1	0	4
MEC385	Thermal Laboratory II	0	0	3	2
MEC392	Community Service Project – Phase II			3	2
	Total	18	2	9	24

Semester VII

Course Code	Course Name	L	T	P	C
HSSxxx	Humanities–Elective III	3	0	0	3

	Free Elective II	3	0	0	3
MECxxx	Major Elective IV	3	0	0	3
	Minor Elective II	3	0	0	3
MEC401	Power Plant Engineering	3	0	0	3
MEC402	Automobile Engineering	3	0	0	3
MEC403	Mechatronics	3	1	0	4
MEC481	Simulation Laboratory	0	0	3	2
	Total	21	1	3	24

Semester VIII

Course Code	Course Name	L	T	P	C
MECxxx	Self Study Elective	3	0	0	3
MEC499	Project Work	0	0	26	10
	Total	3	0	26	13

Total Credit (from 1st semester to 8th semester) =183

MAJOR ELECTIVES

Course Code	Course Name	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	3	0	0	3

	Conditioning				
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
MEC325	Welding Technology	3	0	0	3
MEC330	Robotics and Robot Applications	3	0	0	3
MEC331	Vibration Analysis and Noise Monitoring	3	0	0	3
MEC332	Renewable Energy Techniques	3	0	0	3
MEC333	Design of Heat Transfer Equipments	3	0	0	3
MEC334	Foundry Mechanization and Management	3	0	0	3
MEC335	Recent Trends in Welding Techniques	3	0	0	3
MEC336	Mechanical Behaviour of Materials	3	0	0	3
MEC337	Manufacturing System and Simulation	3	0	0	3
MEC338	Gear manufacturing and Inspection	3	0	0	3
MEC339	Tooling for Production	3	0	0	3
MEC340	Composite Materials Science	3	0	0	3
MEC341	Principles of Component Design	3	0	0	3
MEC342	Computational Fluid Dynamics and Heat Transfer	3	0	0	3
MEC343	Heat treatment and surface treating	3	0	0	3
MEC412	Micro Electro Mechanical Systems	3	0	0	3
MEC414	Sensors and	3	0	0	3

	Transducers				
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
MEC424	Industrial Automation and Robotics	3	0	0	3

MINOR ELECTIVES

Course Code	Course Name	L	T	P	C
BIT307	Environmental biotechnology	3	0	0	3
CHE311	Corrosion science and engineering	3	0	0	3
CHE405	Computational Heat Transfer	3	0	0	3
CIV367	Air pollution and control	3	0	0	3
CIV369	Environmental impact assessment	3	0	0	3
CIV425	Disaster Management and Thermo Dynamics	3	0	0	3
CIV464	Industrial Waste Water Management	3	0	0	3
CIV465	Solid and hazardous waste management	3	0	0	3
CSE206	Object oriented programming	3	0	0	3
CSE314	Digital Image Processing	3	0	0	3
ECE301	Digital signal processing	3	0	0	3
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
EIE313	Power Plant Instrumentation and	3	0	0	3

	Control				
EIE319	Piping and Instrumentation	3	0	0	3
INT355	Internet and web technology	3	0	0	3
MEC427	Nano-Structured materials	3	0	0	3

HUMANITIES ELECTIVES

Course Code	Course Name	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

ONE CREDIT COURSES

Course Code	Course Name	Credits
MECX001	Non destructive testing	1
MECX002	Advanced welding processes	1
MECX003	CNC programming	1
MECX004	Plastic processing technology	1

ONLINE COURSES

Course Code	Course Name	Credits
MECO001	Material selection and design	3
MECO002	Micro and smart systems	3
MECO003	Finite element analysis of solids and fluids - i	3
MECO004	Mechanical assembly and its role in product development	3

THEORY SUBJECT WITH PRACTICAL COMPONENT (*)

1.	Material Science (MEC206)
2.	Heat and Mass Transfer (MEC327)
3.	Non Traditional Machining Techniques (MEC311)
4.	Vibration Analysis and Noise Monitoring (MEC331)

LABORATORY COURSES WITH PROJECT ()**

1.	Manufacturing Technology Lab (MEC282)
2.	Machine Drawing Practice Lab (MEC387)
3.	Simulation Lab (MEC481)

SEMESTER I

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

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, 17th 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, 7th 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.

MAT101	MATHEMATICS I (Common to all Branches)	L	T	P	C
		3	0	0	3

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 Coordinates – 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, 8th Edn., 2001.
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume I, Scitech Publications (India) Pvt. Ltd., Chennai, 2nd Edn., Reprint 2000, 1999.

REFERENCES

1. Grewal , B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edn., 5th Reprint 2004, 2003.
2. Venkataraman, M. K., Engineering Mathematics First Year, The National Publishing Company, Chennai, 2nd 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-Gamma ray- spectroscopy, characterization 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, 28th Edition, 2001.

CHY106	CHEMISTRY	L	T	P	C
		3	0	0	3

WATER

Water quality parameter (Industry and Drinking Water) - Hardness, Definition, Classifications, Expressions, Units of Hardness of Water with respect to CaCO₃, 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 sludge - 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, 14th Edition, 2002
2. Sharma, B.K., Industrial Chemistry, Goel Publishing House, Meerut, 12th Edition, 2001

REFERENCES

1. Puri, B.R., Sharma, L.R., Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., Jalandhar, 40th Edition, 2003
2. Vogel, A.I., A text book of Quantitative Inorganic Analysis, ELBS, London, 3rd Edition, 2000
3. Mick Wilson and Kamali Kannangara, Nanotechnology: Basic science and emerging Technology, Overseas India Pvt. Ltd. Press, New Delhi, 1st Edition, 2005
4. Bandyopadhyay, A.K., Nano Materials, New Age International Publishers, New Delhi, 1st Edition, 2007
- 5.

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

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 – missing view - 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, projection of polygonal surface and circular lamina located in first quadrant inclined to one or both reference planes.

PROJECTION OF SOLIDS 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 – types of section – full section and half section -conventional section lines - section of simple solids like prisms, pyramids, cylinder and cone in 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

ISOMETRIC AND PERSPECTIVE PROJECTION

Principles of isometric projection – isometric view and projections of simple solids, truncated prisms, pyramids, cylinders and cones - Orthographic to isometric view – Introduction to perspective projection.

Text Book

1. Basant Aggarwal and C. Aggarwal, Engineering Drawing, Tata McGraw-Hill publishing company, New Delhi, 2008

References

1. Shah, M.B., and Rana, B.C., Engineering Drawing, Pearson Education, New Delhi, 2005.
2. Natarajan, K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2006.
3. Bhatt, N.D., Engineering Drawing, Charotar publishing House, New Delhi, 46th Edition, 2003.
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.

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

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.

MEC181	WORK SHOP	L	T	P	C
		0	0	3	1

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.

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

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

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

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, 4th Edition, 1986.
5. Tom Hutchinson, Alan Waters, English for Specific Purpose, Cambridge University Press, 1987.

MAT102	MATHEMATICS II (Common to all Branches)	L	T	P	C
		3	0	0	3

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, 8th Edn., 2001.
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Engineering Mathematics Volume II, Scitech Publications (India) Pvt. Ltd., Chennai, 1st Edn., Reprint 2000, 1999.

REFERENCES

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

REFERENCES

1. Aswani K.G., A Text book of Material Science, S.Chand & Co., Ltd., New Delhi, 2nd 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.

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

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, 9th 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 , 2nd 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, 1st edition 2004.

REFERENCES

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, 1st edition 2001.
2. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. USA, 2nd edition 2004.
3. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media., New Delhi, 2nd edition 2004.
4. Masters, G. M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 2nd edition 1997
5. Henry, J. G. and Heike, G. W. Environmental Science and Engineering, Prentice Hall International Inc., New Jersey, 1st edition 2005.

CSE102	PROGRAMMING LANGUAGES (Common to all Branches)	L	T	P	C
		2	0	0	2

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 – go to 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 - Start up 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.

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

STATICS OF PARTICLES

Six Fundamental principles and concepts - vector algebra- basics, external and internal forces, concurrent and non-concurrent coplanar forces - resultant and resolution static equilibrium of particles in 2-D and 3-D,

STATIC OF RIGID BODIES

Moment about point and about axis - Varignon's theorem - Static equilibrium of rigid body in 2-D and 3-D, free body diagram, supports and reactions - Problem formulation concept in 2-D and 3-D.

FRICTION

Frictional forces- Types- laws of dry friction- simple contact friction - Sliding block, wedges, ladder friction - rolling resistance - belt friction - Axle friction, disk friction –Examples.

PROPERTIES OF SURFACES AND SOLIDS

Centroids of lines - areas, volumes, composite bodies, Centre of gravity- center of mass - Area moment of Inertia - principal moment of inertia

DYNAMICS OF PARTICLES

Introduction – Kinematics of particles – Displacements, velocity and acceleration, their relationship - Equations of motions– Rectilinear motions - relative motion – Curvilinear motion –Kinetics of particles - Newton's second law – Equations of motion – rectangular components – Work Energy equation of particles.

TEXT BOOK

1. Beer, F.P., and Johnson, E.R., Vector Mechanics for Engineers – Statics and Dynamics, Tata McGraw Hill, 2007.

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, Prentice Hall of India Pvt. Ltd., 2004.

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

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

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

1. To write a simple menu driven calculator program using switch statement
2. To write a program to print Pascal’s triangle.
3. To write a program for electricity bill preparation.
4. To write a program to print the sine and cosine series.
5. To print Fibonacci series up to N numbers.

3. ARRAYS AND FUNCTIONS

1. To write a program to perform Matrix multiplication.
2. To write a program to sort a given set of numbers.
3. To write a program to perform string manipulation manipulations function like string concatenations, comparison, find the length and string copy without using library functions.
4. To write a program to arrange names in alphabetical order.
5. To write a C program to check whether a number is palindrome or not using functions.
6. To write a program to calculate the factorial of the given number using functions.

4. POINTERS, STRUCTURES AND FILES

1. To print the mark sheet of n students using structures.
2. 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.
3. To write a program for find the average of numbers using files.

- To write a program to merge the given two files arguments using command line arguments.

5. UNIX PROGRAMMING

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

SEMESTER – III

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

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

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

REFERENCES

- Grewal, B.S., Grewal, J.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 37th Edition, 5th Reprint 2004, 2003

2. Venkataraman, M. K., Engineering Mathematics –III A, The National Publishing Company, Chennai, 11th Edition., Reprint 2002, 1998
3. Venkataraman, M. K., Engineering Mathematics - III B, The National Publishing Company, Chennai, 13th Edition., Reprint 1999, 1998.

MEC201	STRENGTH OF MATERIALS	L	T	P	C
		3	1	0	4

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.

EEE259	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
		3	0	0	3

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.

MEC202	THERMODYNAMICS	L	T	P	C
		3	1	0	4

BASIC CONCEPT, FIRST LAW AND SECOND LAW

Classical approach, concept of continuum, thermodynamic systems - closed, open and isolated, Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. First law of thermodynamics for open and closed systems, first law applied to a control volume. Internal energy, specific heat capacities, enthalpy, and steady flow energy equation.

SECOND LAW OF THERMODYNAMICS

Second law of thermodynamics – Kelvin’s and Clausius statements of second law.

Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy.

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. Standard Rankine cycle, Reheat and regenerative cycle.

PROPERTIES OF GAS MIXTURES AND THERMODYNAMIC RELATIONS

Equation of state – Properties of mixture of gases – Dalton’s law of partial pressure, Use of compressibility – entropy of gas mixtures, Maxwell’s equations – Ratio of heat capacities – Energy equation – Joule Thompson co-efficient – Tds equation – Gibbs phase rule – types of equilibrium – Clausius-Claperyon equation – third law of thermodynamics. Use of compressibility chart 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 BOOKS

1. Nag, P.K., Engineering Thermodynamics, Tata McGraw-Hill Co. Ltd., 1993

REFERENCES

1. Cengel, Thermodynamics – An Engineering Approach, Tata Mc Graw Hill, New delhi, Third edition, 2003.
2. Radhakrishnan E., Fundamentals of Engineering thermodynamics, Second edition, Prentice hall, India, 2006.
3. Holman J.P., Thermodynamics, McGraw-Hill, 3rd Edition, 1995
4. Vanwlen and sontag, Classical Thermodynamics, john wiley, 2000
5. Arora C.P., Thermodynamics, Tata McGraw-Hill, New Delhi, 2003

MEC203	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	1	0	4

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 π 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, 7th 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, 5th edition,1995.
4. White, F.M., Fluid Mechanics, Tata McGraw-Hill, c, 5th 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, 2nd Edition, 2004.

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

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
2. Orifice meter.
3. Determination of the Coefficient of discharge of given
4. Venturimeter.
5. Calculation of the rate of flow using Rota meter.
6. Determination of friction factor for a given set of pipes.
7. Conducting experiments and drawing the characteristic
8. curves of Centrifugal pump / Submergible pump.
9. Conducting experiments and drawing the characteristic
10. curves of reciprocating pump.
11. Conducting experiments and drawing the characteristic
 - a. curves of Gear pump.
12. Conducting experiments and drawing the characteristic
 - a. curves of Pelton wheel.
13. Conducting experiments and drawing the characteristics
 - a. curves of Francis turbine.
14. Conducting experiments and drawing the characteristic
 - a. curves of Kaplan turbine.

EEE299	ELECTRICAL SCIENCES LABORATORY	L	T	P	C
		0	0	3	2

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

11. Load test on single phase Induction Motor.
12. Study of DC and AC Starters

SEMESTER IV

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

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- Lab assignments for Numerical methods using **MatLap / C / C++**.

TEXT BOOKS

1. Kreyszig, E., Advanced Engineering Mathematics, John Wiley and Sons (Asia) Limited, Singapore, 8th Edn. , 2001.
2. Arumugam, S., Thangapandi Isaac, A., Somasundaram, A., Numerical Methods, Scitech Publications (India) Pvt. Ltd., Chennai, 2nd 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, 4th Edn., 2003.
2. Francis Scheid, Theory and Problems of Numerical Analysis, Schaum’s Outline Series, Singapore, 2nd Edition, 1989.

MEC204	KINEMATICS OF MACHINERY	L	T	P	C
		3	1	0	4

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 TRAIN

Gear trains – epicyclic gear trains - differentials - automotive transmission gear trains.

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, 3rd 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 Dukupati, R.V., Mechanism and Machine Theory, Wiley-Eastern Ltd., New Delhi, 1992.
5. Robert L Norton. , Design of Machinery, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2005

MEC205	FLUID POWER TRANSMISSION SYSTEMS	L	T	P	C
		3	1	0	4

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, 5th 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.

MEC206	MATERIAL SCIENCE	L	T	P	C
		3	0	0	3

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, twinning, stacking faults, deformation bands and strain hardening.

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

Nickel and nickel alloys – inconel, Monel, etc , Copper and copper alloys – brass, bronze and cupronickel – aluminum and al-cu – precipitation strengthening treatment – polymers, composites, ceramics, glasses- their fabrication, processing methods, engineering properties and applications.

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.

Practical: demo on testing of hardness, fatigue, creep and impact strength, demo on optical microscope.

Text Book

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

References

1. William D Callister Jr., Material Science and Engineering, John Wiley and Sons, 6th 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.

MEC207	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	1	0	4

METAL CASTING PROCESS

Moulding sands - types and properties - patterns – types, selection of patterns, pattern allowances - design of patterns - classifications of castings according to mould materials and moulding methods – solidification and cooling – riser and gating design – design considerations - 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.

FORMING PROCESS

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

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

MACHINING PROCESS

Mechanics of machining, single and multipoint cutting tool, tool - geometry, life and wear - Lathe - Capstan and Turret lathe - Drilling and Boring machine classification, principles of working - work holding and tool holding devices.

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.

MEC209	THERMAL ENGINEERING	L	T	P	C
		3	1	0	4

GASPOWER CYCLES

Otto, Diesel, Dual, Brayton cycles, Gas turbine (Brayton) cycle- description and analysis, regenerative gas turbine cycle, inter cooling and reheating in gas turbine cycles Calculation of mean effective pressure, and air standard efficiency - Actual and theoretical PV diagram of four stroke and two stroke engines.

INTERNAL COMBUSTION ENGINES

Classification of IC engine, IC engine components and functions. Valve timing diagram and port timing diagram. Comparison of two stroke and four stroke engines. Comparison of petrol and diesel engines. Fuels, Air-fuel ratio calculation, Knocking and Detonation. Fuel supply systems, Ignition Systems, Lubrication system and cooling system. Exhaust gas analysis, pollution control norms.

STEAM NOZZLES & TURBINES

Flow of steam through nozzles, shape of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Steam turbine- impulse and reaction principles, compounding, velocity diagrams for simple and multistage turbines, speed regulations and governors.

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.

REFRIGERATION

Vapor 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.

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.

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: Inclined hole, reaming, 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.

MEC283	THERMAL LABORATORY – I	L	T	P	C
		0	0	3	2

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

MEC328	ADVANCED MACHINE TOOLS AND METROLOGY	L	T	P	C
		3	0	0	3

SPECIAL MACHINES

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

CNC MACHINES

NC, CNC and DNC machine tools - manual part programming, CAPP and CMPP process planning systems, APT- post processors, APT programming.

ROBOTICS

Robot – Definition – Robot Anatomy – work volume - drives and end effectors –Robot programming - Robot programming Languages– VAL Programming – Applications.

NON-CONVENTIONAL MACHINING PROCESS

Ultrasonic machining – Abrasive jet machining – Water jet machining – Electro chemical machining – Electrical discharge machining – Wire EDM – Electron beam machining – Laser beam machining – Shaped tube electrolytic machining

QUALITY CONTROL AND MEASUREMENTS

Quality control - statistical quality control - control charts - inspection system.

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.

MEC303	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	1	0	4

SIMPLE STRESSES

Mechanical Engineering Design- A Broad Perspective - Types of simple stresses - static and varying loading- theories of failures - allowable stress - factor of safety - stress concentration factor- curved beams - fluctuating stresses- S-N diagram - design for combined fatigue loading- Soderberg, Goodman and Gerber relations.

DESIGN OF SHAFTS AND ASSOCIATED PARTS

Design principles of shafts - static, fatigue loading- critical speed -design of keys - design of couplings

DESIGN OF THREADED FASTENERS AND PERMANENT JOINTS

Threaded fasteners - design of welded joints, eccentric loading of welded and bolted joints - design of riveted joints – Adhesive joints

DESIGN OF SPRINGS AND LEVERS

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

DESIGN OF FLYWHEELS AND BEARINGS

Design of flywheels, Design and selection of journal and antifriction bearings

TEXT BOOK

1. Shigley, J.E., and Mischke, C.R., Mechanical Engineering Design, McGraw-Hill International, Eighth Edition, 2008.
2. Bhandari V.B, “Design of Machine Elements”, Tata McGraw-Hill Book Co, 2007.

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, 2002.
3. Spottes, M.F., Design of Machine Elements, Prentice-Hall India, 1994.
4. R.L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998.

HAND BOOK

Design Data book, PSG College of Technology, Coimbatore, 2006.

MEC304	DYNAMICS OF MACHINERY	L	T	P	C
		3	1	0	4

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, aero plane, 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 Dukkupati, R.V., Mechanism and Machine Theory, Wiley-Eastern Limited, New Delhi, 1992.
5. Robert L Norton. , Design of Machinery, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2005.

MEC329	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	1	0	4

ISENTROPIC FLOW

Energy and momentum equations for compressible fluid flows, various regions of flows, reference velocities, stagnation state, velocity of sound, critical states, Mach number, types of waves, Mach cone, Mach angle, effect of Mach number on compressibility,

Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers

NORMAL SHOCKS

Flow with Normal Shock Waves: Fundamental equation for normal shock, normal shock equation for a perfect gas, Prandtl relation for normal shock, tables for computation of normal shock, normal shock on T-S diagram. Flow with Oblique Shock waves: Fundamental Relations, Prandtl's equation, Rankine-Hugoniot equation, Variation of flow parameters, Mach Waves.

FANNO AND RAYLEIGH FLOW

Effects of friction in one dimensional flow: Adiabatic flow in constant area duct with friction, Fanno line, Effects of heat exchange in one dimensional flow: frictionless flow in constant area duct with heat transfer, Raleigh line, Rayleigh equations for a perfect gas, and tables for computation of Rayleigh flow.

METHODS OF FLOW MEASUREMENT AND FLOW VISUALIZATION:

Pressure probes, Prandtl probe, Pitot tube, Prandtl pitot static tube, Supersonic pitot tube, Shock tube. Rayleigh supersonic pitot formula, temperature recovery factor, hot wire anemometer, working principles of shadow graph, Velocimeter, Schlieren apparatus and interferometer. Wind Tunnels – Subsonic and Supersonic Wind tunnels.

PROPULSION

Aircraft Propulsion – Jet propulsion – types of jet engine, Performance analysis - rocket propulsion – types of rocket engines, performance analysis. Rocket propulsion – rocket engines thrust equation – effective jet velocity specific impulse – rocket engine performance, solid and liquid propellants, comparison of different propulsion systems

Text Book

1. Yahya, S.M., Fundamental of compressible flow, New Age International (p) Ltd., New Delhi, 1996.
2. Patrich.H. Oosthvizen, William E.Carscallen, "Compressible fluid flow", McGraw-Hill, 1997

References

1. Cohen, H., Rogers, R.E.C., and Saravanamutoo, Gas turbine theory, Addison Wesley Ltd., 1987.
2. Ganesan, V., Gas Turbines, Tata McGraw-Hill, New Delhi, 1999.
3. Rathakrishnan, E., Gas Dynamics, Prentice Hall of India, New Delhi, 2001.

MEC387	MACHINE DRAWING PRACTICE LABORATORY	L	T	P	C
		1	0	3	2

I. Machine Drawing Conventions:

- a. **Need for drawing conventions** – Introduction to IS conventions
- b. Title boxes, their size, location and details - common abbreviations & their liberal usage

- c. Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.
- d. Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
- e. Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centres, curved and tapered features.
- f. Fits and tolerance - allocation of fits for various mating parts - tolerance data sheet - tolerance table preparation - Geometric tolerance
- g. Types of Drawings – working drawings for machine parts.

II Drawing of Machine Elements and simple parts

Selection of Views, additional views for the following machine elements and parts with every drawing proportion.

- a. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
- b. Keys, cottered joints and knuckle joint
- c. Rivetted joints for plates
- d. Shaft coupling, spigot and socket pipe joint
- e. Journal, pivot and collar and foot step bearings

III. Assembly Drawings

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

- a) Engine parts – stuffing boxes, cross heads, Eccentrics, Petrol Engine connecting rod, piston assembly.
 - b) Other machine parts - Screws jacks, Machine Vices Plummer block, Tailstock
 - c) Valves : Steam stop valve, spring loaded safety valve & feed check valve
- NOTE: First angle projection to be adopted.

TEXT BOOKS

1. Machine Drawing – R.K Dhawan, S.Chand Publications,1998.
2. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy, New Age International Publishers, 2007.
3. Machine Drawing – N.D. Bhatt, Charotar Pub. House, 2002

REFERENCES

1. Machine Drawing – P.S.Gill, s.k Kataria & Sons(publishers), 2010
2. Machine Drawing – K.R Gopalakrishna, Subhas publications,6th edition,1992.

MEC382	MACHINE TOOL AND METROLOGY LABORATORY	L	T	P	C
		0	0	3	2

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

MEC383	DYNAMICS AND VIBRATION LABORATORY	L	T	P	C
		0	0	3	2

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

MEC307	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	1	0	4

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. Shigley, J.E., and Mischke, C.R., Mechanical Engineering Design, McGraw-Hill International, Eighth Edition, 2008.
2. Bhandari V.B, “Design of Machine Elements”, Tata McGraw-Hill Book Co, 2007.

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

HAND BOOK

Design Data book, PSG College of Technology, Coimbatore, 2006.

MEC327	HEAT AND MASS TRANSFER	L	T	P	C
		3	1	0	4

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 and irradiation.

MASS TRANSFER

Mass transfer – Fick’s 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.
2. Y. A. Çengel and R. H. Turner, “Heat Transfer”, McGraw-hill, 2nd Ed

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.

MEC386	Mini Project	L	T	P	C
		0	0	3	2

MEC385	THERMAL LABORATORY – II	L	T	P	C
		0	0	3	2

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

MEC401	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

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.

MEC402	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

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., 2nd 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.

MEC403	MECHATRONICS	L	T	P	C
		3	1	0	4

INTRODUCTION TO MECHATRONICS

Introduction to Mechatronics systems - measurement systems-control systems, Introduction of bio mechanics, Bio-micro electrical mechanical system.

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.
4. Singh M.D., Joshi J.G., Mechatronics, PHI 2009.

MEC481	SIMULATION LABORATORY	L	T	P	C
		0	0	3	2

A. SIMULATION

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

B. ANALYSIS (SIMPLE TREATMENT ONLY)

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

MAJOR ELECTIVES

MEC309	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	L	T	P	C
		3	0	0	3

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 – Jigless manufacturing concept

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.
2. Joshi, P.H., Jigs and Fixtures, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition, 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. Hiram E Grant, Jigs and Fixture, Tata McGraw-Hill, New Delhi, 2003.
4. Fundamentals of Tool Design, ASTME, CEEE Edition, 1983.
5. James,. Nevins, Danie .E. Whitney, Thomas. . DeFazio, Concurrent Design of products and processes, McGraw-Hill, 1989.

HAND BOOK

Design Data book, PSG College of Technology, Coimbatore, 2006.

MEC310	CNC MACHINING	L	T	P	C
		3	0	0	3

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.

MEC311	NON-TRADITIONAL MACHINING TECHNIQUES	L	T	P	C
		3	0	0	3

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.

PRACTICAL COMPONENT (NOT FOR EXAMINATION)

Demo on operation of Electrical Discharge machining and Abrasive water jet machining

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.

MEC312	INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3

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, turbo charging, introduction to thermodynamic analysis of CI engine combustion.

POLLUTANTS

Pollutants - sources and types, formation of NO_x, 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.

MEC313	TURBO MACHINERY	L	T	P	C
		3	0	0	3

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.

MEC314	ENERGY ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

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.

MEC315	DESIGN FOR MANUFACTURE	L	T	P	C
		3	0	0	3

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.

MEC316	THEORY OF METAL CUTTING	L	T	P	C
		3	0	0	3

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. **Demo on Measurement of cutting temperature using thermal image analyzer**

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.

MICROMACHINING

Theory of micromachining – chip formation - surface finish – Size effect in micromachining – microturning, micromilling, microdrilling - tool design

ECONOMICS OF MACHINING

Introduction to economics of machining, Machining Time- Estimation of machining time in different machining operations, estimation of cost and optimum cutting conditions.

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.

MEC317	TRIBOLOGY	L	T	P	C
		3	0	0	3

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. Huling, J., Principles of Tribology, MacMillan , 1984.
5. Williams, J.A., Engineering Tribology, Oxford Univ. Press, 1995.

MEC318	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

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.

MEC319	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

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, planning, 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.

MEC320	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

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 – applications to plane trusses – bending of beams – finite element formulation of stiffness matrix and load vectors.

TWO DIMENSIONAL PROBLEMS – SCALAR VARIABLE PROBLEMS

Introduction – finite element modeling – scalar valued problem – CST and LST element stiffness matrix – force vector – Galarkin approach – stress calculation – temperature effects – applications to scalar variable problems.

TWO DIMENSIONAL PROBLEMS – VECTOR VARIABLE PROBLEMS

Vector variable problems – elasticity equation – plain stress and strain - Axisymmetric formulation – element stiffness matrix and force vector - boundary conditions – applications to cylinders under internal or external pressures – rotating discs.

ISOPARAMETRIC ELEMENTS FORMULATION

The four node quadrilateral – shape functions – element stiffness matrix and force vector numerical integration – Gaussian quadrature – Examples.

TEXT BOOK

1. Chandrupatla, T.R., and Belegundu, A.D., Introduction to Finite Elements in Engineering, Pearson Education, New Delhi, 3rd Edition, 2002.
2. P. Seshu, Introduction To Finite Element Analysis, PHI, 2007.

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, 4th Edition, 2003.
5. Reddy, J.N., An Introduction to Finite Element Method, McGraw-Hill International Student Edition, 1985.
6. P. Seshu, Finite Element Analysis, Prentice Hall of India New Delhi, 2006.

MEC321	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

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, simplex and duplex 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.

MEC322	MODERN MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

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, 10th Edition, 2000.
4. HMT, Production Technology, Tata McGraw-Hill, New Delhi, 1996.

MEC323	MATERIALS MANAGEMENT	L	T	P	C
		3	0	0	3

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 - vendor 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.

MEC324	PLANT LAYOUT AND MATERIAL HANDLING	L	T	P	C
		3	0	0	3

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.

MEC325	WELDING TECHNOLOGY	L	T	P	C
		3	0	0	3

WELDING PROCESS AND EQUIPMENTS

Welding processes and grouping, welding nomenclatures. Equipments, parameter controls, Electrode specification and filler metals. Special welding process - Resistance welding, high energy density welding, Thermit welding, and solid state welding.

HEAT FLOW IN WELDING

Heat transfer in weldments, dissipation of welding heat, cooling rates and weld metal cooling curves. Calculation of HAZ width, solidification rate and effects of heat input.

WELDING METALLURGY

Weld solidification, phase transformation in weldments, strengthening due to welding. Microstructures of HAZ, PMZ, and fusion line. Weld cracking, residual stresses and distortion. Use of constitution diagram (Schaffler, Delong, and WRC 92).

WELDING OF FERROUS MATERIALS

Welding of Stainless steels, and cast irons – Welding procedure qualification, Microstructures of weldments, electrode and filler material selection, defects and remedies.

WELDING OF NON FERROUS MATERIALS

Welding of Aluminium, Nickel, and Titanium alloys - Welding procedure qualification, Microstructures of weldments, electrode and filler material selection, defects and remedies.

Text Book

- Howard B Cary, “Modern Welding technology”, Prentice Hall, New Jersey, 2002.

References

- American Society of Metals, “Metals hand book, Vol. VI” ASM Metal park Ohio, USA, 1991.
- AWS Welding Handbook, Vol 1 & Vol 2, AWS New York, 1997.
- Lancaster J F, “Metallurgy of Welding”, George Allen Co, Boston, 1980.

MEC330	ROBOTICS AND ROBOT APPLICATIONS	L	T	P	C
		3	0	0	3

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. Aggrawal, 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.

MEC331	VIBRATION ANALYSIS AND NOISE MONITORING	L	T	P	C
		3	0	0	3

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.

MEC332	RENEWABLE ENERGY TECHNIQUES	L	T	P	C
		3	0	0	3

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.

MEC333	DESIGN OF HEAT TRANSFER EQUIPMENTS	L	T	P	C
		3	0	0	3

HEAT EXCHANGERS

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

FRICITION 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.

MEC334	FOUNDRY MECHANIZATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

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, 2nd 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, 3rd Edition, 1995.
4. Srinivasan, N. K., Foundry Technology, Khanna Publications, 1986.

MEC335	RECENT TRENDS IN WELDING TECHNIQUES	L	T	P	C
		3	0	0	3

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, 4th Edition, 1994
3. Jackson, M. D., Welding Methods and Metallurgy, Griffin, London, 1967.
4. Lancaster, L.F., The Physics of Welding, Pergamon Press, 1984.

MEC336	MECHANICAL BEHAVIOUR OF MATERIALS	L	T	P	C
		3	0	0	3

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, 3rd 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, 4th Edition, 1984.

4. Honeycombe, R.W.K., Plastic Deformation of Materials, Edward Arnold Publishers, 1984.

MEC337	MANUFACTURING SYSTEM AND SIMULATION	L	T	P	C
		3	0	0	3

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.

MEC338	GEAR MANUFACTURING AND INSPECTION	L	T	P	C
		3	0	0	3

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, Kalakathir Publishers, 2006.

MEC339	TOOLING FOR PRODUCTION	L	T	P	C
		3	0	0	3

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.

MEC340	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.
4. Autar K. Kaw, Mechanics of Composite Materials, Taylor & Francis, 2006.
5. Krishnan K. Chawla, Composite materials science and engineering, Springer Publications, Second Edition, 2002.

MEC341	PRINCIPLES OF COMPONENT DESIGN	L	T	P	C
		3	0	0	3

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.

MEC 342	COMPUTATIONAL FLUID DYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

INTRODUCTION

Physical phenomena governing differential equation, - conservation of mass, momentum and energy equation- special form of Navier-Stokes equations –boundary layer theory- Buoyancy driven flow-compressible flow - turbulent flow –classification of governing equations - initial and boundary conditions- grid independence test.

FINITE DIFFERENCE METHOD

Basics of finite difference method – finite difference approximations for derivatives – explicit and implicit method – consistency, stability, numerical errors – upwind differencing-application of FDM to heat transfer conduction and convection– SOLA method - mixed boundary condition - Gauss- Siedel and SOR Methods – ADI method to solve ψ - ω form of NS equation.

FINITE VOLUME METHOD

Control volume approach - steady and unsteady one dimensional conduction - two dimensional problems – FVM applied to advection diffusion equation - predictor – corrector step- pressure correction technique- SIMPLE algorithm – upwind scheme - power law scheme

FINITE ELEMENT METHOD

Finite element method an introduction – Basic concepts – Galerkin’s method - steady state diffusion – transient diffusion - one dimensional and two dimensional regions – FEM to 1D problem – 2D problems – finite element formulations– validation of CFD results - benchmark problems –cavity flow - inflow outflow problems –open domain problems

GRID GENERATION AND POST PROCESSING

Physical domain – computational domain – algebraic method – differential equation methods – adaptive grids – body fitted co-ordinates system – stream line contours – vector plots - Turbulent flow an introduction – modeling of turbulent flow - Turbulent flow k- ϵ model

Text Books

1. Muralidhar, K., Sundararajan, T., Computational fluid flow and heat transfer ,Narosa publishing house, New Delhi,2nd 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. Versteeg. H.K. and Malalasekara. W., An Introduction to Computational Fluid Dynamics, Longman Publishers, 1995.
2. Suhas Patankar., Numerical Heat Transfer and Fluid Flow, (Hemisphere Series on Computational Methods in Mechanics and Thermal Science), Taylor and Francis,1st Edition ,1980.
3. Jaluria and Torrance, Computational Heat Transfer, Hemisphere Publishing Corporation, New York, 1986.

MEC343	HEAT TREATMENT AND SURFACE TREATING	L	T	P	C
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HEAT TREATMENT ATMOSPHERE AND PRINCIPLES

Furnaces and heat treatment atmosphere, quenching media, fixtures, temperature measurements and controllers. Phase transformations – Austenitic, Pearlitic, bainitic, martensitic transformations.

HEAT TREATMENT OF FERROUS ALLOYS

Heat treatment of steels - stainless steels, Tool steels, Maraging steels, HSLA steels, and cast irons – processes, heat treatment defects, causes, remedies, inspections and quality control.

HEAT TREATMENT OF NON FERROUS ALLOYS

Heat treating of Aluminium, copper, nickel, titanium and magnesium alloys – processes, heat treatment defects, causes, remedies, inspections and quality control.

SURFACE AND SPECIAL TREATMENT

Carburizing, nitriding, carbonitriding, boriding, flame and induction hardening, PVD and CVD process, sputter coating, ion plating, electron beam and laser beam hardening, ion implantation, spray coatings, thermo-mechanical treatments – mechanisms, structural changes, and property relations.

HEAT TREATMENT OF ENGINEERED COMPONENTS

Heat treatment of wrought steel components – auto body sheets, plates, bars, and shafts. Heat treatment of cast and forged steel components – gears, couplings, and valves - Heat treatment procedure qualification.

TEXT BOOK

1. Rajan and Sharma, "Industrial Heat treatment", Oxford and IBH, New delhi.1995.

REFERENCES

1. American Society of Metals, "Metals hand book, Vol. IV" ASM Metal park Ohio, USA, 1991.
2. Karl Eric Thelning, "Steel and its Heat treatment", Butterworth Publications, 2000.
3. Sudharsan, T.S, "Surface Engineering", Ohio State University, 1992.

MEC412	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
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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.

MEC414	SENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

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 - microslyn.

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.

MEC416	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

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. McCornick, E.J., and Sanders, M.S., Human Factors in Engineering and Design, Tata McGraw-Hill, 1982.

MEC417	WORK STUDY	L	T	P	C
		3	0	0	3

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.

MEC418	RAPID PROTOTYPING	L	T	P	C
		3	0	0	3

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.

MEC419	PRODUCTION PLANNING AND CONTROL	L	T	P	C
		3	0	0	3

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.

MEC420	INDUSTRIAL ENGINEERING	L	T	P	C
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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.

MEC421	NON-DESTRUCTIVE EXAMINATION	L	T	P	C
		3	0	0	3

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.

MEC424	INDUSTRIAL AUTOMATION AND ROBOTICS	L	T	P	C
		3	0	0	3

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.

CIM AND FMS

Nature role and development of CIM Architecture- computers in CIM-simulation software - Group technology-part families-parts classification and coding-Production Flow analysis-cellular manufacturing cell design-benefits MRP I and II -computer aided quality control. Definitions – classifications – flexibility – typical configurations – computer control systems – planning the FMS – analysis methods for flexible manufacturing systems – applications and benefits.

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 noncontact inspection methods – machine vision.

INDUSTRIAL ROBOTICS

Robot definition and types – Robot anatomy - Mobile Robot and its advantages – Case studies – pick and place robot – automatic camera – washing machine – Application 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).

MINOR ELECTIVES

BIT307	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

INTRODUCTION

Introduction to ecosystem - Microbial flora of soil – Interaction among Soil microorganisms
– Bio geochemical cycle - Role of soil microorganisms

DEGRADATION OF XENOBIOTICS

Xenobiotics - Simple aromatics, chlorinated polyaromatic compounds, petroleum products, pesticides and surfactants - Mechanism of detoxification, oxidation, dehalogenation - Degradation of metals - Biotransformation of metals – Bioremediation

MICROBIAL TECHNOLOGY FOR WASTE WATER TREATMENT

Waste water characteristics - Biological waste water treatment – Unit operation - Design and modeling of activated sludge process - Anaerobic digested dynamics

TREATMENT OF INDUSTRIAL WASTES

Dairy, pulp, dye, leather and pharmaceuticals - Solid waste management

MICROBIAL LEACHING

Extraction of metals from ores, recovery of metals from solutions - Microbes in petroleum extraction - Microbial desulphurization of coal - Degradative plasmids and genetically engineered microbes in environment

TEXT BOOKS

1. Karnely, Chakrabarty, D., Omen, G.S., Biotechnology and Biodegradation, Advances in Applied Biotechnology Series, Vol I, Gulf Publications Company, London, 1st Edition, 1989
1. Foster, C.F., John Ware, D.A., Environmental Biotechnology, Ellis Harwood Ltd, 1st Edition, 1987

REFERENCES

1. Young, M.Y., Comprehensive Biotechnology (Vol. 1- 4), Pergamon Press, Oxford, 1st Edition, 1985
2. Wanwright, M., An Introduction to Environmental Biotechnology, Springer Verlag, London, 1st Edition, 1999

CHE311	CORROSION SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

CORROSION

Corrosion - Definition, classification, forms of corrosion, expressions for corrosion rate, emf and galvanic series, merits and demerits, Pourbaix diagram for iron, magnesium and aluminium - Forms of corrosion, Uniform, pitting, intergranular, stress corrosion - Corrosion fatigue - Dezincification - Erosion corrosion – Crevice corrosion - Cause and remedial measures, Pilling Bedworth ratio, High temperature oxidation

BOILERS

Boiler water corrosion by carbon dioxide and unstable salts - Corrosion prevention methods by treatment cooling water, specification, types of scales and causes, use of antiscalant - Water

treatments - Maintenance of boilers - Protection of boilers during off loading, high temperature, corrosion, turbine corrosion – Corrosion inhibitors, principles and practice, inhibitors for acidic neutral and other media - Corrosion failure - Inspection and analysis of corrosion damage.

CORROSION TESTING

Purpose of corrosion testing, classification, susceptibility tests for intergranular corrosion, stress corrosion test, salt spray test, humidity and porosity tests, accelerated weathering tests - ASTM standards for corrosion testing.

POLARIZATION

Polarization - Exchange current density, Activation polarization, Tafel Equation , Passivating metals and nonpassivating metals, Effect of oxidizing agents

ELECTROLESS PLATING AND ANODISING

Electroless plating and Anodizing - Cathodic protection, metallic, organic and inorganic coatings, corrosion inhibitors – Special surfacing processes - CVD and PVD processes, sputter coating -

Laser and ion implantation, arc spray, plasma spray, flame spray, HVOF

TEXT BOOKS

1. Fontana and Greene., Corrosion Engineering, McGraw Hill Book Co, New York, 1983
2. Raj Narayan ., An Introduction to Metallic Corrosion and its prevention, Oxford and IBH, New Delhi, 1983

REFERENCES

1. Budinski, K.G., Surface Engineering for Wear Resistance, Prentice Hall Inc., Engelwood Cliff, New Jersey, USA, 1988
2. Uhlig, H.H ., Corrosion and Corrosion Control , John Wiley and Sons, New York, USA, 1985

CHE405	COMPUTATIONAL HEAT TRANSFER	L	T	P	C
		3	0	0	3

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, siedel 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

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

REFERENCES

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

CIV 367	AIR POLLUTION AND CONTROL	L	T	P	C
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INTRODUCTION

Air resource management system - Air quality management – Scales of air pollution problem - Sources and classification of pollutants and their effect on human health vegetation and property – Global implications of air pollution - Meteorology Fundamentals - Atmospheric stability –Atmospheric turbulence - mechanical and thermal turbulence - Wind profiles – Plume rise - Ambient air quality and emission standards – Air pollution indices – Indoor Air Pollutants – Models – Air Quality Sampling and Monitoring.

CONTROL OF PARTICULATE CONTAMINANTS

Settling chambers - Filters, gravitational, Centrifugal – multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory – ESP design – Operational Considerations – Process Control and Monitoring – Automobile air pollution and control.

CONTROL OF GASEOUS CONTAMINANTS

Absorption – principles - description of equipment-packed and plate columns - design and performance equations – Adsorption - principal adsorbents - Equipment descriptions – Design and performance equations – Condensation - Incineration – Equipment description.

BIOLOGICAL AIR POLLUTION

Biological Air Pollution - Control Technologies – Bio-Scrubbers, Biofilters – Operational Considerations – Process Control and Monitoring.

NOISE CONTROL

Noise Standards - Measurement – Modeling - Control and preventive measures.

TEXT BOOKS

1. Noel de Nevers, Air Pollution Control Engg., McGraw-Hill, New York, 2000.

REFERENCES

1. Lawrence Kwan, Norman C Perelra, Yung-Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. David H.F Liu, Bela G.Liptak, Air Pollution, Lewis Publishers, 2000.
3. Singal, S.P., Noise Pollution and Control Strategy, Narosa Publishing House, New Delhi, 2005.

CIV369	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

INTRODUCTION

Impact of development projects under Civil Engineering on environment - Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA.

METHODOLOGIES

Methods of EIA –Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives – Case studies.

PREDICTION AND ASSESSMENT

Assessment of Impact on land, water and air, noise, social, cultural flora and fauna;Mathematical models; public participation – Rapid EIA.

ENVIRONMENTAL MANAGEMENT PLAN

Plan for mitigation of adverse impact on environment – options for mitigation of impact on water, air and land, flora and fauna; Addressing the issues related to the Project Affected People – ISO 14000.

CASE STUDIES

EIA for infrastructure projects – Bridges – Stadium – Highways – Dams – Multi-storey Buildings – Water Supply and Drainage Projects

TEXT BOOKS

1. Canter,L., Environmental Impact Assessment, McGraw-Hill Inc., New Delhi, 1996.
2. Shukla, S.K. and Srivastava, P.R., “Concepts in Environmental Impact Analysis”, Common Wealth Publishers, New Delhi, 1992.

REFERENCES

1. John G. Rau and David C Hooten (Ed)., Environmental Impact Analysis Handbook, McGraw-Hill Book Company, New York, 1990.
2. Environmental Assessment Source book, Vol. I, II & III. The World Bank, Washington, D.C., 1991.
3. Judith Petts, Handbook of Environmental Impact Assessment Vol. I & II, Blackwell Science, 1999.

CIV425	DISASTER MANAGEMENT AND THERMODYNAMICS	L	T	P	C
		3	0	0	3

ESSENTIAL COMPONENTS AND CO-ORDINATION IN DISASTER RESPONSE

Disaster Response Plan - Communication, Participation and Activation of Emergency - Preparedness Plans - Search, Rescue, Evacuation and other logistic management - Needs and Damage Assessment; Types and Technique - Disaster Response: Central, State, District and Local Administration - Armed Forces in Disaster Response: Role and Responsibility - Disaster Response: Police and Other organizations - Role of Multiple stakeholders in Disaster Response

HUMAN BEHAVIOR AND RESPONSE MANAGEMENT

Psychological Response and Psychological Rehabilitation - Trauma and Stress Management - Rumour and Panic Management - Medical and Health Response to Different Disasters - Role of Information and Communication Technology in Response Management

RELIEF MEASURES

Minimum Standard of Relief - Relief Management- essential components - Funding Relief - short term and long term - Disaster Site Management - Recovery

ENERGY AND IRREVERSIBILITY

Review of fundamental concepts and definitions - Review of first and thermodynamics – entropy - properties of substances - quality of energy, maximum work in a reversible process – reversible work by an open system exchanging heat only with surroundings - useful work - dead state – availability - irreversibility and Gouy-Stodala Theorem - Mathematical conditions for exact differential - Maxwell's equation - Tds equation - Thompson coefficient and Inversion curve - coefficient of volume expansion

GAS POWER CYCLES AND GAS COMPRESSORS Gas power cycles: Carnot cycle - Stirling cycle - Ericsson cycle - Air standard cycles - Otto cycle - Diesel cycle - Limited pressure cycle or Dual cycle - comparison of Otto, Diesel and Dual cycles - Brayton cycle - Aircraft propulsion - Brayton-Rankine combined cycle Gas compressors: Compression processes - work of compression - single stage reciprocating air compressor - volumetric efficiency - multi stage compression - air motors - rotary compressors - blowers and fans

TEXT BOOKS

1. Jagbir Singh, Disaster Management: Future Challenges and Opportunities, I K International Publishing House Pvt. Ltd, 2007.
2. Kapoor Mukesh, Disaster Management Paperback, Saurabh Publishing House, 2010
3. Tushar Bhattacharya, Disaster Science and Management Paperback, McGraw Hill Education (India) Private Limited, 2012
4. Engineering thermodynamics by Jones and Dugans, PHI Learning Pvt. Ltd.
5. Gas turbine Theory & Practice, by Cohen & Rogers, Addison Wesley Longman Ltd.

REFERENCE BOOKS

1. Taori, K (2005) Disaster Management through Panchayati Raj, Concept Publishing Company, New Delhi.
2. Fundamentals of thermodynamics by Sonntag, Wiley India

3. Fundamentals of Classical Thermodynamics by Van Wylen, John Wiley and Sons.

CIV 464	INDUSTRIAL WASTE WATER MANAGEMENT	L	T	P	C
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INTRODUCTION

Industrial activity and Environment – Sources and types of industrial wastewater – Industrial wastewater and environmental impacts – Industrial waste survey – Industrial wastewater generation rates, characterization and variables – Population equivalent – Toxicity of industrial effluents and Bioassay tests.

INDUSTRIAL POLLUTION PREVENTION

Prevention Vs Control of Industrial Pollution – Benefits and Barriers – Source reduction techniques – Waste Audit – Evaluation of Pollution prevention options – Environmental statement as a tool for pollution prevention – Waste minimization

INDUSTRIAL WASTEWATER TREATMENT

Equalization - Neutralization – Oil separation – Flotation – Precipitation – Aerobic and anaerobic biological treatment – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies

WASTEWATER REUSE AND RESIDUAL MANAGEMENT

Individual and Common Effluent Treatment Plants – Joint treatment of industrial wastewater - Quality requirements for Wastewater reuse – Industrial reuse – Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – management.

CASE STUDIES

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – Sugar and Distilleries

REFERENCES

1. Eckenfelder, W.W., Industrial Water Pollution Control, McGraw-Hill, 1999.
2. Arceivala, S.J., Wastewater Treatment for Pollution Control, Tata McGraw-Hill, New Delhi, 1998.
3. Frank Woodard Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi, 2001.
4. World Bank Group Pollution Prevention and Abatement Handbook – Towards Cleaner Production, World Bank and UNEP, Washington D.C.1998.
5. Paul L. Bishop Pollution Prevention: - Fundamentals and Practice, McGraw-Hill International, 2000.

CIV 465	SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
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INTRODUCTION

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management – Elements of solid waste management - Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes.

WASTE CHARACTERISATION AND SOURCE REDUCTION

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – Source reduction of wastes – Recycling and reuse.

STORAGE, COLLECTION AND TRANSPORT OF WASTES

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Transfer and transport –compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

WASTE PROCESSING TECHNOLOGIES

Objectives of waste processing – material separation and processing technologies –methods and controls of Composting – incineration – solidification and stabilization of hazardous wastes

WASTE DISPOSAL

Waste disposal options – Disposal in landfills – Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills

REFERENCES

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil “Integrated Solid Waste Management, McGraw- Hill International edition, New York, 1993
2. CPHEEO “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
3. Micheael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, McGraw-Hill International edition, New York, 2001
4. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.

CSE206	OBJECT ORIENTED PROGRAMMING	L	T	P	C
		3	0	0	3

INTRODUCTION

Introduction to OOP – Basic Concepts of OOP – Applications of OOP- Introduction to C++ - Introduction to C++ stream I/O – declarations in C++ - Creating New data types in C++ - function Prototypes – Inline functions – Reference Parameters – Const Qualifier – Dynamic memory allocation – default arguments – Unary Scope resolution operator – Linkage specifications.

CLASSES, CONSTRUCTORS AND FRIEND CLASS

Introduction – Comparing class with Structure – Class Scope – Accessing Members of a class – Constructor – Destructor – Const objects – Const member functions – Friend class – Friend function – This pointer – Data abstraction and Information hiding – container classes and Iterators.

OVERLOADING & INHERITANCE

Operator Overloading – Fundamentals – Restrictions – Overloading stream – Insertion and stream extraction operators – Overloading unary & binary operators – Converting between types – Overloading ++ and --. Inheritance – Introduction – Protected members – Casting base _class pointers to derived _class pointers – Overloading Base class members in a Derived class – Public, Protocols and Private inheritance – Direct base classes and Indirect Base Classes – Using Constructors and Destructors in Derived classes – Implicit Derived class object to base class object conversion.

VIRTUAL FUNCTIONS, STREAMS AND FILES

Introduction – Type fields and switch statements – Virtual functions – Abstract base classes and concrete classes – Polymorphism – Dynamic binding – Virtual destructors. C++ Stream I/O: Streams – Stream Input – Stream Output – Unformatted I/O – Stream manipulators – Stream format states – Stream error – States. Files: File Operations, File pointers, Error Handling during file Operations.

TEMPLATES & EXCEPTION HANDLING

Templates – Function templates – Class templates – Overloading template functions – Class template and non type parameters – Templates with Multiple parameters. Exception Handling – When exception handling, Basic of C++ exception, Catching an exception, re throwing an exception, exception specifications.

TEXT BOOK

1. Goran Svenk , Object-Oriented Programming Using C++ for Engineering and Technology, Thomson Delmer Learning, 2003

REFERENCES

1. Bjarne Stroustrup, The C++ Programming Language, Addison Wesley, 2000.
2. John R.Hubbard, Programming with C++, Schaums outline series, TMH 2003.
3. Deitel H.M., and Deitel P.J., How to program C++, PHI 2003.

CSE314	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

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.

REFERENCs

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

ECE301	DIGITAL SIGNAL PROCESSING	L	T	P	C
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BASIC ELEMENTS

Digital Signal Processing System —advantages of digital over analog signal processing - Applications of DSP, FFT algorithms – Radix-2 FFT algorithms – decimation in time – decimation in Frequency algorithms –Applications of FFT algorithms

IIR FILTERS

Design of Butterworth filters - Chebyshev Type I and Type II filters - IIR filter design using bilinear transformation - impulse invariant transformation - frequency transformation in analog and digital domain

FIR FILTERS

Design of Linear phase FIR filters using Rectangular, Hamming, Kaiser windows – Design of linear phase FIR filters using frequency sampling techniques

FINITE WORD LENGTH EFFECTS

Number representations – fixed point and floating point numbers - Quantization of fixed and floating point numbers, coefficient of quantization - over flow error – truncation error – co-efficient of quantization error - limit cycle oscillation – signal scaling

MULTIRATE DSP

Decimation by a factor D - Interpolation by a factor I – Filter design and implementation for sampling rate conversion – multistage implementation of sampling rate conversion – Sampling rate conversion by an arbitrary factor – applications of multirate signal processing.

TEXT BOOK

John G Proakis, Dimtris G Manolakis, Digital Signal Processing Principles, Algorithms and Application, PHI, 3rd Edition, 2000.

REFERENCES

1. Oppenheim and Schafer, 'Discrete Time Signal Processing', PHI, 1992.
2. S.K.Mitra, "Digital Signal Processing– A Computer based approach", TMH, 1998

EEE306	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

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 DC 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 BOOKS

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.

REFERENCE BOOKS

1. Kenjo, T., Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 1984.

- Kenjo, T., Nagamori, S., Permanent Magnet and Brushless DC Motors, Clarendon Press, London, 1988.

EEE410	NEURAL NETWORK AND FUZZY LOGIC	L	T	P	C
		3	0	0	3

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 OF NEURAL NETWORK AND FUZZY LOGIC

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

- Jang, J.S.R., Sun, C.T., E. Mizutani., Neuro-Fuzzy and Soft Computing, Prentice Hall of India (P) Ltd, New Delhi, 2005.
- Timothy J. Ross., Fuzzy Logic with Engineering Applications, Tata McGraw Hill, 1997.
- Sivanandam S, Sumathi S, Deepa, Introduction To Neural Networks Using Matlab 6.0, Tata McGraw Hill, 2009.

REFERENCE BOOKS

- Laurance Fausett, Englewood cliffs, N.J., Fundamentals of Neural Networks, Pearson Education, 1992.
- Zimmermann, H.J., Fuzzy Set Theory & its Applications, Allied Publication Ltd., 1996.
- John Yen & Reza Langari., Fuzzy Logic – Intelligence Control & Information, Pearson Education, New Delhi, 2003.
- Timothy Ross, Fuzzy Logic with Engineering Applications, Second Edition, John Wiley & Sons, Ltd, 2004.
- B. Yegnanarayana, Artificial neural networks, Prentice-hall Of India Pvt Ltd, 2008.

EIE310	INDUSTRIAL DRIVES AND CONTROLS	L	T	P	C
		3	0	0	3

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.

EIE313	POWER PLANT INSTRUMENTATION AND CONTROL	L	T	P	C
		3	0	0	3

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 $\hat{U}P$ 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.

EIE 319	PIPING AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

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, 4th 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.

INT355	INTERNET AND WEB TECHNOLOGY	L	T	P	C
		3	0	0	3

BASICS OF NETWORKS

Introduction to Internet and Web – Basics of computer networks – Topologies – signaling methods – Internet and its basics – Web servers – Browsers – Issues for the design of networking – Security issues.

WEBSITE AND WEBCASTING TECHNIQUES

Introduction – Creation of a website – Hyper text and HTML – Document structuring tags – Dynamic HTML – XML – Search Engines – Tools – Channels Push Technology.

JAVA PROGRAMMING

Language basics – Java classes – constructors – Java objects and their creations – Interfacing methods – Classes – Data encapsulation techniques – Java IO.

JAVA COMPONENTS / NETWORK PROGRAMMING

Computer Interface – Creation of GUI – Applets – Java Beans – CORBA – EJBs – Network Programming – Socket creation – URL classes – Socket classes – Programming for security.

DYNAMIC FUNCTIONALITY IN WEB PAGES

CGI – Four steps for CGI – Script specification – CGI Script languages – Dynamic page functionalities using servelets – JSPs – ASPs – COMs – DCOMs,.

TEXT BOOK

1. RajKamal, Internet and Web Technologies, TMH, 2005.

REFERENCE

1. Markur Pope, Mastering Internet Programming , Galgotia Publications, 1996.

MEC427	NANOSTRUCTURED MATERIALS	L	T	P	C
		3	0	0	3

INRODUCTION

Definition of nonmaterial, classification - Zero, one dimensional, two dimensional, three dimensional nanomaterials, and their applications. Structure of nanostructured material.

SYNTHESIS OF NANOMATERIALS

Basic Approaches – top down , bottom up, and other methods. Mechanical methods – (solid state) mechanical alloying and mechanical milling. Chemical synthesis – Sol gel method, chemical vapour deposition (CVD) and physical vapor deposition (PVD).

CHARACTERIZATION EQUIPMENTS FOR NANOMATERIALS

Characterization techniques – X-Ray Diffraction (XRD), Transmission Electron, Microscopy (TEM) and Atomic Force Microscopy (AFM) – elemental analysis, phase identification and microscopic analysis. Consolidation of nanomaterials – FAST technique, high pressure shock method.

PROPERTIES OF NANOSTRUCTURED MATERIALS

Physical – Density, magnetic, heat conduction, optical and electronic behavior. Chemical – bonding, chemical interaction, corrosion behavior and size concerned chemical properties. Mechanical properties – strength, ductility, elongation, hardness, and impact toughness.

APPLICATION AND SCOPE OF NANOSTRUCTURED MATERIALS

Structural application, electronic, optical and energy storage devices, biomedical and bioactive applications. Future trends of nanostructured materials.

TEXT BOOK

1. Carl.C.Koch. handbook of Nanomaterials, William Andrew Publications, New York, 2002

REFERENCES

1. Ying.J.Nanostructured Materials, Academic press, New York, 2001.
2. Bharath Bhusan, Springer Handbook of Nanotechnology, Springer- Verlag, New York, 2004.

HUMANITIES ELECTIVES

HSS001	TOTAL QUALITY	L	T	P	C
	MANAGEMENT	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.

HSS002	ENGINEERING MANAGEMENT	L	T	P	C
		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.

HSS003	INDIAN ECONOMIC DEVELOPMENT	L	T	P	C
		3	0	0	3

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.

HSS004	INDUSTRIAL PSYCHOLOGY	L	T	P	C
		3	0	0	3

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.

HSS006	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

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.

HSS008	BASICS OF ECONOMICS	L	T	P	C
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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.

HSS010	INTERNATIONAL TRADE AND FINANCE	L	T	P	C
		3	0	0	3

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 Lading, 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.

HSS011	INFORMATION SYSTEMS FOR MANAGERIAL DECISION MAKING	L	T	P	C
		3	0	0	3

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.

HSS013	COST ANALYSIS AND CONTROL	L	T	P	C
		3	0	0	3

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

HSS014	MARKETING MANAGEMENT	L	T	P	C
		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.

HSS015	MANAGEMENT CONCEPTS AND TECHNIQUES	L	T	P	C
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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.

HSS016	ORGANIZATIONAL PSYCHOLOGY	L	T	P	C
		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.

HSS017	INTERNATIONAL ECONOMICS	L	T	P	C
		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, 2nd edition, 1998.
2. Obstfeld M., and K. Rogoff, Foundation of International Macroeconomics, McGraw-Hill, 1996.
3. Romer, D., Advanced Macroeconomics, McGraw Hill, 1996.

HSS018	COMMUNICATION SKILLS	L	T	P	C
		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.

HSS019	OPERATIONS RESEARCH	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.

HSS020	HUMAN RESOURCE	L	T	P	C	INTRODUCTION Functions of a human resources
	MANAGEMENT	3	0	0	3	

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, 6th 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.

HSS022	BANKING THEORY AND PRACTICE	L	T	P	C
		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.

HSS023	ENTREPRENEURSHIP DEVELOPMENT	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.

HSS024	INDUSTRIAL PSYCHOLOGY	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.

HSS031	ENGLISH ADVANCE LEVEL	L	T	P	C
		3	0	0	3

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. 20th 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.

MECX001	NON DESTRUCTIVE TESTING	L	T	P	C
		1	0	0	1

Introduction and Radiography

Introduction to NDT – need – advantages and limitations

Radiography – Sources – IR192, cobalt 60 – X-ray film – processing – testing methods – film interpretation

Ultrasonic testing

A,B,C scan, immersion Testing, Normal and Angle Probe Testing

Magnetic particle Testing

Methods – particles - wet, dry and fluorescent

Dye penetrant testing

Surface preparation –Testing procedure - types of penetrant

Other NDT methods

Thermography, Image processing TOFD and Phased Array - leak testing – Halogen, Helium

REFERENCES

1. Barry Hull and Vernon John, Non Destructive Testing, MacMillan, 1988.
2. Non-Destructive Test and Evaluation of Materials by J Prasad , C. G. Krishnadas Nair, McGraw Hill Education (India) Private Limited; 2 edition
3. Non-Destructive Testing Techniques by Ravi Prakash, New Age International Pvt Ltd Publishers; Revised edition (1 December 2010)

MECX002	ADVANCED WELDING PROCESSES	L	T	P	C
		1	0	0	1

Introduction and Safety: Introduction to Welding – importance – recent technologies, Safe handling of machines and gases – tools and equipments

Geometry: Welding Geometry – grooves – types – weld joints

Advanced Fusion Welding Processes: Electron beam welding, laser beam welding, plasma arc welding, Interpulse TIG welding, Cold metal transfer welding

Advanced Solid state welding processes: Diffusion Bonding, Friction stir welding, friction stir spot welding

Defects: Welding defects – types – causes – remedial action

REFERENCES

1. Howard B Cary, "Modern Welding technology", Prentice Hall, New Jersey, 2002.
2. William A Bowditch, Welding Technology Fundamentals, Good Heart Willcox Publishers, 2006.

MECX003	CNC PROGRAMMING	L	T	P	C
		1	0	0	1

CNC Machines

Numerical control – definition – components of NC systems, Development of NC, DNC, CNC, and adaptive control systems, Working principle of a CNC system, features and advantages of CNC machines

Introduction to CNC systems - fanuc oi, siemens 840D, Heidenhein, current trends in programming, Human Machine Interface software – siemens – fanuc systems

CNC Hardware System

CNC system elements, Drives, Slide ways, Feedback devices, ATC and Tool Magazines, and Machine Control Units

CNC Part Programming

Part program structure, CNC program procedure – coordinate system, Sequence number, preparatory functions and G codes, miscellaneous functions and M codes, NC dimensioning – reference points – machine zero, work zero, tool zero and tool offsets, Types of motion control: point-to-point, paraxial and contouring

Part Program – tool information – speed – feed data – interpolations, Macro – subroutines – canned cycles - Mirror images – thread cutting, Sample programs for lathe and milling, Conversational automatic programming, and APT programming

Introduction to Computer assisted part programming – EdgeCAM, Master CAM etc.,

REFERENCES

1. CAD/CAM/CIM, R.Radhakrishnan, S.Subramanian, V.Raju, 2nd, 2003, New Age International Pvt. Ltd.
2. CAD/CAM, Mikell P.Groover, Emory Zimmers Jr. Indian Reprint Oct 1993, Prantice Hall of India Pvt., Ltd.
3. S.K.Sinha, NC Programming, I Edition, 2001, Galgotia Publications Pvt. Ltd.
4. Dr.P.N.Rao, CAD/CAM Principles and Applications, 2002, Tata Mc Graw Hill Publishing Company Ltd.
5. Ibrahim Zeid, Mastering CAD/CAM, Special Indian Edition 2007, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
6. Mikell P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, 2nd Edition, Reprint 2002, Pearson Education Asia.
7. Yoram Koren, Computer control of manufacturing systems, International Edition 1983, McGraw Hill Book Co

MECX004	PLASTIC PROCESSING TECHNOLOGY	L	T	P	C
		1	0	0	1

INJECTION MOULDING

Terminology – Process description- Theory of injection moulding – Design and consideration -moulding cycle —Trouble shooting operations. Types Injection unit & Elements of plastication process – Classification of screw – Screw design – Process control – Clamping unit.

BLOW MOULDING

Terminology – Basis in blow moulding - Process variables – Injection & stretch blow moulding – Single and multi layer. Extrusion blow moulding – Extrusion heads, moulding process controls for blow moulding – Machine, process and product controls. Thermoforming –Thermoforming machinery – Heating of sheet – Heating cycle - Stretching – Concept – Heat balance – Shrinkage –Trimming operations.

EXTRUSION AND COMPRESSION MOULDING

Principle – Types of Extruders – Single screw and twin-screw extruders – Metering – Screw Design - process control variables – Types of dies –Extrusion of Pipes- Extrusion profiles – Extrusion line for cable industry – Blown films – Flat film- Cast film - sheet film.

Types and procedure machinery and equipment moulding of thermoplastics – moulding of Thermosets - Transfer moulding advantages – Limitations-Rotational moulding – types of machines moulds – materials.

REFERENCES:

1. Manas Chanda, Salil.K.Roy, Plastic Technology handbook. – CRC Press, Third edition 1998.
2. V. Rosato Kluwer, Injection moulding handbook. - Academic Publishers Boston 2nd edition 1995.
3. Richard C. Progelhof James. L. Throne, Polymer Engineering Principles, Hanser Publisher Munich 1993.
4. N.P. Charemisinoff & P.N. Chere, Handbook of applied Polymer processing Technology, Marcel Dekker Inc, NY 1996.
5. Herbert Rees, Understanding of Injection moulding Technology, Hanser Publications, Munich 1994
6. Vishu Shah, “Handbook of Plastics testing and Failure Analysis” — 3rd edition. John Wiley, NY, 2007.

MECO001	MATERIAL SELECTION AND DESIGN	L	T	P	C
		3	0	0	3

Introduction to Mechanical System Design

Materials and Design ,Evolution of Engineering Materials, Evolution of Engineering Materials, Material Resource in Indian Context, Classification of Materials, Case Study: Materials Selection for Vehicle Body,

Mechanical Properties of Materials

Overview of Material Properties, Surface Properties of Materials, Other Functional Properties of Materials,

Basic Structure of Materials

Material Properties; The Role of Crystal Structure, Material Properties; The Role of Crystal Structure, Metals and Metallic Structure, METALLIC ALLOYS, CERAMICS & GLASSES ,Introduction to Polymeric Materials, Phases and microstructure of Polymers, Polymers for Mechanical Design

Overview of Composite Materials

Reinforcement Fibres for Composite Materials, Special type of Composites Metal Matrix Composite, Ceramic Matrix Composite, Design of Laminated Composite

The Design Process

Material Selection using Ashby Method - Case Study, Multiple Constraints in material selection, Multiple Objectives, Role of Materials in Shaping the Product Character, Case

Studies, The Role of Shape Factors in Material Selection, Design Case Studies - Guitar String Design

REFERENCES

1. Kenneth G. Budinski and Michael K. Budinski, Engineering Materials, Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.
2. Ronald Gibson, Principles of Composite Material Mechanics, Tata McGraw Hill, New Delhi, 1994.
3. Agarwal, B.D., and Broutman, L.J., Analysis and Performance of Fiber Composites, John Wiley and Sons, New York, 1980.

MECO002	MICRO AND SMART SYSTEMS	L	T	P	C
		3	0	0	3

Introduction

Glimpses of Microsystems; scaling effects, Smart materials and systems: an overview, Microsensors Microactuators, Microsystems: some examples, Examples of smart systems: structural health monitoring and vibration control

Microfabrication processes

Structure of silicon and other materials, Silicon wafer processing; Thin-film deposition, Lithography, wet etching and dry etching, Bulk micromachining and Surface micromachining, Wafer-bonding; LIGA and other moulding techniques, Soft lithography and polymer processing, Thick-film processing; Low temperature co-fired ceramic processing, Smart material processing

Mechanics of Solids

Stresses and deformation: bars and beams, Microdevice suspensions: lumped modelling, Residual stress and stress gradients, Poisson effect; Anticlastic curvature; examples of micromechanical structures, Thermal loading; bimorph effect, Dealing with large displacements; in-plane and 3D elasticity equations, Vibrations of bars and beams, Gyroscopic effect, Frequency response; damping; quality factor, Basic micro-flows for damping calculation,

Finite element method

Types of numerical methods for solving partial differential equations, What is finite element method? Variational principles, Weak form; shape functions, Isoparametric formulation and numerical integration, Implementation of the finite element method, FEM for piezoelectrics,

Electronics and packaging

Semiconductor devices: basics, OpAms and OpAmp circuits, Signal conditioning for microsystems devices, Control and Microsystems, Vibration control of a beam, Integration of microsystems and microelectronics, Packaging of Microsystems: why and how, Flip-chip, ballgrid, etc.; reliability, Case-study 1 (Pressure sensor), Case-study 2 (Accelerometer)

REFERENCES

1. S.D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
2. Tai-Ran Hsu, MEMS & Microsystems Design and Manufacture, McGraw Hill, 2002.
3. V.K. Varadan, K.J. Vinoy, and S. Gopalakrishnan, Smart Material Systems and MEMS: Design and Development Methodologies, Wiley, 2006.

MECO003	FINITE ELEMENT ANALYSIS OF SOLIDS AND FLUIDS - I	L	T	P	C
		3	0	0	3

Introduction to finite element analysis process, Analysis of solids/structures and fluids, the principle of virtual work, The finite element formulation, Finite element solution process, Demonstration on using ADINA, Nonlinear finite element analysis of solids and structures, Heat transfer analysis, Finite element analysis of heat transfer and incompressible fluid flow, Physical explanation of Gauss elimination, Solution of dynamic equilibrium equations, Demonstration on finite element methods in ADINA, Modeling for dynamic analysis and solution, Wave propagation response, Solution of the generalized eigenvalue problem, Solution of $K\phi = \lambda M\phi$

References

Bathe, K. J. *Finite Element Procedures*. Cambridge, MA: Klaus-Jürgen Bathe, 2007. ISBN: 9780979004902.

MECO004	MECHANICAL ASSEMBLY AND ITS ROLE IN PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

Introduction, Logistics, Context, History, Assembly in the Small - Step-by-step Process - Assembly Motions and Forces, Assembly in the Small-Rigid Part Mating Theory and RCC, Student project descriptions due, Key Characteristics, Mathematical Models of Assemblies, Feature-based Modeling of Assemblies, Constraint in Assembly, Variation Build up in Assemblies, Assembly Sequence Analysis, Algorithms, and Software, The Datum Flow Chain, Assembly in The Large - Basic Issues, Economics, Step-by-step Process, Product Architecture, Flexibility, Design for Assembly - Theory and Examples, AITL System Design Issues: Kinds of Assembly Lines and Equipment, Production Volume, Cycle Times, Assembly in The Large: Workstation Design Issues, Assembly System Design Techniques and Simulation, Economic Analysis of Assembly Systems, Flexible Manufacturing Systems, Outsourcing, and Supply Chain Management , 767 Wing Case Study

TEXT BOOK:

Whitney, Daniel E. *Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development*. New York, NY: Oxford University Press, 2004. ISBN: 9780195157826.