ANURAG
Engineering Engineers

ANURAG GROUP OF INSTITUTIONS

(AUTONOMOUS)

(Formerly CVSR College of Engineering)

Venkatapur, Ghatkesar, Hyderabad – 500 088.

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B.Tech. Programs:

Chemical Engineering
Civil Engineering
Computer Science and Engineering
Electrical and Electronics Engineering
Electronics and Communication Engineering
Information Technology
Mechanical Engineering
Artificial Intelligence

Pharmacy Programs:

B.Pharmacy
Pharma-D
Pharma-D (Post Baccalaureate)
M.Pharm (Pharmaceutics)
M.Pharm (Pharmacology)
M.Pharm (Pharmaceutical Analysis & Quality Assurance)
M.Pharm (Industrial Pharmacy)

M.Tech. Programs:

M.Tech (Computer Science and Engineering)
M.Tech (Power Electronics & Electrical Drives)
M.Tech (Electrical Power Systems)
M.Tech (Machine Design)
M.Tech (VLSI System Design)
M.Tech (Embedded Systems)
M.Tech (Structural Engineering)

Master of Business Administration

COURSE STRUCTURE AND DETAILED SYLLABUS

II, III & IV – B.Tech – I & II Semesters

R18-Regulations

MECHANICAL ENGINEERING

FOR
B.TECH FOUR YEAR DEGREE COURSE
(Applicable for the batches admitted from 2018-19)

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II YEAR I SEMESTER **COURSE STRUCTURE**

Subject Code	Category	Course Title	L	T	P	Credits
A53014	PCC	Theory of Machines-I	3	0	0	3
A53006	HS	Managerial Economics and Financial Analysis	2	1	0	3
A53015	PCC	Materials Engineering	3	0	0	3
A53002	ESC	Basic Electrical Engineering	2	1	0	3
A53016	PCC	Strength of Materials	2	1	0	3
A53017	PCC	Thermodynamics	2	1	0	3
A53205	PCC	Materials Engineering Lab	0	0	2	1
A53206	PCC	Strength of Materials Lab	0	0	2	1
A53007	MC-I	Gender Sensitization	2	0	0	0
		Total	**16**	**04**	**04**	**20**

II YEAR II SEMESTER **COURSE STRUCTURE**

Subject code	Category	Course Title	L	T	P	Credits
A54015	PCC	Applied Thermodynamics-I	2	1	0	3
A54016	PCC	Fluid Mechanics & Hydraulic Machinery	2	1	0	3
A54017	PCC	Theory of Machines-II	3	0	0	3
A54018	BSC	Mathematics III	3	0	0	3
A54019	PCC	Manufacturing Technology-I	3	0	0	3
A54205	PCC	Manufacturing Technology-I Lab	0	0	2	1
A54206	PCC	Fluid Mechanics & Hydraulic Machinery-Lab	0	0	2	1
A54207	PCC	Machine Drawing & Drafting Lab	0	0	4	2
A54208	HS	Soft Skills for Success Lab	0	0	2	1
A54007	MC – II	Environmental Studies	2	0	0	0
Total			**15**	**02**	**10**	**20**

III YEAR II SEMESTER **COURSE STRUCTURE**

Subject code	Category	Course Title	L	T	P	Credits
A55023	PCC	Manufacturing Technology-II	3	0	0	3
A55024	PCC	Design of Machine Elements-I	3	0	0	3
A55025	PCC	Applied Thermodynamics-II	3	0	0	3
A55026 A55027 A55006	HS	Open Elective-I 1) Essential English & Employability Skills 2) JAVA Programming 3) Logical Reasoning, Verbal and Quantitative Ability	3	0	0	3
A55028 A55029 A55030	PEC	Elective I 1.Automation in Manufacturing 2.Industrial Engineering and Management 3.Renewable Energy Sources	3	0	0	3
A55031	PCC	Engineering Metrology& Surface Engineering	3	0	0	3
A55206	PCC	Thermal Engineering Lab	0	0	2	1
A55207	PCC	Manufacturing Technology-II Lab	0	0	2	1
TOTAL			**18**	**00**	**04**	**20**

III YEAR II SEMESTER **COURSE STRUCTURE**

Subject code	Category	Course Title	L	T	P	Credits
A56018	PCC	Heat Transfer	3	0	0	3
A56019	PCC	Design of Machine Elements-II	2	1	0	3
A56020 A56021 A56022	PEC	Elective-II 1) Alternative Fuels for IC Engines 2) Modern Machining and Forming Methods 3) Automobile Engineering	3	0	0	3
A56023 A56024 A56025	PEC	Elective III 1)Composite Materials 2) Production Planning and Control 3) Refrigeration and Air Conditioning	3	0	0	3
A56026	HS	Operations Research	2	1	0	3
A56027	PCC	Finite Element Methods	3	0	0	3
A56206	PCC	Heat Transfer Lab	0	0	2	1
A56207	HS	Advanced English Communication Skills Lab	0	0	2	1
		Total	**16**	**02**	**04**	**20**

IV YEAR I SEMESTER **COURSE STRUCTURE**

Subject code	Category	Course Title	L	T	P	Credits
A57027	PCC	Robotics	3	0	0	3
A57028 A57029 A57030	PEC	Elective-IV 1) Mechanical Vibrations 2) Mechatronics Systems 3) Intellectual Property Rights	3	0	0	3
A57031 A57032 A57033	PEC	Elective-V 1) Introduction to CNC 2) Power Plant Engineering 3) Tool Design	3	0	0	3
A57034 A57035 A57036	PEC	Elective VI 1. Jet Propulsions & Rocket Engineering 2. Maintenance and Safety Engineering 3. Computational Fluid Dynamics	3	0	0	3
A57037	PCC	Mechanical Measurements	3	0	0	3
A57038	PCC	Computer Aided Design &Manufacturing	3	0	0	3
A57207	PCC	Mechanical Measurements & Robotics lab	0	0	2	1
A57208	PCC	Computer Aided Design & Manufacturing Lab	0	0	2	1
A57209	PROJ	Mini Project	0	0	4	2
TOTAL			**18**	**00**	**08**	**22**

IV YEAR II SEMESTER **COURSE STRUCTURE**

Subject Code	Category	Course Title	L	T	P	Credits
A58011 A58012 A58006	OEC	Open Elective-II 1. Language and Life Skills 2. Total Quality Management 3. NanoScience & NanoTechnology	3	0	0	3
A58013 A58014 A58015	OEC	Open Elective-III 1.English For Professionals 2.Industrial Safety and Hazard Management 3.Entrepreneurship Development	3	0	0	3
A58207		Technical Seminar	0	0	6	2
A58208		Comprehensive Viva-voice	0	0	0	2
A58209	PROJ	Project Work	0	0	15	10
TOTAL			**06**	**00**	**21**	**20**

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II Year B.Tech. Mech-I Sem	**L**	**T / P / D**	**C**
	3	- / - / -	3

THEORY OF MACHINES – I
(Professional Core Course)

PRE REQUISITES: Engineering Mechanics

COURSE OBJECTIVES:
The objectives of this course are to:
1. Gain knowledge on various types of mechanisms and machines.
2. Impart skills to analyze the position, velocity and acceleration in Mechanisms.
3. Draw the Cam profile for various followers.
4. Estimate the transmission of power by gears.
5. Calculate the transmission of power by gears trains.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Develop the models of machines and mechanisms.
2. Analyze the planar mechanism for displacement, velocity and acceleration graphically.
3. Design cam profile for follower of various configurations and motions.
4. Categorize the various motion transmission elements.
5. Select of gear trains with respect to different applications.

UNIT – I
Mechanisms: Elements of Links – classification – rigid link, flexible and fluid link – types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained.

Machines: Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains.

Straight Line Motion Mechanisms: Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russul – Grasshopper – Watt T. Chebicheff and Robert mechanisms and straight line motion, pantograph.

UNIT – II
Kinematics: Velocity and acceleration – motion of link on machine – determination of velocity and acceleration diagrams – graphical method – application of relative velocity method four bar chain.

Analysis of Mechanisms: Analysis of slider crank chain for displacement, velocity and acceleration of slider – acceleration diagram for a given mechanism, Coriolis acceleration, determination of Coriolis component of acceleration.

Plane Motion of Body: Instantaneous center of motion, centroids and axodes – relative motion between two bodies – three centres in line theorem – graphical determination of angular velocity of points and links.

Steering Mechanisms: Conditions for correct steering – Davis steering gear, Ackermans steering gear – velocity ratio.

UNIT – III

Cams : Definition of cam and followers – their uses – types of followers and cams – terminology- types of follower motion – uniform velocity – simple harmonic motion and uniform acceleration, maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

Hooke's Joint: Single and double Hooke's joint – universal coupling – application – problems.

UNIT – IV

Higher Pairs: Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, form of teeth, cycloidal and involute profiles, velocity of sliding – phenomena of interferences – methods of interference, condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact – introduction of helical, bevel and worm gearing.

UNIT – V

Gear Trains: Introduction – train value – types – simple and reverted wheel train – epicyclic gear train, methods of finding train value or velocity ratio of epicyclic gear train –selection of gear box – differential gear for an automobile.

TEXT BOOKS:

1. Theory of Machines, R.K Bansal, Laxmi Publications (P) Ltd.
2. Theory of Machines, Rattan .S.S, Tata McGraw-Hill Education, 2009 Edition.
3. Theory of Machines, R.S Khurmi and J.K Gupta, Eurasia Publishing House.

REFERENCE BOOKS:

1. Theory of Machines, Thomas Bevan, CBS.
2. Theory of Machines, PL. Ballaney, Kharina Publishers.
3. Theory of Machines, Sadhu Singh, PearsonsEducation.
4. Mechanism and Machine Theory, JS Rao and RV Dukkipati, New Age International (P) Ltd. Publishers.
5. Theory of Machines, Shigley, Oxford.

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II Year B.Tech.Mech-I Sem	**L**	**T / P / D**	**C**
	2	1 / - / -	3

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS
(Humanity and Social Sciences including Management Courses)

COURSE OUT COMES:

After completion of this course, students will be able to:

1. Describe the concept of demand and its determinants in managerial decisions.
2. Analyze the cost concepts and breakeven analysis in production.
3. Evaluate the market structures and different pricing strategies.
4. Apply the capital budgeting techniques in financial decisions.
5. Application of Ratios in solving of business problems and taking correct decisions.

UNIT – I

Introduction to Managerial Economics: Definition, Nature and scope of Managerial Economics, Demand Analysis- Demand Determinants, Law of Demand and its exceptions.

Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Methods of Demand Forecasting (Survey Methods, Statistical Methods, Expert Opinion Method, Test Marketing, Controlled Experiments, Judgmental Approach to Demand Forecasting)

UNIT – II

Theory of Production and Cost Analysis: Production Function – Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs.

Cost Analysis: Cost concepts, Opportunity Cost, Out of Pocket Costs vs. Imputed Costs. Breakeven Analysis (BEA) – Determination of Breakeven Point (simple problems), Managerial Significance and limitations of BEA.

UNIT – III

Market Structures and Pricing Policies:

Market structures: Types of Competition, Features of Perfect Competition, Monopoly and Monopolistic Competition, Price - Output determination in Perfect Competition and monopoly.

Objectives and Policies of Pricing: Objectives of pricing**,** Methods of Pricing - Cost Plus Pricing, Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing, Two - Part Pricing, Block Pricing, Peak Load Pricing, Cross Subsidization.

UNIT – IV

Introduction to Financial Accounting: Accounting, Double-Entry Book Keeping, Journal, Ledger, and Trial Balance, Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

UNIT – V

Financial Analysis through ratios: Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and Quick Ratio), Activity Ratios (Inventory Turnover Ratio and Debtor Turnover Ratio), Capital Structure Ratios (Debt – Equity, Interest Coverage Ratio), and Profitability Ratios (Gross Profit Ratio, Net Profit Ratio, Operating Profit Ratio, P/E Ratio and EPS).

TEXT BOOKS:

1. Varshney and Maheshwari, Managerial Economics, Sultan Chand& Sons.
2. S.A. Siddiqui and A.S. Siddiqui, Managerial Economics and Financial Analysis, New Age International Publishers, Hyderabad.

REFERENCES:

1. R. K. Sharma & Shashi K Gupta, Financial and Management Accounting, Sultan Chand.
2. V. Rajasekaran & R. Lalitha, Financial Accounting, Pearson Education, New Delhi.
3. Domnick Salvatore, Managerial Economics in a Global Economy, Cengage Learning.
4. Subhash Sharma & M. P. Vittal, Financial Accounting for Management, Text & Cases, Machmillan.
5. S. N. Maheshwari& S. K. Maheshwari, Financial Accounting, Vikas Publications.

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II Year B.Tech. Mech-I Sem	**L**	**T / P / D**	**C**
	3	- / - / -	3

MATERIALS ENGINEERING
(Professional Core Course)

PREREQUISITES: Engineering Chemistry.

COURSE OBJECTIVES:
The objectives of this course are to:
1. Identify the relation between processing, structure and physical properties.
2. Study the heat treatment principles.
3. Classify the different types of non-ferrous metals.
4. Understand the phase diagrams of binary systems.
5. Learn the recent developments in materials science and engineering.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Discuss the crystal structure and defects.
2. Assess the mechanical property measurement of different alloys tests.
3. Construct the equilibrium diagrams of different alloys.
4. Explain about heat treatment methods for various alloys.
5. Calculate the percentage of alloying element in Cast Irons and Steels.

UNIT-I
Crystal Structure: Unit cells, metallic crystal structures, ceramics, imperfection in solids: point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

UNIT-II
Mechanical Property Measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; hardness: Rockwell, Brinell and Vickers and their relation to strength, introduction to Non-Destructive Testing (NDT)

UNIT-III
Alloys, Substitutional and Interstitial Solid Solutions: Phase diagrams: interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid andmonotectic reactions, iron iron-carbide phase diagram and microstructural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

UNIT-IV
Heat Treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development, continuous cooling curves and interpretation of final microstructures and properties, austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

UNIT-V

Alloying of Steel: Properties of stainless steel and tool steels, maraging steels, cast irons- grey, white, malleable and spheroidal cast irons, copper and copper alloys- brass, bronze and cupro-nickel, aluminum and Al-Cu – Mg alloys, nickel based superalloys and titanium alloys.

TEXT BOOKS:

1. Introduction to Physical Metallurgy, Sidney H. Avener, Tata Mc-Graw Hill Publications.
2. Essential of Materials for Science and Engineering, Donald R. Askeland, CL Engineering Publications.
3. Material Science and Metallurgy, Kodgire, Everest Publishing Home.

REFERENCE BOOKS:

1. Science of Engineering Materials, Agarwal, McGraw Hill Education.
2. Materials Science and Engineering, William and collister, John Wiley and Sons.
3. Elements of Material Science, V. Raghavan,Prentice Hall India Learning Pvt Ltd.
4. An Introduction to Material Science, W.G. Vinas& HL Mancini, Princeton University Press.
5. Engineering Materials and their Applications, R.A Flinn and P.K Trojan, Jaico books.

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II Year B.Tech. Mech-I Sem	**L**	**T / P / D**	**C**
	2	1 / - / -	3

BASIC ELECTRICAL ENGINEERING

(Engineering Science Course)

Course Objectives:

- To impart knowledge of basic electrical equipment
- To introduce the concept of electrical circuits and its components.
- To impart the knowledge of AC circuits, Phasor algebra related to alternating quantities
- To acquaint the students with principles of operation of transformers, Electrical machines and electrical installations

Course Outcomes:

At the end of the course, students will be the able to

- Understand the importance of various theorems.
- Analyze basic electric circuits with DC excitation.
- Determine the losses and efficiency of single transformers.
- Compare the difference between the performance and applications of three phase and single phase induction motor.
- Demonstrate the principle of operation of alternator, the importance of fuse, circuit breaker.

UNIT-I DC Circuits:

Basic definitions, types of elements, types of sources, Kirchhoff's Laws**,** resistive networks, series, parallel circuits, Star- Delta and Delta- Star transformation, Network theorems- Superposition & Thevenin's - simple problems.

UNIT-II AC Circuits:

Representation of sinusoidal waveforms, peak, rms and average values. Elementary treatment of single-phase AC circuits consisting of R, R-L, R-C, R-L-C combinations (series only). Phasor representation, power factor, real power, reactive power, apparent power, resonance concept. Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT –III: Magnetic Circuits &Transformers:

Magnetic circuits: Magnetic materials, B-H characteristics, Faraday's laws of Electromagnetic Induction, Lenz Law, Fleming's Right hand Rule, Fleming's Left hand Rule Magnetic Circuits - concept of Self & Mutual Inductance.

Transformers:

Ideal and practical single phase transformer, OC-SC tests, losses in transformer, regulation and efficiency - simple problems.

UNTI-IV: DC Machines and Induction Motors:

DC Machines:

Construction, Principle of Operation of DC Generator & DC Motor.

Three Phase Induction Motor:

Construction, Principle of operation of three phase Induction Motor, torque slip characteristics, -simple problems.

Single Phase Induction Motor

Single phase Induction Motor construction and working principle, capacitor start- applications

UNIT –V: AC Generator & Electrical Installation:

AC Generator

Construction, Principle of operation of Synchronous Generator.

Electrical Installation:

Fuse, Relay and Circuit breakers, difference between fuse, Relay and circuit breaker, Types of Batteries, battery backup.

TEXT BOOKS:

1. Basic Electrical Engineering-By M.S. Naidu and S. Kamakshiah-TMH.
2. Principles of Electrical Engineering-by V.K.Mehta & Rohit Mehta-S.Chand Publications.
3. Basic Electrical Engineering - by T.K. Nagasarkar and M.S. Sukhija, Oxford University press.
4. Electrical and Electronics technology- By Hughes-Pearson Education.

REFERENCE BOOKS:

1. Network Analysis by Sudhakar & Shyam Mohan.
2. Theory and problems of Basic Electrical Engineering by D.P.Kothari & I.J. Nagrath, PHI.
3. L.S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. V.D. Toro, “Electrical Engineering Fundamental”, Prentice Hall India, 1989.

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STRENGTH OF MATERIALS
(Professional Core Course)

PREREQUISITES: Engineering Mechanics

COURSE OBJECTIVES:
The objectives of this course are to:
1. Gain knowledge of different types of stresses and strains.
2. Solve the shear force and bending moment for various beams with various loads.
3. Solve the shear Stress and bending stress for various cross section of beams.
4. Know the deflection calculation of various types of beams with various methods.
5. Impart the geometric elongations of cylinders.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Classify the types of stresses, strains and relationship among elastic constants.
2. Construct the shear force and bending moment diagram of the beam subjected to various loads.
3. Solve the bending and shear stresses induced for various cross sections of the beams.
4. Determine the deflection of beams by various methods.
5. Examine the stresses, geometric elongations of thin and thick cylinders.

UNIT – I
Simple Stresses and Strains: Elasticity and plasticity, types of stresses and strains, Hooke's law, stress–strain diagram for mild steel, working stress, Factory of Safety, lateral strain, Poisson's ratio and volumetric strain, Elastic Moduli and the relationship between them, Principal Stresses and Principal Planes, Mohr's Circle.

UNIT – II
Shear Force and Bending Moment: Definition of beam, types of beams, concept of Shear Force(S.F.) and Bending Moment(B.M.), S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, Uniformly Distributed Loads (UDL), Uniformly Varying Loads (UVL) and combination of these loads, point of contra flexure, relation between S.F, B.M and rate of loading at a section of a beam.

UNIT – III
Flexural Stresses: Theory of simple bending, assumptions, derivation of bending equation: M/I=f/y=E/R, neutral axis, determination bending stresses, section modulus of rectangular and circular sections (solid and hollow), I,T angle and channel sections, design of simple beam sections.

Shear Stresses: Derivation of formula – shear stress distribution across various beams sections like rectangular, circular, triangular I, T angle sections.

UNIT – IV
Deflection of Beams: Bending into a circular arc, slope, deflection and radius of curvature, differential equation for the elastic line of a beam, double integration and Macaulay's methods, determination of

slope and deflection for cantilever and simply supported beams subjected to point loads, UDL and UVL, Mohr's theorems, moment area method, application to simple cases including overhanging beams.

UNIT – V

Thin Cylinders: Thin seamless cylindrical shells, derivation of formula for longitudinal and circumferential stresses, hoop, longitudinal and volumetric strains, changes in diameter, and volume of thin cylinders, riveted boiler shells, thin spherical shells.

Thick Cylinders: Lame's equation, cylinders subjected to inside and outside pressures, compound cylinders.

TEXT BOOKS:

1. Strength of materials, Dr.R.K. Bansal, Laxmi Publications.
2. Strength of materials, Ryder, G.H, Macmillan Education.
3. Strength of materials, W.A Nash, Tata McGraw-Hill Education.

REFERENCE BOOKS:

1. Basics of Strength of Materials, Stephen P.Timoshenko, Dover Publications, INC, New York.
2. Analysis of Structures, V.N.Vazirani and M.M.Ratwani, Khanna Publications.
3. Mechanics of Structures Vol-III, S.B. Junnarkar, Charotar Publishing House Pvt.Ltd.
4. Strength of Materials, S.S.Rattan, Tata McGraw-Hill Higher Education.
5. Strength of Materials, W.A.Nash, Tata McGraw-Hill Higher Education.

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II Year B. Tech Mech-I Sem	**L**	**T / P / D**	**C**
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THERMODYNAMICS
(Professional Core Course)

PREREQUISITES: Engineering Physics

COURSE OBJECTIVES:

The objectives of this course are to:

1. Discuss perfect gas laws and mixtures of gases.
2. Analyze the basic definitions of thermodynamics and identify the significance of Zeroth law of thermodynamics.
3. Determine the importance and application of first law of thermodynamics & second law of thermodynamics.
4. Identify the properties of pure substances and use of Mollier diagram & its significance and psychrometry.
5. Evaluate various air standard cycles, their importance and their comparison.

COURSE OUTCOMES:

After completion of this course, the students will be able to:

1. Identify various thermodynamic processes and importance of equation of state and Vander walls equation of state.
2. Analyze the basic concepts of thermodynamics.
3. Explain the laws of thermodynamics and introduction of entropy.
4. Discuss the importance of pure substances and introduction to psychromerty.
5. Evaluate the efficiencies of different power cycles and representing them on P-V & T-S diagrams.

UNIT –I

Perfect Gas Laws: Equation of state, specific heats and universal gas constants, various non-flow processes, properties, end states, heat and work transfer, changes in internal energy, throttling and free expansion processes, various thermodynamic processes, Vander Walls Equation of state, mixtures of perfect gases, mole fraction, volume fraction and mass fraction, gravimetric and volumetric analysis, Dalton's Law of partial pressure, Avogadro's Laws of additive volumes.

UNIT – II

Basic Concepts: System, control volume, surrounding boundaries, universe, types of systems, macroscopic and microscopic view points, concept of continuum, thermodynamics equilibrium, state, property, process, cycle, reversibility, quasi – static process, irreversible process, Causes of irreversibility, energy in state and transition, types, work and heat, point and path function, Zeroth law of thermodynamics, concept of quality of temperature, principles of thermometry, reference points, constant volume gas thermometer, scales of temperature, ideal gas scale.

UNIT – III

First Law of Thermodynamics: PMM of first kind, Joule's experiments, First law of thermodynamics, corollaries, First law applied to a process, applied to a flow system, steady flow energy equation, limitations of the first law, thermal reservoir, heat pump, parameters of performance.

Second Law of Thermodynamics: Kelvin Planck and Clausius statements and their equivalence/ corollaries, PMM of second kind, Carnot's principle, Carnot cycle and its specialties, thermodynamic scale of temperature, Clausius inequality.

Entropy: Principle of Entropy, energy equation, availability and irreversibility, thermodynamic potentials, Gibbs and Helmhoultz functions, Maxwell relations, elementary treatment of the third law of thermodynamics.

UNIT – IV

Pure Substances: P-V-T surfaces, T-S and h-s diagrams, Mollier charts, phase transformations, triple point at critical state properties during change of phase, dryness fraction, Clausius – Clapeyron equation, steam calorimeters.

Psychrometry: Dry bulb, wet bulb and dew point temperatures, specific humidity, relative humidity, saturated air, vapour pressure, degree of saturation, adiabatic saturation, Carrier's equation, psychrometric chart.

UNIT – V

Power Cycles: Otto, Diesel, Dual combustion cycles, Sterling cycle, Atkinson cycle, Ericsson cycle, Lenoir cycle, description and representation on P-V and T-S diagram, thermal efficiency, mean effective pressures on air standard basis, comparison of cycles.

TEXT BOOKS:

1. Engineering Thermodynamics, PK Nag, Tata McGraw-Hill Publishing Company Limited
2. Thermodynamics, An Engineering Approach , Yunus Cengel and Michael A. Boles, Tata McGraw-Hill Publications.
3. Engineering Thermodynamics, D.S. Kumar, S K Kataria & Sons.

REFERENCE BOOKS:

1. Solution Manual to Introduction to Thermodynamics, YVC Rao, Universities press.
2. Engineering Thermodynamics, J.B.Jones and R.E. Dugan, Prentice Hall India Learning Private Limited.
3. Thermodynamics Theory and Applications, Balmer Robert, Jaico Publishing House Mumbai.
4. Engineering Thermodynamics, K.Ramakrishna, Anuradha Publishers.
5. Fundamentals of Engineering Thermodynamics, Moran, MS and Shapiro, HN, John Wiley Sons.
6. Steam Tables with Mollier Diagram, R.S.Khurmi, S.Chand Publications.

NOTE: STEAM TABLES BOOK IS PERMITTED.

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II Year B.Tech. Mech-I Sem	**L**	**T / P / D**	**C**
	-	- / 2 / -	1

MATERIALS ENGINEERING LAB
(Professional Core Course)

PREREQUISITES: Materials Engineering

COURSE OBJECTIVES:
The objectives of this course are to:
1. Provide fundamental knowledge like properties, selection and application on various engineering materials.
2. Develop the necessary industry oriented background skills in the materials-related areas.
3. Acquire knowledge on preparation of metallographic samples.
4. Understand the significance of microstructure of different materials.
5. Study the micro structural changes after different heat treatment processes.

COURSE OUTCOMES:
After the completion of this course, student will be able to:
1. Explain the relationship between the properties and microstructures of various ferrous and non-ferrous metals and their alloys.
2. Analyze the hardness of steels before and after heat treatment.
3. Compare the microstructure of steels before and after heat treatment.
4. Inspect the types of heat treatment process based on their properties.
5. Evaluate the change in hardness based on various cooling methods.

LIST OF EXPERIMENTS:
1. Preparation and study of the micro structure of pure iron.
2. Preparation and study of the micro structure of pure copper.
3. Preparation and study of the micro structure of pure aluminum.
4. Preparation and study of the micro structure of mild steel.
5. Preparation and study of the micro structure of low carbon steel.
6. Preparation and study of the micro structure of high carbon steel.
7. Preparation and Study of the micro structure of cast iron.
8. Preparation and Study of the micro structure of non-ferrous alloys.
9. Preparation and Study of the micro structure of heat treated steels.
10. Determination of the hardenability of steels by Jominy End Quench test.
11. Determination of the hardness of heat treated steel.
12. Determination of the hardness of untreated steels.

REFERENCE BOOKS:
1. Introduction to Physical Metallurgy, Sidney H. Avener, Tata Mc-Graw Hill Publications.
2. Essential of Materials for Science and Engineering, Donald R. Askeland, CL Engineering Publications.

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STRENGTH OF MATERIALS LAB
(Professional Core Course)

PREREQUISITE: Engineering Mechanics

COURSE OBJECTIVES:

The objectives of this course are to:

1. Know the different types of forces acting on various metal components.
2. Know the various beams and applications.
3. Determine hardness of various metal components.
4. Impart knowledge about mechanical behavior of springs under loads.
5. Summarize the mechanical properties by conducting various tests.

COURSE OUTCOMES:

After the completion of this course, student will be able to:

1. Analyze different types of forces acting on various metal samples.
2. Choose a beam based on strength for an application.
3. Investigate the various mechanical properties by conducting different tests.
4. Make use of springs based on stiffness.
5. Utilize the Charpy and Izod test rigs to find the impact strength of specimen.

LIST OF EXPERIMENTS:

1. Tensile test on the given specimen using Universal Testing Machine (UTM).
2. Shear test on the given rod using UTM.
3. Compression test on the cement cube using UTM.
4. Compression test on the wooden specimen using UTM.
5. Bending test on a simply supported beam.
6. Bending test on a cantilever beam.
7. Torsion test on the given rod.
8. Determination of Brinell Hardness of the given specimen.
9. Determination of Rockwell Hardness of the given specimen.
10. Determination of stiffness of the spring under compressive loads.
11. Determination of stiffness of the spring under tensile loads.
12. Charpy V-Notch test on the given specimen.
13. Izod Impact test on the given specimen.

REFERENCE BOOKS:

1. Strength of materials, Dr.R.K. Bansal, Laxmi Publications.
2. Strength of materials, S.Ramamrutham and R.Narayan, Dhanpat Rai Publications.

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GENDER SENSITIZATION
(Mandatory Course-I)

COURSE OUTCOMES:
After completion of this course the students will be able to:

1. Students will have developed a better understanding of important issues related to gender in contemporary India.
2. Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
3. Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
4. Students will acquire insight into the gendered division of labour and its relation to politics and economics.
5. Men and women students and professionals will be better equipped to work and live together as equals.
6. Students will develop a sense of appreciation of women in all walks of life.
7. Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT-I
Understanding Gender:
Gender: Why should we study it? (Towards a world of equals: Unit-1)
Socialization: Making Women, Making Men (Towards a world of equals: Unit-2)
Introduction, Preparing for womanhood.Growing up male.First lesson in caste.Different Masculinities.
Just Relationships: Being Together as Equals (Towards a world of equals: Unit-12)
Mary Kom and Onler. Love and acid just do not mix. Love Letters. Mothers and Fathers. Further reading: Rosa Parks-The Brae Heart.

UNIT-II
Gender and Biology:
Missing Women: Sex Selection and its Consequences (Towards a world of equals: Unit-4)
Declining Sex Ration.Demographic Consequences.
Gender Spectrum: Beyond The Binary (Towards a world of equals: Unit-10)
Two or many?Struggles with Discrimination.
Additional Reading: Our Bodies, Our Health (Towards a world of equals: Unit-13)

UNIT-III
Gender and Labour:
Housework: The invisible Labour (Towards a world of equals: Unit-3)
"May Mother doesn't work". "Share the Load".
Women's work: its politics and economics (Towards a world of equals: Unit-7)
Fact and Fiction.Unrecognized and unaccounted work. Further Reading: Wages and Conditions of Work.

UNIT-IV

Issues of Violence:

Sexual Harassment: Say No! (Towards a world of equals: Unit-6)

Sexual Harassment, not Eve-teasing-coping with everyday Harassment-Further Reading: "Chupulu".

Domestic Violence: Speaking out (Towards a world of equals: Unit-8)

Is Home a Safe Place? – When Women Unite [Film]. Rebuilding Lives. Further Reading: New Forums for Justice.

Thinking about sexual Violence (Towards a world of equals: Unit-11)

Blaming the Victim- "I Fought for my life….." – Further reading: The Caste Face of Violence.

UNIT-V

Gender Studies:

Knowledge: Through the lens of gender (Towards a world of equals: Unit-5)

Point of View.Gender and the Structure of Knowledge. Further Reading: unacknowledged Women artists of Telangana.

Whose History? Questions for Historians and others (Towards a world of equals: Unit-9)

Reclaiming a past.Writing other Histories. Further Reading: Missing Pages from Modern Telangana History.

Essential Reading: All the Units in the Textbook, " Towards a world of Equals; A Bilingual Textbook on Gender" written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasantha, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu.

Note: Since it is interdisciplinary Course, Resource Persons can be drawn from the fields of english Literature or Sociology or Political Science or any other qualified faculty who has exertise in this field.

REFERENCE BOOKS:

1. Sen, Amartya. "More than one million Women are Missing". New York review of books 37.20 (20 December 1990). Print. ' We Were Making History….' Life Stories of Women in the Telangana People's Struggle. New Delhi: Kali for Women 1989.
2. Tripti Lahari. "By the numbers: Where Indian Women Work. "Women's studies journal (14 November 2012) Available online at: http:// blogs.wsj.com/indiarealtime/2012/11/14/by the numbers where Indian women work/ >.
3. K. Satyanarayana & Susie Tharu (ed.) Steel are sprouting: New Dalit Writing From South India, Dossier 2: Telugu And Kannada hhtp://herpercollins.co.in/Bookdetail.asp? Book _code = 3732.
4. Monon, Nivedita, Seeing like a Feminist, New Delhi: Zubaan-Penguin Bokks, 2012.
5. Virginia Woolf: A Room of One's Own. Oxford: Black swan. 1992.

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APPLIED THERMODYNAMICS – I
(Professional Core Course)

PREREQUISITES: Thermodynamics

COURSE OBJECTIVES:
The objectives of this course are to:
1. Demonstrate basic knowledge by understanding the basic working principles of IC Engines and its applications in engineering.
2. Show the combustion phenomena of knocking in SI and CI Engines.
3. Understanding the performance parameters and heat balance sheet applied to IC Engines.
4. Demonstrate the working principles of reciprocating air compressor and their applications.
5. Make the students understand the concepts of various refrigeration systems.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Distinguish between SI and CI Engines.
2. Importance of combustion in SI and CI Engines.
3. Testing of the IC Engines including their performance characteristics
4. Assessment of reciprocating compressors.
5. Importance of refrigeration and properties.

UNIT-I
IC Engines: Definition of engine and heat engine, IC Engines-classification, parts of IC Engines, working principle of IC Engines, two stroke and four stroke, SI and CI Engines, Valve and Port Timing Diagrams. Comparison of air standard and actual cycles, time loss factor, heat loss factor, exhaust blow down.

UNIT-II
Combustion in IC Engines
Combustion in SI Engines: SI Engines- Normal combustion and abnormal combustion, importance of flame speed and effect of engine variables, types of abnormal combustion, pre-ignition and knock, knock limited parameters, effect of engine variables on knock, combustion chamber requirements and types of combustion chambers.
Combustion in CI Engines: Stages of combustion, delay period and its importance, effect of engine variables, diesel knock-suction, compression and combustion induced turbulence, direct and indirect injection combustion chambers, fuel requirements, fuel rating and anti-knock additives.

UNIT -III
Testing and Performance of IC Engines: Parameters of performance, measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, brake power, determination of frictional losses and indicated power, performance test, heat balance sheet and chart.

UNIT-IV

Compressors: Classification of compressors, reciprocating compressors, principle of operation, work required, isothermal efficiency volumetric efficiency and effect of clearance, stage compression, under cooling, minimum work condition for stage compression, multi stage compression, inter-cooling.

Centrifugal Compressors: Mechanical details and principle of operation, energy transfer, impeller blade shape, losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient, velocity diagrams.

Axial Flow Compressors: Mechanical details and principle of operation.

UNIT -V

Refrigeration: Units of refrigeration, introduction to air refrigeration system, vapor compression refrigeration systems, calculation of COP, effect of superheating and sub cooling, desired properties of refrigerants and common refrigerants and their nomenclature, vapour absorption system, mechanical details, working principle, use of p-h charts for calculations.

TEXT BOOKS:

1. Internal Combustion Engines, VGanesan, Tata McGraw-Hill Education.
2. Internal Combustion Engines, Ramalingam KK, Scitech Publications Pvt.Ltd.
3. Thermal Engineering, R.K Rajput, Lakshmi Publications.

REFERENCE BOOKS:

1. Internal Combustion Engines, M.L. and Sharma, R.P. Mathur, Dhanpat Rai Publications.
2. Engineering Fundamentals of Internal Combustion Engines, Willard W. Pulkrabek, Pearson Publications.
3. Thermal Engineering, R.Rudramurthy, Tata McGraw-Hill Education.
4. Thermodynamics and Heat Engines, B Yadav, Central Publishing House, Allahabad.
5. Internal Combustion Engine Fundamentals, John.B.Heywood, Tata McGraw-Hill Education.

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FLUID MECHANICS AND HYDRAULIC MACHINERY
(Professional Core Course)

PRE REQUISITES: Maths, Physics and Engineering Mechanics

COURSE OBJECTIVES:
The objectives of this course are to:
1. Understand the concept of fluid and its properties, hydrostatic forces.
2. Study the basic laws of fluids, flow patterns and their corresponding problems.
3. Outline the concepts of losses in pipes, boundary layer theory, flow separation, concepts of dimensional analysis.
4. Explain the hydrodynamic forces acting on vanes and their performance evaluation.
5. Summarize the importance, function and performance of hydraulic systems.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Classify the properties of fluids and its measurement.
2. Analyze the flows and identify the fluids behavior in motion.
3. Develop the expression for Bernouli expression and to study the losses.
4. Study the performance of vanes and design the turbines.
5. Analyze the performance of hydraulic turbines, understand the basics of pumps, their types and efficiencies.

UNIT – I
Fluid Statics: Definition of fluid, physical properties of fluids, specific gravity, viscosity, surface tension, vapor pressure, atmospheric pressure, gauge and vacuum pressures, measurement of pressure, Piezometer, U-tube Manometer, differential and inverted Manometers.

UNIT – II
Fluid Kinematics: Steam line, path line, streak lines and steam tube, classification of flows-steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational flows, continuity equation for one dimensional flow and three dimensional flows.

Fluid Dynamics: Surface and body forces – Euler's and Bernoulli's equations for fluid flow along a stream line, momentum equation and its application on force on pipe bend.

Measurement of Flow: Venturimeter, Orificemeter, Pitot tube.

UNIT – III
Closed Conduit Flow: Reynold's experiment, Darcy Weisbach equation, Minor losses in pipes – pipes in series and pipes in parallel, equivalent pipes.

Boundary Layer Concepts: Definition, thickness, characteristics along the thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

UNIT – IV

Basics of Turbo Machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip velocity diagrams, work done and efficiency, flow over radial vanes.

Hydraulic Turbines: Classification of turbines, heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design, draft tube theory, functions and efficiency.

UNIT – V

Performance of Hydraulic Turbines: Geometric similarity, unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

Centrifugal Pumps: Classification, working, work done, barometric head, losses and efficiencies, specific speed, performance characteristic curves, NPSH.

Reciprocating Pumps: Discharge, work done, power, slip, indicator diagrams.

TEXT BOOKS:

1. Hydraulics & Fluid Mechanics Including Hydraulics Machines,P.N. Modi and S.M. Seth, Rajsons Publications.
2. Fluid Mechanics and Hydraulic Machines, R K Rajput, S Chand Publications.
3. Fluid Mechanics and Hydraulic Machines, R.K.Bansal, Laxmi Publications.

REFERENCE BOOKS:

1. Fluid Mechanics and Fluid Power Engineering, D.S Kumar, S.K. Kataria and Sons.
2. Fluid Mechanics and Machinery, D. Rama Durgaiah, New Age International Publishers.
3. Hydraulic Machines, Banga and Sharma, Khanna Publishers.
4. Hydraulics, Fluid Mechanics and Hydraulic Machines, R.S.Khurmi, S.Chand Publications.
5. Fluid Mechanics and Hydraulic Machines, Sukumar Pati, Tata McGraw-Hill Education.

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THEORY OF MACHINES – II
(PROFESSIONAL CORE COURSE)

PREREQUISITE: Engineering Mechanics, Theory of Machines – I

COURSE OBJECTIVES:
The objectives of this course are to:
1. Gain knowledge of gyroscopic forces and analysis of forces in basic mechanisms.
2. Impart knowledge of dynamometers and understanding of synthesize the mechanisms.
3. Understand the governors, flywheel and turning moment diagrams.
4. Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses.
5. Classify vibrations and its significance.

COURSE OUTCOMES:
After completion of this course, the student will be able to:
1. Analyze the effect of a gyroscopic forces and the effect of forces on planar mechanisms.
2. Select suitable dynamometer and fly wheel for given applications.
3. Differentiate various governors and methods of synthesis of linkages.
4. Develop an ability to identify a problem on the fundamental concepts of rotating and reciprocating masses.
5. Investigate the effect of vibration on any system with moving parts.

UNIT – I
Precession: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships.

Static and Dynamic Force Analysis of Planar Mechanisms: Introduction, free body diagrams – conditions for equilibrium – two, three and four force members – Inertia forces and D' Alembert's principle – planar rotation about a fixed center.

UNIT –II
Turning Moment Diagram and Fly Wheels: Turning moment – inertia torque connecting rod angular velocity and acceleration, crank effort and torque diagrams – fluctuation of energy – fly wheels and their design

Dynamometers: Dynamometers – absorption and transmission types, general description and methods of operations.

UNIT – III
Governors: Watt, Porter and Proell governors, Spring loaded governors – Hartnell and Hartung with auxiliary springs, sensitiveness, isochronisms and hunting.

Synthesis of Mechanisms: Introduction to linkage synthesis three position graphical synthesis for motion and path generation

UNIT – IV

Balancing: Balancing of rotating masses single and multiple, single and different planes-balancing of reciprocating masses, primary and secondary balancing of reciprocating masses- analytical and graphical methods – unbalanced forces and couples – balancing of "V" Engine, multi cylinder in line and radial engines, balancing of locomotive.

UNIT – V

Vibration: Free vibration of mass attached to vertical spring, vibration isolation and transmissibility – whirling of shafts, critical speeds, torsional vibrations of two and three rotor systems.

TEXT BOOKS:

1. Theory of Machines, Rattan .S.S, Tata McGraw-Hill Education.
2. Theory of Machines, R.K Bansal, LaxmiPublications(P) Ltd.
3. Theory of Machines, R.S Khurmiand J.K Gupta, S Chand and Co Ltd.

REFERENCE BOOKS:

1. Theory of Machines, Thomas Bevan, CBS Publishers.
2. Theory of Machines, PL. Ballaney, Kharina Publishers.
3. Theory of Machines, Sadhu Singh, Pearsons Education.
4. Mechanism and Machine Theory, JS Rao and RV Dukkipati, New Age International (P) Ltd. Publishers.
5. Theory of mechanisms and machines, Jagadish Lal, Metropolitan Book Co Pvt Ltd.

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MATHEMATICS-III

NUMERICAL METHODS & PARTIAL DIFFERENTIAL EQUATIONS

(Common to Mechanical, Civil & Chemical)

(Basic Science Course)

COURSE OUTCOMES:

After completion of this course the students will be able to:

1. Know and understand various types of special functions.
2. Solve potential functions, stream functions and velocity potential.
3. Understand functions of complex variables place a vital role in many areas in engineering for example the motion of fluids, the transfer of heat, the processing of signals, electromagnetic and electrostatic field theory.
4. Classify and solve the contour integration of complex functions.
5. Know the complex variable techniques and knowledge of mapping and transforms play a major role in several areas of engineering.

UNIT-I

Solution of Non- Linear Equations: Solution of Algebraic and Transcendental Equations – The Bisection Method – The Method of False Position – Newton-Raphson Method.

Interpolations: Introduction- Finite differences (Forward Differences, Backward differences and divided difference)Lagrange's Interpolation formula, Newton divided, Newton's forward and backward difference interpolation formulae - Problems.

UNIT-II

Numerical Differentiation using Interpolation Formulae.

Numerical Integration: Newton's cotes quadrature formulae, Trapezoidal rule, Simpson's 1/3rd and 3/8 rules.

UNIT-III

Numerical Solution of Ordinary Differential Equations: Solution by Taylor's series-Picard's Method of successive Approximations- Euler and modified Euler's methods-Runge-Kutta Method.

UNIT-IV

Partial Differential Equations of First Order: Introduction and Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions, solutions of first order linear (Lagrange) equation and nonlinear (Standard type) equations, Charpits Method.

UNIT-V

Partial Differential Equations Of Second Order: Method of separation of Variables for second order equations. Classification of general second order partial differential equations. Applications of Partial Differential Equations-One dimensional wave equation, Heat equation.

TEXTBOOKS:

1. Advanced Engineering Mathematics, Erwin kreyszig, John Wiley & Sons, 2006.
2. Higher Engineering MathematicsB.S. Grewal, Khanna Publishers, 35th Edition, 2010.
3. Introductory methods of numerical analysis, S.S. Sastry, PHI, 4th Edition, 2005.

REFERENCE BOOKS:

1. Numerical Methods, P. Kandasamy, K. Thilagavathy, K. Gunavathi, S. Chand and Company, 2nd Edition, Reprint 2012.
2. A text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2010.
3. Elements of Partial Differential Equations, Ian Sneddon,Tata McGraw-Hill, 1964.

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MANUFACTURING TECHNOLOGY – I
(PROFESSIONAL CORE COURSE)

PREREQUISITES: Workshop Technology

COURSE OBJECTIVES:
The objectives of this course are to:
1. Learn the sand casting and metal casting techniques.
2. Impart the knowledge of various welding processes.
3. Understand about the importance rolling, forging and sheet metal operations.
4. Understand about the processing of plastics.
5. Impart knowledge on selection of suitable manufacturing process for the typical components.

COURSE OUTCOMES:
After completion of this course the students will be able to:
1. Design the gating and riser system and utilize the different special casting processes in real time.
2. Explain the different welding processes for joining the parts for fabricating the final product.
3. Identify the different metal forming and working process and their applications in practical.
4. Distinguish the plastics and able to produce the plastic parts.
5. Classify the different unconventional machining processes.

UNIT – I
CASTING: Steps involved in making a casting, advantage of casting and its applications, patterns and pattern making, types of patterns, materials used for patterns, pattern allowances and their construction, principles of gating, gating ratio and design of gating systems.

UNIT – II
ADVANCED CASTING PROCESSES: Solidification of casting, concept, solidification of pure metal and alloys, short and long freezing range alloys, risers, types, function and design, casting design considerations, special casting processes 1) Centrifugal 2) Die 3) Investment.

Methods of Melting: Crucible melting and cupola operation, steel making processes.

UNIT – III
METAL JOINING PROCESSES:
A) **Welding:** Classification of welding process types of welds and welded joints and their characteristics, design of welded joints, gas welding, arc welding, forge welding, resistance welding, thermit welding and plasma welding.
B) **Cutting of Metals:** Oxy – Acetylene Gas cutting, water plasma, cutting of ferrous metals.
C) **Inert Gas Welding:** TIG and MIG welding, friction welding, induction welding, explosive welding, laser welding, soldering and brazing, Heat Affected Zones in welding, welding defects – causes and remedies – Destructive, Non-Destructive Testing of welds.

UNIT – IV

METAL FORMING AND WORKING: Hot working, cold working, strain hardening, recovery, re-crystallization and grain growth, comparison of properties of cold and hot worked parts, rolling fundamentals, theory of rolling, types of rolling mills and product forces in rolling and power requirements.

Stamping, forming and other cold working processes, blanking and piercing, bending and forming, drawing and its types, deep drawing, wire drawing and tube drawing, coining, hot and cold spinning, types of presses and press tools, forces and power requirement in the above operations.

UNIT – V

EXTRUSION OF METALS: Basic extrusion process and its characteristics, hot extrusion and cold extrusion, forward extrusion and backward extrusion, impact extrusion, hydrostatic extrusion.

FORGING PROCESSES: Principles of forging, tools and dies, types of forging – smith forging, drop forging, roll forging, forging hammers, rotary forging and forging defects.

PROCESSING OF PLASTICS: Types of plastics, properties, applications and their processing methods and equipment (blow and injection molding).

TEXT BOOKS:

1. Manufacturing Processes for Engineering Materials, SeropeKalpakjian and Steven R Schmid, Pearson Publication.
2. Manufacturing Technology, P.N Rao, Tata McGraw-Hill Education.
3. Production Technology, Sarma P.C, S.Chand publication.
4. Production Technology, R.K Jain, Khanna Publishers.

REFERENCES:

1. Process and Material of Manufacture, Lindberg, Pearson Education India.
2. Principles of Metal Castings, Richard Heine,CarlLoper, Philip Rosenthal, Tata McGraw-Hill Education.
3. Welding Processes and Technology, R.S.Paramar, Khanna Publishers.
4. Production Engineering, Suresh Dalela and Ravi Shanker, Galgotia Publications Pvt. Ltd.
5. Manufacturing Engineering and Technology, Kalpakjin.S, Pearson Publication.

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MANUFACTURING TECHNOLOGY-I LAB
(Professional Core Course)

PREREQUISITES: Manufacturing Technology-I

COURSE OBJECTIVES:
The objectives of this course are to:

1. Impart hands-on practical exposure on manufacturing processes and equipment.
2. Know the design and manufacture of simple patterns.
3. Expertise in sand testing, arc welding, gas welding and resistance welding equipment.
4. Operate pipe bending and injection molding equipment.
5. Evaluate various manufacturing methods and their use.

COURSE OUTCOMES:
After completion of this course the students will be able to:

1. Explain pattern preparation, sand molding and melting of metal.
2. Identify the various types of metal joining processes.
3. Discuss the working processes of sheet metal operations.
4. Build the plastic components through different processes.
5. Utilize techniques, skills and modern engineering tools necessary for manufacturing process.

I. METAL CASTING LAB:

1. Pattern design and making – for one casting drawing – 1 Exercise.
2. Sand properties testing – strengths and permeability – 1Exercise.
3. Sand moisture testing –1 Exercise.
4. Moulding Melting and Casting – 1 Exercise.

II. WELDING LAB:

1. ARC Welding Butt Joint – 1 Exercise.
2. Spot Welding – 1 Exercise.
3. TIG Welding – 1 Exercise.
4. Gas Welding – 1. Exercise.
5. Brazing – 1 Exercise.

III. MECHANICAL PRESS WORKING

1. Blanking and piercing operation and study of simple, compound and progressive press tool – 1 Exercise.
2. Hydraulic Press: Deep drawing and extrusion operation – 1 Exercise.
3. Bending operations – 1 Exercise.

IV. PROCESSING OF PLASTICS

1. Injection Moulding - 1 Exercise.
2. Blow Moulding -1 Exercise.

REFERENCE BOOKS:

1. Manufacturing Engineering and Technology, Kalpakjin. S, Pearson Publication.
2. Manufacturing Technology, P.N Rao, Tata McGraw-Hill Education.

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FLUID MECHANICS AND HYDRAULIC MACHINERY LAB
(Professional Core Course)

PREREQUISITE: Fluid Mechanics and Hydraulic Machinery

COURSE OBJECTIVES:

The objectives of this course are to:

1. Impart the experimental skills in flow measurement and real fluid problems.
2. Gain knowledge in performance testing of hydraulic machines.
3. Provide practical knowledge in verification of principles of fluid flow.
4. Illustrate the types of losses in pipes.
5. Find the efficiency of vanes.

COURSE OUTCOMES:

After completion of this course, the students will be able to:

1. Compare the performance of different turbines and pumps.
2. Utilize the theoretical knowledge in calibrating the coefficient of discharge for flow measuring devices.
3. Examine the losses in pipes both major and minor losses.
4. Test for verifying the Bernoulli's theorem.
5. Determine the efficiency of a vane.

LIST OF EXPERIMENTS:

1. Determination of Efficiency of Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal pump.
7. Performance Test on Reciprocating Pump.
8. Determination of Coefficient of Discharge of Venturimeter.
9. Determination of Coefficient of Discharge of Orificemeter.
10. Determination of Friction Factor for a given pipe line.
11. Determination of minor losses in a pipe line.
12. Verification of Bernoulli's Theorem.

REFERENCE BOOKS:

1. Hydraulics & Fluid Mechanics Including Hydraulics Machines, P.N. Modiand S.M. Seth, Rajsons Publications.
2. Fluid Mechanics and Hydraulic Machines, R.K.Bansal, Laxmi Publications.

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MACHINE DRAWING & DRAFTING LAB
(Professional Core Course)

PRE REQUISITE: Engineering Graphics and Design

COURSE OBJECTIVES:

The objectives of this course are to make use of AUTOCAD software for

1. Applying conventional representation for materials and machine elements.
2. Designing fastening arrangements such as screws, nuts, bolts, keyed joints, riveted joints and pin joints.
3. Modeling Shaft couplings for different styles of attachment of shafts.
4. Designing of different Bearings for shafts.
5. Developing the assembly of various machine or engine components and miscellaneous machine components.

COURSE OUTCOMES:

After completion of this course, the students will be able to use AUTOCAD Software to

1. Apply conventional representation of materials for common machine elements.
2. Classify and draw type of Keys, Cotters and Pin Joints.
3. Sketch different types of shaft couplings.
4. Design different types of bearings.
5. Develop assembled views for the part drawing.

PART-A:

DRAWING OF MACHINE ELEMENTS AND SIMPLE PARTS:

Selection of views, additional views for the following machine elements and parts with every Drawing proportion should be drafted using AUTOCAD.

1. Conventional representation of materials and popular forms of screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
2. Keys, cotter joints and knuckle joint.
3. Rivetted joints for plates.
4. Shaft coupling, spigot and socket pipe joint.
5. Journal, pivot and collar and foot step bearings.

PART-B:

ASSEMBLY DRAWINGS:

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

1. Steam engine parts – Stuffing Boxes, Cross Heads, Eccentrics.
2. Machine tool parts: Tail stock, Tool Post, Machine Vices.
3. Other machine parts - Screw jack, Petrol engine connecting rod, Plummer block
4. Simple designs of Feed Check Valve.

PART-C:

GEOMETRIC DIMENSIONING AND TOLERENCES:

1. Principles and Methods of Geometric Dimensioning.

2. Form and Positional Tolerances: Introduction and Indication of the tolerances of form and position on drawings, deformation of runout and total runout and their indication.

TEXT BOOKS:

1. Machine Drawing, K.L Narayana, P.Kannaiah and K.Venkata Reddy, New Age Publishers.
2. Machine Drawing, N.D Bhatt, Charotar Publications.
3. Machine Drawing, Ajeet Singh, Tata McGraw-Hill Education.
4. Production drawing – K.L.Narayana&P.Kannaiah / New Age
5. Machine Drawing with AutoCAD – Pohit and Ghosh,PE
6. Geometric dimensioning and tolerancing – James D.Meadows / B.S Publications.

REFERENCE BOOKS:

1. Machine Drawing, P.S. Gill, Katson Books Pvt.Ltd.
2. Machine Drawing, R.S.Kurmi and J.K.Gupta, S.Chand Publications.
3. Machine Drawing, Rajput, Laxmi Publications.
4. Fundamentals of Machine Drawing, Sadhu Singh, P.L.Sah, PHI Publications.
5. Machine Drawing, Dr.R.K.Dhavan, S.Chand Publications.

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(AUTONOMOUS)

II Year, B.Tech. MECH – II Sem | **L** | **T / P / D** | **C**
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SOFT SKILLS FOR SUCCESS LAB
(Humanity and Social Sciences including Management Courses)

Introduction:

The primary focus of the course is to highlight various categories and applications of Soft Skills through various cases taken from the real field and other research case studies. The fundamental concepts and distinctions between Soft Skills and Hard Skills are discussed. The course is tailored very effectively to introduce various Soft Skill application examples.

Objectives:

To identify and participate in meaningful conversations

Course Outcomes:

Students will be able to

1 exhibit communication skills in various situations
2 handle the emotions with peers and classmates
3 demonstrate respect for the opinions, personal space, and beliefs of others
4 connect and work with others to achieve a set task
5 assess and identify the requirements and strengths within the team

Unit-I

Soft Skills Development: An Introductory Overview - Self-Discovery & Goal Setting - Johari Window

Unit-II

Personality Development - Body Language - Etiquette & Manners

Unit-III

Presentation Skills (Individual & Team) Oral & Written - Teamwork & Leadership Qualities

Unit-IV

Debates - Group Dynamics -Dos & Don'ts - Techniques to Participate and Conclude

Unit-V

Emotional Intelligence - Conflict Management - Stress Management

References:

1. **Soft Skills for Everyone** by Butterfield, Jeff. New Delhi: Cengage Learning. 2010.
2. **Soft Skills** by Chauhan, G.S. & Sangeeta Sharma. New Delhi: Wiley. 2016.
3. **Working with Emotional Intelligence** by Goleman, Daniel. London: Banton Books. 1998.
4. **Theories of Personality** by Hall, Calvin S. et al. New Delhi: Wiley. 2011.
5. **Corporate Conversations** by Holtz, Shel. New Delhi: PHI. 2007.

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ENVIRONMENTAL STUDIES
(Mandatory Course-II)

PRE REQUISITE: Engineering Graphics and Design

COURSE OBJECTIVES:

The objectives of this course are to

1. Introduce the knowledge about environment.
2. Introduce students to the concepts of pollution, bio-diversity.
3. Develop an awareness about global environmental problems.
4. Learn to protect environment and awareness on legal issues.
5. Learn about importance of sustainable development and role of IT in environment

COURSE OUTCOMES:

After completion of this course, the students will be able to:

1. Understand fundamental physical and biological principles that govern natural processes.
2. Understand fundamental concepts from the social sciences and the humanities underlying environmental thought and governance.
3. Integrate and apply perspectives from across the natural sciences, social sciences, and the humanities in the context of complex environmental problems.
4. Communicate integrated perspectives on complex environmental problems in the form of written and oral argument to both professional and lay audiences.
5. Design and conduct independent research that contributes to environmental thought and/or problem solving.

UNIT – I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Need for Public Awareness.

(a) Ecosystems: Concept of an ecosystem – Classification, structure and function of different ecosystems - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids.

(b) Biodiversity and its conservation: Introduction - Definition: genetic, species and ecosystem diversity. -Bio-geographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wild life conflicts. ICUN categories of biodiversity and RED DATA book - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – II

Natural Resources: Renewable and non-renewable – Natural resources and associated problems: Forest resources – Use and over – exploitation, deforestation,– Timber extraction, mining, dams and other effects on forest and tribal people: Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. - Food resources: World

food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. - Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources: Equitable use of resources for sustainable lifestyles.

UNIT – III

(a) Environmental Pollution: Definition, Cause, effects and control measures of different kinds of pollution (Air, Water , Soil , Marine , Noise , Thermal, Nuclear, e –Waste).

(b)Social Issues and the Environment: From Unsustainable to Sustainable development - Urban problems related to energy -Water conservation, rain water harvesting, and watershed management. -Climate change, global warming, ozone layer depletion, nuclear accidents and holocaust.

UNIT – IV

(a) Waste management technology: Solid waste Management: Causes, effects and control measures of urban and industrial wastes. - Role of an individual in prevention of pollution, Disaster management: floods, earthquake, cyclone and landslides.

Waste water and sewage treatment technology: primary, secondary and tertiary treatments. Bioremediation, Phyto-remediation, ZLD (zero liquid discharge), membrane technology. Application of GIS and GPS system in environmental science.

(b) Environmental policy, Rules and regulations. EIA (Environmental Impact Assessment) & EMP (ENVIRONMENTAL Management Plan) – Environment Protection Act. - Air (Prevention and Control of Pollution) Act. -Water (Prevention and control of Pollution) Act-Wildlife Protection Act –Forest Conservation Act.-Public awareness. Global environmental problems and global efforts.

UNIT – V

(a) Towards sustainable future: concept of sustainable development, threats of sustainability, population and its explosion, over exploitation of resources, strategies for achieving sustainable development. Environmental education, Conservation of resources. Urban sprawl, sustainable cities and sustainable communities, human health. Role of IT in environment, environmental ethics, concept of green building, Basic principles of Green engineering, clean development mechanism (CDM), Low carbon life cycle, Polluters-pay principle.

(b) Field work: Visit to a local area to document environmental assets River/forest grassland/hill/ mountain Visit to a local polluted site-Urban/Rural/industrial/Agricultural Study of common plants, insects, birds, Visit to effluent treatment plant/sewage treatment plant Study of simple eco systems pond, river, hill slopes, etc.

Mini projects by students which is mandatory.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, University Press.
2. Environmental studies, From Crisis to cure by R.Rajagopalan,2005

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T.Wright. PHL Learning Private Ltd New Delhi
2. Environmental Engineering and science by Gilbert M.Masters and Wendell P.Ela Prentice Hall India Learning Pvt. Ltd.

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MANUFACTURING TECHNOLOGY – II
(Professional Core Course)

PREREQUISITE: Manufacturing Technology – I

COURSE OBJECTIVES:
The objectives of this course are to:
1. Understand about the importance of metal cutting and its theory.
2. Remember the working principle of various machine tools.
3. Impart the knowledge on design and construction of various machine tools.
4. List out applications of different machine tools.
5. Differentiate various machine tools for different machining operations.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Explain the theory of metal cutting, the formation of different types of chips in cutting, use of cutting tools for different practical applications.
2. List various machine tools for different purposes of manufacturing.
3. Make use of the machines for producing the desired part.
4. Design and fabricate the work holding devices like jigs and fixtures for required purpose.
5. Classify grinding machines, jigs and fixtures.

UNIT – I
Elementary Treatment of Metal Cutting Theory: Element of cutting process, geometry of single point tool and angles, chip formation and types of chips, built up edge and its effects, chip breakers, Mechanics of orthogonal cutting, Merchant's Force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, coolants, machinability, tool materials.

UNIT – II
Engine Lathe: Principle of working, specification of lathe, types of lathe, work holders and tool holders, box tools, taper turning and thread turning, for lathes and attachments.

Turret and Capstan Lathes: Collet chucks, other work holders, tool holding devices, box and tool layout.
Principal Features of Automatic Lathes: Classification, Single Spindle and Multi spindle automatic lathes.

UNIT – III
Shaping Slotting and Planning Machines: Principles of working, principal parts, specification classification, operations performed, and machining time calculations.

Drilling and Boring Machines: Principles of working, specifications, types, operations performed, tool holding devices, twist drill, boring machines, fine boring machines, jig Boring machine, deep hole drilling machine.

UNIT – IV

Milling Machines: Principles of working, specifications, classifications of milling machines, principal features of horizontal, vertical and universal milling machines, machining operations and geometry of milling cutters, method of indexing, accessories to milling machines.

UNIT – V

Grinding Machines: Fundamentals, theory of grinding, classification of grinding machine, cylindrical and surface grinding machines, tool and cutter grinding machine, special types of grinding machines, different types of abrasives, bonds, specification and selection of a grinding wheel.

Finishing Operations: Lapping, honing and broaching machines, comparison to grinding, lapping and honing processes, broaching Machines, constructional features of speed and feed units, machining time calculations.

Jigs & Fixtures: Principles of design of jigs and fixtures and uses, classification of jigs and fixtures, principles of location and clamping, types of clamping and work holding devices, typical examples of jigs and fixtures.

TEXT BOOKS:

1. Metal Cutting Principles, M.C. Shaw, Clarendon Press, Oxford.
2. Workshop Technology, Hazra Choudary, Vol. II, Media Publications.
3. Manufacturing Technology – Metal Culling & Machine Tools, P.N. Rao, Vol. 2, Tata McGraw-Hill Education Pvt. Ltd.
4. Production Technology, R. K. Jain, Khanna Publications.

REFERENCE BOOKS:

1. Machine Tools, C.Elanchezhian and M.Vijayan, Anuradha Agencies Publishers.
2. Modern Machining Process, P.C.Pandey and Shan HS, Tata McGraw-Hill Education.
3. Principles of Machine Tools, Bhattacharya A and Sen.G.C., New Central Book Agency.
4. Metal Cutting Theory and Practice, A. Bhattacharya, New Central Book Agency (P) Ltd.
5. Manufacturing Science, Amitabh Ghosh and Mallick, Associate East West Press Pvt. Ltd.

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DESIGN OF MACHINE ELEMENTS –I
(Professional Core Course)

PRE REQUISITE: Engineering Mechanics, Engineering Drawing and Design, Strength of Materials.

COURSE OBJECTIVES:
The objectives of this course are to:
1. Learn the importance of materials and their properties in the design of Engineering.
2. Calculate the size of rivets and welded joints.
3. Analyze the various failures of Keys, Cotters and Knuckle joints.
4. Design of shafts and couplings subjected to twisting and bending.
5. Differentiate various springs for stresses and deflections.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Predict the failure of members subjected to bi-axial loading.
2. Estimate the rivet and weld sizes of members subjected to eccentric loading.
3. Design keys, cotters and knuckle joints based upon the practical need.
4. Design of aligned and misaligned shafts subjected to twisting and bending.
5. Determine the stresses and deflections of helical, torsional and leaf springs for static and fatigue loading.

UNIT – I
Introduction: General considerations in the design of engineering, materials and their properties, selection, manufacturing consideration in design.

Stresses in Machine Members: Simple stresses, complex stresses, impact stresses, stress strain relations, static theories of failure, factor of safety, design for strength and rigidity. The concept of stiffness in tension, bending, torsion and combined situations.

Stresses due to Fatigue Loading: Stress concentration – Theoretical stress – Concentration factor – Fatigue stress concentration factor notch sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Fatigue theories of failure – Goodman and Soderberg.

UNIT – II
Riveted and Welded Joints: Riveted joints: Modes of failure of riveted joints, strength equations, efficiency of riveted joints, design of boiler joints, eccentrically loaded riveted joints.

Welded Joints: Design of fillet welds, axial loads, circular fillet welds, bending and torsion, eccentrically loaded joints.

UNIT – III
Bolted Joints: Design of bolts with pre-stresses, design of joints under eccentric loading, bolt of uniform strength, cylinder cover joints.

Axially Loaded Joints: Keys, cotters and knuckle joints: Design of keys, stresses in keys, cotter joints, spigot and socket, sleeve and cotter, gib and cotter joints (for square rods), knuckle joints.

UNIT – IV

Design of Shafts: Design of solid and hollow shafts for strength and rigidity, design of shafts for complex loads, design of shaft for a gear and belt drives.

Design of Shaft Couplings: Rigid couplings, muff, split muff and flange couplings, flexible couplings, pin, bush coupling.

UNIT – V

Mechanical Springs: Stresses and deflections of helical springs, extension, compression springs, springs for static and fatigue loading, natural frequency of helical springs, energy storage capacity, helical torsion springs, co-axial springs, design of leaf springs.

TEXT BOOKS:

1. Mechanical Engineering Design, Bahi and Goel, Standard Publications.
2. Machine Design, R.L.Norton, Mc Graw-Hill.
3. Machine Design, R.S.Khurmi,S.Chand and Company Ltd.

REFERENCE BOOKS:

1. Machine Design, Timothy H. Wenzell PE, Cengage Publications.
2. Machine Design, V. Bandari, Tata McGraw-Hill Publishing Company Ltd.
3. Machine Design,Schaum Series, McGraw Hill-Education.
4. Machine Design, Pandya and Shah, Charoater publisher.
5. Design Data Book, S.MD.Jalaluddin,Anuradha Agencies Publishers.

NOTE: DESIGN DATA BOOK IS PERMITTED.

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APPLIED THERMODYNAMICS – II
(Professional Core Course)

PREREQUISITES: Thermodynamics, Applied Thermodynamics-I.

COURSE OBJECTIVES:
The objectives of this course are to:

1. Describe the working principle of various components of steam power cycles and types of boilers in power plants. Study the different types of nozzles.
2. Classify the various steam turbines and velocity triangles in order to calculate power developed by the turbines.
3. Classify Steam Condensers and Gas turbines and to study various methods to improve the efficiency of gas turbine cycles.
4. Student will acquire basic knowledge in various types of jet propulsion systems and Rocket engines.

COURSE OUTCOMES:
After completion of this course, the students will be able to:

1. Analyze the performance of Rankine cycle, Regeneration cycle and Reheat & Classify boilers.
2. Develop the criteria to decide the nozzle statement and its applications.
3. Distinguish between impulse and reaction steam turbines and to develop the expression for power development.
4. Classify the Steam Condensers and to determine the performance of open cycle gas turbine.
5. Analyze the principles of Jet Propulsion and Rockets and their applications.

UNIT – I
Basic Concepts of Rankine Cycle: Schematic layout, Thermodynamic analysis, methods to improve the cycle performance, regeneration and reheating.

Steam Generators: Classification, working principles, mountings and accessories, equivalent evaporation and efficiency.

UNIT – II
Draught: Classification of draught, natural draught, height of chimney for a given draught and discharge, condition for maximum discharge, efficiency of chimney, artificial draught.

Steam Nozzles: Introduction, types, thermodynamic analysis, velocity of nozzle at exit-ideal and actual expansion in nozzle, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape, super saturated flow wilson line.

UNIT – III
Steam Turbines: Classification, impulse turbine-velocity diagram, power developed, axial thrust, blade or diagram efficiency, condition for maximum efficiency.
Methods to reduce rotor speed-velocity compounding and pressure compounding, two row velocity

compounded impulse turbine.

Reaction Turbine: Principle of operation, thermodynamic analysis of a stage, degree of reaction, velocity diagram, Parson's reaction turbine, condition for maximum efficiency.

UNIT – IV

Steam Condensers: Requirements of steam condensing plant, classification of condensers, working principle, vacuum efficiency and condenser efficiency, air leakage, sources and its affects, air pump, cooling water requirement.

Gas Turbines: Classification, Open Cycle Gas Turbine, methods for improvement of thermal efficiency of open cycle gas turbine, Closed Cycle Gas Turbine, analysis.

UNIT – V

Jet Propulsion: Principle of operation, classification of jet propulsive engines, Turbo jet engines, working principles with schematic diagrams and representation on T-S diagram, thrust, thrust Power, propulsive power, thermal efficiency, thrust specific fuel consumption and propulsive efficiency.

Rockets: Applications, working principle, classification, propellant type, specific impulse, solid and liquid propellant rocket engines.

TEXT BOOKS:

1. Thermal Engineering, R.K Rajput, Lakshmi Publications.
2. Gas Turbines, V. Ganesan, Tata McGraw-Hill Publishing Company Ltd.
3. Thermal Engineering, Mahesh M Rathore, Tata McGraw-Hill Publishing Company Ltd.

REFERENCE BOOKS:

1. Thermodynamics and Heat Engines, R.Yadav, Central Book Depot.
2. Gas Turbines and Propulsive Systems, P. Khajuriaand S.P.Dubey, Dhanpatrai and Co.
3. Gas Turbines, Cohen Rogers and SaravanaMuttoo, Addison Wesley – Longman.
4. Thermal Engineering, R.S.Khurmi, JS Gupta, S.Chand Publications.
5. Thermal Engineering, P.L Bellaney, Khanna publishers.
6. Steam Tables with Mollier Diagram, R.S.Khurmi, S. Chand Publications.

NOTE: STEAM TABLE BOOK IS PERMITTED.

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ESSENTIAL ENGLISH & EMPLOYABILITY SKILLS
(Open Elective-I)

1. Introduction:

The purpose of graduate education is not only to gain knowledge but also to acquire employability skills fit for the qualification. The challenge of fresh graduates does not end with merely acquiring a job but to maintain credibility and sustainability throughout their career. Hence, varied skills and competencies are the pre-requisites for professional students who emerge from colleges and are ready to take up global careers.

2. Objectives:

a. To enable students to develop their personality, infuse confidence and increase employability skills in any chosen career.
b. To provide the students hands-on experience to cope with the demands of the world of recruiters.
c. To help the students acquire the job skills essential for employment.

3. Learning Outcomes:

a. Enhancement of employability skills and professional etiquette.
b. Acquisition of productive knowledge, competent learning and innovative thinking skills.
c. Implementation of verbal and non-verbal communication competencies in work place.

Textbooks Prescribed:
Textbook 1: "English for Employability" by **K Purushotham** published by **Orient Black Swan, Hyderabad**
Textbook 2: "Personality Development and Soft Skills" by **Barun K.Mitra,** published by **Oxford University Press**

UNIT-I

"Six Sigma: Dabbawala" from **"English for Employability"** by K Purushotham published by Orient Black Swan, Hyderabad, India.

"Personality Development: A Must for Leadership and Career Growth" from **"Personality Development and Soft Skills"** by Barun.K.Mitra, published by Oxford Publications -
Introduction, Learning about Personality Development from 3 Cases, Personality Analysis, Freudian analysis of Personality Development, Swami Vivekananda's Concept of Personality Development, Personality Begets Leadership Qualities.

UNIT-II
"Yet I am not defeated!" from **"English for Employability"** by K Purushotham published by Orient Black Swan, Hyderabad, India.

"Interpersonal skills" from **"Personality Development and Soft Skills"** by Barun.K.Mitra, published

by Oxford Publications -
The Personality Attribute of Taking Bold Decisions, Personality Types and Leadership Qualities, Personality Tests

UNIT-III
"Patricia Narayanan: An Entrepreneur by accident", from **"English for Employability"** by K Purushotham published by Orient Black Swan, Hyderabad, India.

"Soft Skills: Demanded by Every Employer" from **"Personality Development and Soft Skills"** by Barun.K.Mitra, published by Oxford Publications
Introduction to Soft Skills, Lessons from the 3 Case Studies, Change in Today's Work place; Soft Skills as a Competitive Weapon, Antiquity of Soft Skills, Classification of Soft Skills

UNIT-IV
"Satya Nadella: CEO of Microsoft" from "English for Employability" by K Purushotham published by Orient Black Swan, Hyderabad, India.

"Interview Skills" from **"Personality Development and Soft Skills"** by Barun.K.Mitra, published by Oxford Publications.

UNIT-V
"Body Language Reveals Your Inner self and Personality" from **"Personality Development and Soft Skills"** by Barun.K.Mitra, published by Oxford Publications -
Introduction, Emotions Displayed by Body Language , Handshake-The Most Common Body Language, Eyes-A Powerful Reflection of One's Inner Self, Entry to My Space – Personal Zones May Vary, Body Language Exhibited during Different Professional Interactions.

References:

1. Cottrell,Stella.*Skills for Success*.London:Palgrave Macmillan,2003.
2. *Enhancing English and Employability Skills*, State Board of Technical Education and Training, Hyderabad: Orient Blackswan Private Limited, 2012.
3. Knight,T.Peter and Mantz Yorke.*Assessment, Learning and Employability*.U.K:Mac Graw-Hill House,2003.
4. Rao,M.S. *Soft Skills Enhancing Employability*.New Delhi: I.K.Publishing House,2010.
5. Rao, Nageshwar.Communication *Skills.* New Delhi: Himalaya Publishing House Pvt.Ltd, 2008.
6. Sharma,T.K.Enhancing Employability in Education.India:Patridge Publishing House.2015.
7. Sharma,T.K.Enhancing Employability in Education.India:Patridge Publishing House.2015.
8. Sinha, K. K.*Business Communication.NewDelhi*: Galgotia Publishing Company ,2008.
9. Yadav, Shalini. *Communication Techniques,* New Delhi: University Science Press,2010.

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JAVA PROGRAMMING
(Open Elective-I)

PREREQUISITES: Any programming language

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand the concept of OOP and learn the basic syntax and semantics of the Java language and programming environment
2. Be familiar with the purpose and usage principles of inheritance, polymorphism, encapsulation and method overloading.
3. Understand Exceptional handling and multithreading concepts
4. Be familiar with GUI applications.

COURSE OUTCOMES:

After completion of this course, the student will be able to:

1. Explain the Object Oriented Programming concepts
2. Design programs using package and interfaces.
3. Apply the concepts of Exceptions and multithreading.
4. Develop GUI applications and AWT using Frames
5. Design the programs using Applet and JDBC Concepts

Unit I

Java Basics: History of Java, Java buzzwords, data types, variables, scope and life time of variables, arrays, operators, expressions, control statements, type conversion and costing, simple java program, concepts of classes, objects, constructors, methods, access control, this keyword, static keyword, garbage collection, overloading methods and constructors, parameter passing, recursion, nested and inner classes, Strings.

Unit II

Inheritance –Introduction, forms of inheritance- specialization, specification, construction**,** extension, limitation, combination, Member access rules, super uses, using final with inheritance.

polymorphism- method overriding, abstract classes, Object class Packages and Interfaces : Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between classes and interfaces, File, Byte Streams, Character Streams

Unit III

Exception handling - Concepts of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes. Package java. util- The Collection Interface, list interface, Queue interface, The Collection class: Linked List Class, Hash Set Class. Tree Set Class, String Tokenizer, Date, Random, Scanner.

Multi threading: Differences between multi threading and multitasking, thread life cycle, creating threads, thread priorities, synchronizing threads, inter thread communication.

Unit IV

Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model,

handling mouse and keyboard events, Adapter classes. Text Book1:Ch22)
AWT: class hierarchy, component, container, panel, window, frame, canvas, graphics, Layout Manager – layout manager types – boarder, grid, flow, card and grib bag.
Unit V
AWT controls: Labels, button, canvas, scrollbars, text components, check box, check box groups, choices, lists panels – dialogs, menu bar.
Applets – Concepts of Applets, differences between applets and applications, life cycle of an applet, create applets, passing parameters to applets.
JDBC Connectivity: JDBC Type 1 to 4 Drivers, connection establishment, Query Execution
TEXT BOOKS:

1. Java- The Complete Reference, Seventh Edition, Herbert Schildt, Tata McGraw Hill
2. Database Programming with JDBC&JAVA, Second Edition,George Reese, O'ReillyMedia

REFERENCE BOOKS:

1. Understanding OOP with Java, updated edition, T. Budd, Pearson Education.
2. Thinking in Java Fourth Edition, Bruce Eckel.
3. Introduction to Java programming, Y. Daniel Liang, Pearson Education.

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LOGICAL REASONING, VERBAL AND QUANTITATIVE ABILITY
(Open Elective-I)

Pre requisites: Basic Mathematics, Statistics and English

Course Outcomes:

1. Enhance the problem solving ability of the students with focusing on basic concepts of arithmetic, algebra, geometry data analysis.
2. Demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.

Unit I:

Number Systems: Classification of numbers, Squares, Fractions, Simplifications, Divisibility Test, Power Cycle, Reminder Cycle, Factors, LCM, HCF, Application of LCM & HCF
Ratio and Proportion: Tricks to solve ratio, proportions, continuous proportions, Variations, Ages
Percentages: Percentage Increase/ Decrease , Results on population , Results on Depreciation, Simple Interest , Principal , Interest , Amount , Application of Simple Interest, Compound Interest , Compound Annually , Compound Half-yearly , Compound Quarterl, Difference between Compound Interest and Simple Interest.

Unit II:

Geometry: Lines , Properties of lines , Triangles, Properties of Triangles, Angles , Sectors , Chords , Planes , Quadrilateral
Mensuration: Area & Perimeter of Triangle, Quadrilateral, Rectangle, Square, Parallelogram, Trapezium, Surface Area & Volume of 3D Figures
Data Interpretation: Table Charts, Pie Charts, Bar Graphs, Line Graphs
Data Sufficiency: Problems On all quant and Logical topics

Unit III:

Seating Arrangement: Circular arrangement, row arrangement, column arrangement, Square arrangement, Double row arrangement
Syllogisms: Two Statements & Conclusion, Three Statements & Conclusion, Six Statements

Unit IV:

Number Series: Letter Series, Number Series, Letter & Number Series
Analogy: Simple Analogy, Double Analogy, Word Analogy, Number Analogy, Choosing Analogy Pairs
Coding & Decoding: Letter Coding, Number Coding, Symbol Coding, Letter - Number Coding, Letter - Symbol Coding, Direct Coding, Indirect Coding
Blood Relations: Based on Dialogue or conversation, Based on puzzles

Unit V:

Nouns: Types of nouns, rules, usages and error spotting
Pronouns: Types of nouns, rules, usages and error spotting
Articles: Definite and indefinite articles, Omission of articles, rules, usage and error spotting
Adjectives and Adverbs: Types of nouns, rules, usages and error spotting
Preposition: Types of nouns, rules, usages and error spotting

TEXT BOOKS:

1. Quantitative Aptitude by R.S.Agarwal

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AUTOMATION IN MANUFACTURING
(Professional Elective Course-I)

PREREQUISITES: Manufacturing Technology-II

COURSE OBJECTIVES:
The objectives of this course are to:

1. Understand the strategies of Automation, its types.
2. Define automated flow line terminology. Analyze flow line behavior with and without storage.
3. Solve Line Balancing problems.
4. Classify Automated material handling systems.
5. Learn to integrate process routings and the techniques of optimization.

COURSE OUTCOMES:
After completion of this course, the students will be able to:

1. Define Automation ,classify types and understand strategies of automation.
2. Analyze automated flow lines and its terminology. Analyze transfer lines with and without buffer storage.
3. Evaluate line balancing and assembly systems, understand methods of improving line balancing and flexible assembly lines.
4. Classify automated material handling systems, automated guided vehicles, automated storage systems and retrieval systems etc.
5. Design a product, understand process routings, apply the optimization techniques.

UNIT-I
Introduction: Types and Strategies of Automation, Pneumatic and Hydraulic components circuits, Automation in Machine Tools, Mechanical feeding and tool changing and machine tool control transfer automation, automation current trends, CAD, CAM, CIM; rigid automation: part handling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centers.

UNIT-II
Automated Flow Lines: Methods of work part transport Mechanical buffer storage control function, design and fabrication considerations.

Analysis of Automated Flow Lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT-III
Assembly System and Line Balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC Adaptive Control.

UNIT-IV

Automated Material Handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems. Automated storage systems, automated storage and retrieval systems, Work in Progress storage, interfacing handling and storage with manufacturing.

UNIT-V

Introduction to Modeling and Simulation: Product Design, process route modeling, Optimization techniques, Case studies and industrial applications.

TEXT BOOKS:

1. Automation, Production Systems and Computer Integrated Manufacturing, M.P.Groover, PHI Publisher.
2. Industrial Process Automation Systems, B.R. Mehta Y. Jaganmohan Reddy, Butterworth, Heinemann imprints.
3. Advanced Machining Processes, VK Jam, Allied Publishers.

REFERNCE BOOKS:

1.Computer Aided Manufacturing, Tien-Chien Chang, Richard A Wysk and Hsu-Pin Wang, Pearson.
2.Modern Machining Process, Pandey P.C. and Shah H.S., Tata McGraw-Hill Education.
3.New Technology, Bhattacharya A, The Institution of Engineers, India.
4.Unconventional Machining Processes, C. Elanchezhian, B. VijayaRamnath and M Vijayan, Anuradha Publications.
5.Advanced Manufacturing Technology, Springer.

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INDUSTRIAL ENGINEERING & MANAGEMENT
(Professional Elective Course-I)

PREREQUISITES: Managerial Economics and Financial analysis

COUSE OBJECTIVES:
The objective of teaching this course is to:

1. Classify various theories of management and correlate between entrepreneurship and organizations. Subdivide types of organizations.
2. Illustrate types and principles of production.
3. Identify the objectives of Materials management and analyze EOQ and ABC concept.
4. Solve problems related to PERT and CPM.
5. Explain strategic management techniques and determine the contemporary management practices.

COURSE OUTCOMES:
After completion of this course the students will be able to:

1. Explain the structure of organization, list various management theories and organizational structures.
2. Distinguish the planning coordination between production, planning and design.
3. Analyze Organization structure human resource planning and control systems to manufacturing and services.
4. Explain inspection and quality control techniques.
5. Illustrate strategic management techniques.

UNIT- I
Introduction to Management: Entrepreneurship and organization - Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Systems Approach to Management, Leadership Styles, Social responsibilities of Management.

UNIT- II
Designing Organizational Structures: Departmentation and Decentralization, Types of Organization structures - Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT- III
Operations Management: Objectives- product design process- Process selection-Types of production system(Job, batch and Mass Production),Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts Design of product layout- Line balancing(RPW method) Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

UNIT- IV

Work Study: Introduction – definition – objectives – steps in work study – Method study – definition – objectives – steps of method study– Time Study –definition – objectives – steps of time study. Work Measurement – purpose –Time Study - types of study – stop watch methods – steps – key rating – allowances – standard time calculations – work sampling. Statistical Quality Control: variables-attributes, Shewart control charts for variables- X chart, R chart, - Attributes-Defective-Defect- Charts for attributes-p-chart –C chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

UNIT- V

Job Evaluation: methods of job evaluation – simple routing objective systems – classification method – factor comparison method – point method– benefits of job evaluation and limitations.

Project Management (PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

TEXT BOOKS:

1. Industrial Engineering and Management, O.P. Khanna, Khanna Publishers.
2. Industrial Engineering and Management Science, T.R. Banga and S.C.Sarma, Khanna Publishers.
3. Industrial Engineering Management, NVS Raju, Cengage Learning.

REFERENCE BOOKS:

1. Motion and Time Study, Ralph M Barnes, John Willey & Sons.
2. Human Factors in Engineering & Design, Ernest J McCormick, Tata McGraw Hill Education.
3. Production & Operation Management, Paneer Selvam, PHI Learning.
4. Industrial Engineering Hand Book, Maynard.
5. Industrial Engineering Management, Ravi Shankar, Galgotia.

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RENEWABLE ENERGY SOURCES
(Professional Elective Course-I)

PREREQUISITES: Environmental Studies

COURSE OBJECTIVES:
The objectives of this course are to:
1. Explain the concepts of solar radiation and measurement.
2. Outline utilization of solar energy.
3. Explain about the wind energy conversion and bio-mass.
4. Outline utilization of geothermal, ocean, tidal and wave energy.
5. Explain the need and principle of direct energy conversion.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Utilize the solar radiation.
2. List the solar energy collectors, storage and applications.
3. Interpret the wind energy and bio-mass.
4. Distinguish the geothermal, ocean, tidal and wave energy.
5. Select the concept of direct energy conversion for power generation.

UNIT – I
Principles of Solar Radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT – II
Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds. Solar Applications – solar heating / cooling techniques, solar distillation and drying, photovoltaic energy conversion.

UNIT – III
Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics.

Bio-Mass: Principles of Bio-Conversion, Anaerobic and aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, IC Engine operation and economic aspects.

UNIT – IV
Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

Ocean Energy: OTEC, principles, utilization, setting of OTEC plants, thermodynamic cycles.
Tidal and Wave Energy: Potential and conversion techniques, mini – hydel power plants, their economics.

UNIT – V
Direct Energy Conversion: Need for DEC, Principles of DEC, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday's laws, thermodynamic aspects, selection of fuels and operating conditions.

TEXT BOOKS:
1. Non – conventional Energy Sources, G. D. Rai, Khanna Publishers.
2. Non-Conventional Energy Sources and Utilisation, Er. R. K. Rajput, S. Chand & Company.
3. Renewable Energy Sources and Emerging Technologies, D. P. Kothari , K. C. Sangal and Rakesh Ranjan, Prentice Hall India Learning Private Limited.

REFERENCES:
1. Renewable Energy Resources, John Twidell and Tony Weir, Routledge Publisher.
2. Renewable Energy Resources, G. N. Tiwari and M. K. Ghosal, Narosa Publishing House.
3. Renewable Energy Engineering and Technology, V V N Kishore, The Energy and Resources Institute, TERI.
4. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle, Oxford University Press.
5. Non-Conventional Energy Resources, D S Chauhan and S K Srivastava, New Age International Private Limited.

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ENGINEERING METROLOGY AND SURFACE ENGINEERING
(Professional Core Course)

PREREQUISITES: Physics, Manufacturing Technology-II.

COURSE OBJECTIVES:
The objectives of this course are to:
1. Impart various knowledge about limit and fit systems.
2. Use of various tools for the measurement of angles and sizes.
3. Understand thread and flatness measurements.
4. Explain about comparators and CMM's.
5. Importance of surface cleaning and surface treatments.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Discuss different limits and fit systems.
2. Distinguish various length and angle standards.
3. Measure thread elements and flatness by optical instruments.
4. Estimate the surface roughness by numerical methods.
5. Elaborate surface treatment methods.

UNIT-I
Systems of Limits and Fits: Introduction, normal size, tolerance limits, deviations, allowances, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly, Indian standard institution system – British standard system, International standard system for plain and screwed work.

UNIT- II
Linear Measurement: Length standard, line and end standard, slip gauges – calibration of the gauges, Dial indicator, micrometers.
Measurement of Angles and Tapers: Different methods – Bevel protractor – angle slip gauges – spirit levels – sine bar – sine plate, rollers and spheres used to determine the tapers.
Limit Gauges: Taylor's principle – Design of go and No go gauges, plug ring, snap, gap. Taper. Profile and position gauges.

UNIT-III
Optical Measuring Instruments: Tool maker's microscope and its uses – collimators, optical projector – optical flats and their uses, interferometer.
Flat Surface Measurement: Measurement of flat surfaces – instruments used – straight edges – surface plates – optical flat and auto collimator.

Screw Thread Measurement: Element of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

UNIT-IV
Comparators: Comparators – Mechanical, Electrical and Electronic Comparators, pneumatic comparators and their uses in mass production.

Coordinate Measuring Machines: Types of CMM, Role of CMM and Applications.
Surface Roughness Measurement: Differences between surface roughness and surface waviness – Numerical assessment of surface finish – CLAIR, R.M.S Valves – Rz value, Methods of measurement of surface finish – profilograph, Talysurf. ISI, symbols for indication of surface finish.

UNIT-V
Surface Engineering: Surface texture and properties, Surface cleaning techniques, Surface integrity, Wear and its measurements, Lubricants and its selection for reducing wear, Laser applications for surface modifications.
Surface Treatments: Mechanical surface treatment and coating, Electroless plating and Electro forming, Ceramic, organic and Diamond coating.

TEXT BOOKS:
1. Manufacturing Engineering and Technology, Serope Kalpakjian and Steven R. Schmid, Ed,4, Pearson Publications.
2. Metrology and Measurement, AnandBewoor, Vinay A. Kulkarni, Tata McGraw Hill Education.
3. Engineering Metrology, R. K. Jain, Khanna Publishers.

REFERENCE BOOKS:
1. Fundamentals of Dimensional Metrology, Connie Dotson, Thomson.
2. Engineering Metrology, I. C Gupta, Dhanpat Rai & Co. Ltd.
3. Surface Engineering with Lasers, Dehosson J.T.
4. Surface Engineering for Corrosion and Wear Resistance, JR Davis, Woodhead Publishers.
5. Precision Engineering and Manufacturing, R.L Murty, Newage Publications.

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THERMAL ENGINEERING LAB
(Professional Core Course)

PREREQUISITES: Thermodynamics, Applied Thermodynamics I & II

COURSE OBJECTIVES:
The objectives of this course are to:
1. Find the characteristics of diesel and petrol engines.
2. Draw the performance characteristics of two stage reciprocating air compressor.
3. Calculate the coefficient of performance of vapor compression refrigeration system.
4. Understand the actual valve timing and port timing diagram for 4-stroke and 2-stroke engines.
5. Explain heat balance sheet.

COURSE OUTCOMES:
After completion of this course the students will be able to:
1. Calculate and compare the performance characteristics of diesel and petrol engines.
2. Apply the concept of Morse test on three cylinders S.I. Engine.
3. Determine the performance of two stage reciprocating air compressor.
4. Compare actual and theoretical valve and port timing diagram.
5. Classify different types of boilers.

LIST OF EXPERIMENTS:
1. IC Engine performance test on two stroke petrol engine.
2. IC Engine performance test on four stroke single cylinder diesel engine.
3. Performance test on two stage reciprocating air compressor.
4. Evaluation of frictional power by conducting Morse test on three cylinder four stroke petrol engine
5. IC Engine valve timing diagram.
6. IC Engine port timing diagram.
7. Evaluation of engine frictional power by conducting retardation test on four stroke single cylinder diesel engine.
8. Evaluation of frictional power by conducting motoring test on four stroke single cylinder petrol engine.
9. Heat balance sheet on four stroke four cylinder diesel engine.
10. Assembly and disassembly of a specific engine by making a practical trail on it.
11. Study of different types of boilers.
12. COP of the vapour compression refrigeration system.

REFERENCE BOOKS:
1. Thermal Engineering, R.K Rajput, Lakshmi Publications.
2. Internal Combustion Engines, V. Ganesan, Tata McGraw-Hill Education.

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MANUFACTURING TECHNOLOGY-II LAB
(Professional Core Course)

PREREQUISITES: Engineering Workshop

COURSE OBJECTIVES:
The objectives of this course are to:
1. Classify the different types of machine tools.
2. Understand the parts of various machine tools and operate them.
3. Learn about cutting tools and geometry in machining processes.
4. Understand the different shapes of products that can be produced on these machine tools.
5. Knowledge of thread manufacturing and gear manufacturing.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Explain the basic concepts of geometrical measurement by using various measuring devices.
2. Discuss the tool wear and thread measurement by using Tool maker's microscope.
3. Calculate the surface roughness of work piece and knowing the operation of Taly surf.
4. Modify the ingots into desired component by using various machines.
5. Explain the various kinematic mechanisms in machine.

SECTION – A:
1. Measurement of lengths, heights, diameters by Vernier calipers, micrometers.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear teeth Vernier calipers and checking the chordal addendum and choral height of spur gear.
4. Tool makers microscope.
5. Angle and taper measurements by Bevel protractor & sine bars.
6. Use of spirit level in finding the flatness of surface plate.
7. Thread measurement by Two wire or Three wire method or Tool makers microscope.
8. Surface roughness measurement by Taly surf.

SECTION – B
1. Step turning and taper turning on lathe machine.
2. Thread cutting and knurling on lathe machine.
3. Drilling and tapping.
4. Shaping.
5. Planning.
6. Slotting.
7. Milling.
8. Cylindrical Grinding.
9. Surface grinding.

REFERENCE BOOKS:
1. Manufacturing Technology – Metal Culling & Machine Tools, P.N. Rao, Vol. 2, Tata McGraw-Hill Education Pvt. Ltd.
2. Production Technology, R. K. Jain, Khanna Publications.

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HEAT TRANSFER
(Professional Core Course)

PREREQUISITES: Mathematics, Thermodynamics, Fluid Mechanics & Hydraulic Machinery.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand the fundamentals of heat transfer mechanisms and their applications.
2. Understand the one dimensional steady state and transient conduction heat transfer.
3. Study the natural and forced convection heat transfer.
4. Study the heat transfer in phase change and radiation.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

1. Distinguish between different modes heat transfer and solve for general heat conduction equation in different systems.
2. Analyze problems in simple geometries for one dimensional steady state heat conduction and transient heat conduction.
3. Categorize convective heat transfer process and to evaluate heat transfer coefficients for natural and forced convection by applying correlations.
4. Evaluate the heat transfer coefficients in phase change process and calculate radiation heat transfer between black body surfaces and gray body surfaces.
5. Analyze heat exchanger performance by using the method of log mean temperature difference and method of effectiveness.

UNIT – I

Introduction: Modes of heat transfer – Fundamental laws of heat transfer–General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier heat conduction equation – General heat conduction equation in cartesian, cylindrical and spherical coordinates –simplification and forms of the field equation – steady and unsteady heat transfer – Initial and boundary conditions.

UNIT – II

One dimensional steady state conduction heat transfer: Homogeneous slabs, hollow cylinders and spheres-Electrical analogy, Composite systems, Extended surfaces (Fins), Critical radius of insulation, Systems with heat generation, Variable Thermal conductivity.

Transient Heat Conduction: Systems with negligible internal resistance(lumped heat analysis) –Chart solutions of transient heat conduction systems.

UNIT – III

Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow. Dimensional analysis as a tool for experimental investigation – Buckingham -theorem and method, application for developing semi – empirical non-dimensional correlation for convection heat transfer. Significance of non-dimensional numbers – use of empirical correlation for convective heat transfer.

Forced convection: External Flows-Flat plates and Horizontal pipes.

Free Convection: Vertical plates and pipes-concepts about Hydrodynamic and thermal boundary layer

along a vertical plate.

UNIT – IV

Phase Change Heat Transfer:

Boiling: Pool boiling– Calculations on Nucleate boiling, Critical Heat flux and Film boiling.

Condensation: Film wise and drop wise condensation –Film Condensation on a vertical and horizontal cylinders using empirical correlations.

Radiation Heat Transfer: Emission characteristics and laws of black body radiation – Total and monochromatic quantities–Radiation from non-black surfaces-emissivity.

Radiation heat exchange between two black surfaces – concept of radiation shape factor –Heat exchange between non black (gray) bodies.

UNIT V

Heat Exchangers: Classification of heat exchangers – overall heat transfer coefficient –Fouling in heat exchangers – Concepts of LMTD and NTU methods for different types of heat exchangers. Multi pass and cross flow heat exchangers.

TEXT BOOKS:

1. Fundamentals of Engineering Heat and Mass Transfer, R.C.Sachdeva, New age Publisher.
2. Heat Transfer, P.K.Nag, Tata McGraw-Hill Publishing Company Ltd.
3. Heat and Mass Transfer, D.S.Kumar,S.K.Kataria& Sons.

REFERENCES:

1. Heat Transfer, J.P.Holman, Tata McGraw-Hill Education.
2. Heat and Mass Transfer, YunusCengel, McGraw Hill Education.
3. Heat Transfer-A Basic approach,M.N.Ozisik,McGraw Hill Education
4. Fundamentals of Heat Transfer & Mass Transfer, Incropera& Dewitt, John Wiley& Sons.
5. Heat and Mass Transfer, R.K. Rajput, S.Chand& Company Ltd.
6. Heat and Mass Transfer Data Book, C.P.Kothandaraman, New Age International Publishers.

NOTE: HEAT AND MASS TRANSFER DATA BOOK IS PERMITTED.

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DESIGN OF MACHINE ELEMENTS – II
(Professional Core Course)

PRE REQUISITES: Engineering Mechanics, Engineering Drawing and Design, Strength of Materials

COURSE OBJECTIVES:
The objective of this course are to:
1. Learn types of bearings subjected to cyclic loads and speeds.
2. Design of brakes and clutches subjected to Torque.
3. Distinguish between various belts and rope drives based on power transmission.
4. Design of spur, helical and bevel gears subjected to bending strength.
5. Design of worm gears subjected to strength and wear rating.

COURSE OUTCOMES:
After completion of this course the students will be able to
1. Utilize the different types of bearings based on application.
2. Design of various brakes and clutches based on forces and torque acting.
3. Solve the transmission of power by belt and rope drives.
4. Design the spur, helical and bevel gears based on the beam strength.
5. Examine the worm gear based on beam strength and wear rating.

UNIT – I
Sliding Contact Bearings: Types of Journal bearings – basic modes of Lubrication – Bearing construction – bearing design – bearing materials – Selection of lubricants.
Rolling Contact Bearings: Types of rolling contact bearings – selection of bearing type – selection of bearing life – Design for cyclic loads and speeds – Static and dynamic loading of ball & roller bearings.
UNIT – II
Brakes: Simple block brakes, internal expanding brake, band brake of vehicle.
Clutches: Friction clutches – Single Disc or plate clutch, Multiple Disc clutch, Cone clutch, Centrifugal clutch.
UNIT – III
Belt, Rope & Chain Drives: Transmission of power by Belt and Rope drives, Transmission efficiencies, Belts – Flat and V types – Ropes – Pulleys for belt and rope drives, Materials, Chain drives.

UNIT – IV
Spur and Helical Gear Drives: Spur and Helical gears – Load concentration factor – Dynamic load factor, Surface compressive strength – Bending strength – Design analysis of Spur and Helical gears – Estimation of center distance, module and face width, check for plastic deformation, Check for dynamic and wear considerations.
BEVEL GEAR DRIVES: Bevel gears – Load concentration factor – Dynamic load factor, Surface compressive strength – Bending strength – Design analysis of Bevel gears – Estimation of centre distance, module and face width, check for plastic deformation, Check for dynamic and wear considerations.
UNIT – V
Design of Worm Gears: Worm gears – Properties of worm gears – Selection of materials – Strength and

wear rating of worm gears – force analysis – Friction in worm gears – thermal considerations.

Design of Power Screws: Design of screw, Square ACME, Buttress screws, design of nut, compound screw, differential screw, ball screw – possible failures.

TEXT BOOKS:

1. Design of Machine Elements, Kulkarni, Mc Graw Hill Education.
2. Machine Design, T.V.Sundarajan Murthy and N,Shanmugam, Anuradha Publications.
3. Design Data Books, P.S.G College of Technology, Mahadevan.

REFERENCES:

1. Machine Design, V.Bandari, Tata Mc Graw Hill Education.
2. Machine Design, R.N.Norton, Mc Graw-Hill Education.
3. Mech. Engg. Design, JE Shigley,SIE publication.
4. Design of Machine Elements, Pandya and Shah, CharoaterPublishers.
5. Design Data Book, S.MD.Jalaluddin, Anuradha Agencies Publishers.

NOTE: DESIGN DATA BOOK IS PERMITTED.

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ALTERNATIVE FUELS FOR IC ENGINES
(Professional Elective Course-II)

PREREQUISITES: Applied Thermodynamics-I

COURSE OBJECTIVES:
The objectives of this course are to:
1. Learn different types of alternative fuels.
2. Study the types of liquid fuels used in SI engines and their Performance and Emission Characteristics.
3. Study the different types of liquid fuels used in CI engines and Performance and Emission Characteristics.
4. Study the different types of gaseous fuels used in SI engines and Performance and Emission Characteristics.
5. Study the different types of gaseous fuels used in CI engines and Performance and Emission Characteristics.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Classify various Potential Alternative Fuels available for internal combustion engines.
2. Evaluate the various techniques used in SI Engines.
3. Importance of fuel blends in IC engines.
4. Identifying the performance and emissions, characteristics of SI and CI engines.
5. Discuss the concept of Dual Fuelling Engines.

UNIT I
Introduction: Availability and Suitability and properties of Potential Alternative Fuels – Ethanol, Methanol, DEE, DME, Hydrogen, LPG, Natural Gas, Producer Gas, Bio gas and Bio-diesel, Properties, Merits and Demerits.

UNIT II
Liquid fuels for SI Engines: Requirements of fuels for SI engines-Different Techniques of utilizing alternative liquid fuels– Blends, Neat form, Reformed Fuels - Manufacturing, Storage and Safety-Performance and Emission Characteristics of alternative liquid fuels.

UNIT III
Liquid fuels in CI Engines: Requirements of fuels for CI engines- Different Techniques for their utilization-Blends, Fuel modifications to suit CI engines, Neat fuels, Reformed fuels, Emulsions, Dual fuelling, Ignition accelerators and other additives– Performance and emission characteristics.

UNIT IV
Gaseous Fuels in SI Engines: Use of Hydrogen, CNG, LPG, Natural Gas, Producer gas and Bio gas in SI engines– Safety Precautions – Engine performance and emissions.

UNIT V

Gaseous Fuels in CI Engines: Use of Hydrogen, Producer Gas, Biogas, LPG, Natural gas, CNG in CI engines. Dual fuelling, Performance and Emission characteristics.

TEXT BOOKS:

1.Present and Future Automotive Fuels, Osamu Hi rao and Richard K.Pefley, John Wiley and Sons.

2. Automotive Fuels Handbook, Keith Owen and Trevor Eoley, SAE Publications, 1990.

3. IC Engines, V.M.Domakundawar, A.V.Domakundawar Dhanpatrai & Co. Ltd.

REFERENCES BOOKS:

1. Alternative Fuels, S.S. Thipse, Jaico Publishing House.
2. IC Engines, V.Ganeshan, Tata McGraw-Hill Education.
3. Alternative Fuels Guide Book, Richard L.Bechtold, SAE Electronic Publications.
4. Algae Biodiesel an Alternate Fuel for Diesel Engine, NirajTopare, Satish Khedkar, Vilasrenge, Lamberd Academic Publishing.
5. Alternative Fuels for Transportaion, A.S.Ramdhas, CRC Press.

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MODERN MACHINING AND FORMING METHODS
(Professional Elective Course-II)

PREREQUISITES: Machine tools

COURSE OBJECTIVES:
The objectives of this course are to:
1. Classification of various modern machining processes.
2. Classification of various forming processes.
3. Study the principles, mechanisms, uses and applications of various modern machining processes.
4. Study the principle, mechanism, uses and applications of modern forming processes.
5. Differentiate the various modern forming processes.

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Categorize various abrasive machining methods.
2. Determine the mechanism of MRR in EDM and ECM.
3. Explain the processes of LBM, PAM,EBM and IBM extrusion processes.
4. Discuss RPF,EMF and HERF processes.
5. Distinguish different stretch forming processes.

UNIT – I
Ultrasonic Machining (USM): Introduction, process description, abrasive slurry, Abrasive materials and their characteristics. Functions of liquid medium in slurry, Types of transducers, effect of process parameters, applications and limitations.
Abrasive Jet Machining (AJM): Principles of operation, process details, process variables and their effect on MRR and accuracy, Equation for MRR, advantages and disadvantages and applications.
Water Jet Machining (WJM): Schematic diagram, equipment used, advantages and applications.

UNIT – II
Electric Discharge Machining (EDM): Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, over cut and side taper, flushing methods, mechanism of metal removal, crater volume, types of power supply circuits, mathematical analysis of metal removal rate (MRR), characteristics of spark eroded surfaces, advantages, disadvantages and applications.
Electro-Chemical Machining (ECM) Schematic of the process parameters, functions and characteristics of electrolyte, chemistry of the process, equation for specific MRR and electrode feed rate, advantages, limitations and applications. Rotary machining, hot machining, high speed machining, description of each process parameters, advantages and applications.

UNIT – III
Laser Beam Machining (LBM): Principle of LASER Beam production, materials used, thermal, analysis of the process, process parameters, equations for power density and machining rate, advantages, limitations and applications.
Plasma Arc Machining (PAM): Introduction to equipment used, process description and parameters,

types of plasma: Transferred arc and non transferred arc and process applications. **Electron Beam Machining (EBM):** Schematic of the process, process parameters, principle of production of electron beam, equipment used advantages, disadvantages and applications.
Ion Etching: Process description and applications.

UNIT – IV
Rubber Pad Forming: Principle of the process, process details and its types; Guerin, Wheelon, Marforming and Hydro forming processes and applications.
Electro-Hydraulic Forming (EHF): Schematic of the process description and its applications.
High Energy Rate Forming (HERF): HERF hammers, principle of explosive forming, Explosive materials, types of explosive forming, standoff distance operation and contact operation, the pressure pulse, gas bubble and the process applications.

UNIT – V
Stretch Forming: Introduction. Types of stretch forming: stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming. Stretch forming equipment and accessories, accuracy and surface finish, process variables and limitations. Tube spinning, Introduction, methods of tube spinning, backward spinning and forward spinning, machines and tools used. Machine variables, speeds and feeds, effect of tube spinning on work metal properties and applications. Hydrostatic forming: Process principle, description and applications. Water Hammer Forming (WHF): Schematic diagram of the process, principle of operation, process variables, work materials, process limitations and applications.

TEXT BOOKS:
1. Modern Machining Process,P.C. PANDEY and H.S. SHAH, Tata Mc-Graw Hill publishing Co. Ltd., New Delhi.
2. New Technology, AMITAB BHATACHARYA,The Institution of Engineers (India).
3. Developments in High Speed Metal Forming, Davies and Austin, The Machinery Publishing Co. Ltd.

REFERENCE BOOKS:
1. Production Technology, HMT, McGraw Hill India.
2. Manufacturing Engineering and Technology, Serope Kalpakjain, Pearson Publications.
3. Unconventional Manufacturing Processes, Singh M.K, New Age International (P) Limited.
4. Modern Production, Operations Management, Baffa & Rakesh Sarin,Wiley publications.
5. Reliability Engineering & Quality Engineering, Dr. C. Nadha Muni Reddy and Dr. K. Vijaya Kumar Reddy, Galgotia Publications, Pvt., Limited.

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AUTOMOBILE ENGINEERING
(Professional Elective Course – II)

PREREQUISITES: Applied Thermodynamics-I

COURSE OBJECTIVES:

The objectives of this course are to:

1. Study the components of automobile.
2. Understand the importance of injection and ignition system.
3. Study the functioning of the transmission and suspension
4. Know the working of Steering and braking system.
5. Recognize the disadvantages of emissions and emission standards.

COURSE OUTCOMES:

After completion of this course, the students will be able to:

1. Classify various types of cooling systems, lubrication systems and discuss about various components of an automobile
2. Categorize the types of injection system, ignition system and study about electrical system of an automobile.
3. Identify the importance of transmission and suspension system in an automobile.
4. Analyze the various types of Steering and Braking system.
5. Examine the pollutants from exhaust and identify the various alternative fuels for an automobile.

UNIT-I

Introduction: Types of Automobiles, Components of four wheeler automobile – chassis, frame and body, types of layouts- rear wheel drive-front wheel drive- 4 wheel drive , types of automobile engines, engine construction, turbo charging and super charging , engine lubrication-splash and pressure lubrication systems, oil filters, oil pumps.

Cooling System: Cooling requirements, types of cooling, Air cooling, Water cooling-components-radiator-types-cooling fans-water pump-thermostat, evaporative cooling, liquid cooling.

UNIT-II

Injection System: Types of fuel injection system-Common rail direct injection system (CRDI)-Multipoint fuel injection system(MPFS),Carburetor, Nozzle, fuel filters, fuel pumps.

Ignition System: Function of an Ignition system, types-Battery ignition system-components-battery-contact breaker points-condenser-spark plug, Magneto ignition system, Transistor based coil ignition system, capacitive discharge ignition system.

Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism, solenoid switch, lighting systems, horn, wiper, fuel gauge, oil pressure gauge, engine temperature indicator etc.

UNIT-III

Transmission System: Clutches, principle, types-cone clutch-single plate clutch- multi plate clutch-magnetic and centrifugal clutches, fluid fly wheel , gear boxes-types-sliding mesh-construct mesh-synchro mesh gear boxes-epicyclic gear box, torque converter, propeller shaft – Hotch Kiss drive-Torque tube drive, universal joint, differential rear axles – types, wheel and tyres.

Suspension System: Objects of suspension systems – rigid axle suspension system-Independent suspension system, torsion bar, shock absorber.

UNIT-IV

Steering System: Steering geometry – camber- castor-king pin rake-combined angle toe in &toe out-center point steering, types of steering mechanism – Ackerman steering mechanism- Davis steering mechanism, steering gears – types, steering linkages.

Braking System: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder, tandem master cylinder, requirement of brake fluid, pneumatic and vacuum brakes, Antilock braking system, electronic brake force distribution and traction control.

UNIT-V

Engine Emission Control: Introduction – types of pollutants, mechanism of formation, concentration measurement, methods of controlling-engine modification needed- exhaust gas treatment-thermal and catalytic converters.

Alternative Fuels for Emission Controls: Natural gas, LPG, bio diesel, bio ethanol, hydrogen fuels– National and International pollution standards.

TEXT BOOKS:

1. Automobile Engineering, William Crouse, Tata McGraw-Hill Publishing Company Ltd.
2. A Systems Approach to Automobile Technology, Jack Erjavec, Yessdee Publishers Pvt. Ltd.
3. Automobile Engineering, Kirpalsingh volume I&II, Standard Publishers-distributors.

REFERNCES:

1. Automotive Mechanics ,G.B.S.Narang , Khanna Publishers.
2. Automotive Mechanics ,Heitner, CBS Publishers.
3. Automotive Engines , Srinivasan, Tata Mc Graw-Hill Publishing Co Ltd.
4. Automobile Engineering , K.K Ramalingam ,Scitech Publications.
5. Automotive Engineering ,Newton steeds & Garrett, Butterworth- Heinemann Ltd.

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COMPOSITE MATERIALS
(Professional Elective Course-III)

PREREQUISITE: Manufacturing Technology-I and Strength of Materials.

COURSE OBJECTIVES:
The objectives of this course are to:
1. Identify the fiber and matrix materials used in composites.
2. Learn the manufacturing methods of composites.
3. Study the various failure theories of laminate.
4. Predict the micro and macro mechanical properties of lamina and laminates.
5. Calculate the stresses and strains of laminates.

COURSE OUTCOMES:
After completion of this course, the student will be able to:
1. Categorize the composite materials based on their applications.
2. Discuss the various manufacturing methods and analysis of lamina.
3. Determine the stresses and strains of an angle lamina using various failure theories.
4. Examine the volume fraction, mass fractions, density, void contents and strength of a lamina.
5. Design a laminate by overcoming various failures.

UNIT I
Introduction to Composite Materials: Introduction**,** classification, polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon-carbon composites, fiber, reinforced composites and nature-made composites and applications.
Reinforcements: Fibers Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide, fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.
UNIT II
Manufacturing Methods: Autoclave, tape production, moulding methods, filament winding, man lay up, pultrusion, RTM.
Macromechanical Analysis Of a "Lamina": Introduction, Definitions: stress, strain, Elastic Moduli, strain Energy. Hooke's Law for different types of materials, Hooks Law for a two dimensional unidirectional lamina, plane stress assumption, reduction of Hooks Law in three dimensions to two dimensions, relationship of compliance and stiffness matrix to engineering elastic constants of a lamina.

UNIT III
Hooke's Law for a Two-Dimensional Angle Lamina, Engineering constants of an Angle Lamina. Invariant Form of Stiffness and compliance Matrices for an Angle Lamina Strength Failure. Envelops, Maximum Strain Failure Theory, Tsai-Hill Failure Theory, Tsai-Wu Failure Theory Comparison of Experimental Results with Failure Theories.
Hygrothermal Stresses and Strains in a Lamina: Hygrothermal Stress-Strain Relationships for a Unidirectional Lamina, Hygrothermal Stress-Strain Relationships for a Angle Lamina.

UNIT IV

Micromechanical Analysis of a Lamina: Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi Empirical Models Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion .

UNIT V

Macromechanical Analysis of Laminates: Introduction, Laminate Code, Stress- Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate, Hygrothermal Effects in a Laminate, Warpage of Laminates.

Failure Analysis and Design of Laminates: Introduction Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues

TEXT BOOKS:

1. Engineering Mechanics of Composite Materials, Isaac and M Daniel, Oxford University Press.
2. Mechanics of Composite Materials, R. M. Jones, McGraw-Hill Company.
3. Composite Materials Science and Engineering, Krishan K. Chawla, Springer.

REFERENCE BOOKS:

1. Analysis and Performance of Fibre Composites, B. D. Agarwal and L.J. Broutman, Wiley-Interscience.
2. Mechanics of Composite Materials, Autar K. Kaw, CRC Publications.
3. Finite Element Analysis of Composite Materials, Ever J. Barbero, CRC Press.
4. Analysis of Laminated Composite Structures,L. R. Calcote, Van NostrandRainfold.
5. Mechanics of Composite Materials and Structures, MadhujitMukhopadhyay, University Press.

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PRODUCTION PLANNING AND CONTROL
(Professional Elective Course-III)

PRE REQUISITE: Manufacturing Technology-I and Manufacturing Technology-II

COURSE OBJECTIVES:
The objectives of this course are to:
1. Knowledge of production planning and control methods currently in use by industrial companies, forecasting models, and plant layout.
2. Understand how Enterprise Resource Planning and MRP systems are used in managing operations and basic concept of inventory control and its technique
3. The ability to develop a systematic approach to the solution of planning and control problemsfor a wide variety of industrial and business organizations.
4. Understand meaning of production scheduling, its scope and objectives and techniques of scheduling.
5. Give concept of Production monitoring & control.

COURSE OUTCOMES:
After completion of this course the students will be able to:
1. List out objectives and functions of production planning and control, forecasting and forecasting techniques.
2. Explain the concepts of inventory management, ABC analysis, VED analysis, EOQ models.
3. Discuss the bill of material, route sheets and factors affecting routing procedure.
4. Identify the importance of material requirement planning, enterprise resource planning, line of balance, just in time technique etc.
5. Elaborate the concepts of Dispatching.

UNIT – I
Introduction: Definitions – objectives of production planning and control – functions of production planning and control – elements of production control – types of production – organization of production planning and control – internal organizations department.
Forecasting – importance of forecasting – types of forecasting, their uses – general principles of forecasting techniques – Qualitative methods and quantitative methods.

UNIT – II
Inventory management – Functions inventory – Relevant inventory cost – ABC analysis – VED Analysis – EOQ model – inventory control systems – P – Systems and Q – Systems
Introduction to MRP And ERP, LOB (Line of balance), jit inventory, Japanease concepts.

UNIT – III
Routing – Definition – routing procedure – Route sheets – Bill of material – factors affecting routing procedure, Schedule – definition – difference with loading.

UNIT – IV
Scheduling policies – techniques, standard scheduling methods – job shop, flow shop.Line balancing, aggregate planning – methods for aggregate planning – Chase planning, expediting, control aspects.

UNIT – V

Dispatching – Activities of dispatcher – Dispatching procedure – follow up – definition – reasons for existence of functions – types of follow up, applications of computer in production planning control.

TEXT BOOKS:

1. Production Planning and Control, M.Mahajan, DhanpatiRai & Co.Ltd.
2. Elements of Production Planning and Control, Samuel Eilon, Macmilan.
3. Production Planning and Control, Dr. V. Jayakumar Lakshmi Publications.

REFERENCES:

1. Production Planning and Control, TextCases, SK Mukhopadhyaya, Prentice Hall India Learning Private Limited
2. Production and Operations Management, R.PaneerSelvam, Prentice Hall India Learning Private Limited.
3. Operations Management, Chase, Prentice Hall India Learning Private Limited
4. Management Science, A.R.Aryasri, Tata McGraw-Hill Education.
5. Operations Management, Heizer, Pearson Publications.

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REFRIGERATION AND AIR CONDITIONING
(Professional Elective Course-III)

PREREQUISITES: Thermal Engineering-I and Thermal Engineering-II

COURSE OBJECTIVES:
The objectives of this course are to:
1. Apply the fundamentals of thermodynamics and its relative laws and effect on the system
2. Evaluate the performance of vapour compression refrigeration system
3. Evaluate the performance vapour absorption refrigeration system
4. Understand the psychrometry and its process.
5. Develop the knowledge of students in selecting the right equipment for a particular application of air conditioning

COURSE OUTCOMES:
After completion of this course the students will be able to:
1. Importance of Refrigeration, Refrigeration Cycles and applications.
2. Determine the COP of vapour Compression Refrigeration System and classify the components.
3. Distinguish between vapour Compression Refrigeration and Vapour Absorption Refrigeration.
4. Importance of psychrometric chart and their process.
5. Explain the types of air conditioning systems.

UNIT - I
Introduction of Refrigeration: Necessity and applications – Unit of refrigeration and C.O.P – Mechanical Refrigeration – Types of ideal cycles of refrigeration.

Air Refrigeration: Bell Coleman cycle, Open and Dense air systems – Actual air refrigeration system – Refrigeration needs of Air crafts.
Refrigerants: Desirable properties – classification of refrigerants used – Nomenclature – Eco-friendly Refrigerants.

UNIT – II
Vapor Compression Refrigeration System: Working principle and essential components of the plant – simple vapor compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – Actual cycle influence of various parameters on system performance – use of p-h charts – numerical problems.
Refrigeration Equipments: Compressors, Condensers, Evaporators & Expansion Devices-working Principle and applications.

UNIT – III
Vapor Absorption Refrigeration System: Description and working of NH_3 – water system, Li Br – water (Two shell & four shell) system, Max COP- Principle of operation Three Fluid absorption system, salient features.
Non–Conventional Refrigeration Systems: Thermoelectric, Vortex tube refrigeration system-working principle, applications, limitations.

UNIT – IV

Introduction to Air Conditioning: Psychometric Properties & Processes – Characterization of Sensible and latent heat loads – Need for Ventilation, Consideration of infiltration – Load concepts of RSHF, GSHF – Problems, Concept of ESHF and ADP. Comfort conditions: Requirement of human comfort and concept of Effective Temperature-Comfort Chart.

UNIT – V

Air Conditioning Systems: Comfort Air Conditioning System, Industrial Air Conditioning System, Summer Air Conditioning System, Winter Air Conditioning System, Year Round Air Conditioning System, Unitary Air Conditioning, Central Air Conditioning System –working principle-numerical problems.

Air Conditioning Equipment and Applications: Humidifier, Dehumidifiers, Air filters, fans and blowers, grills and register, duct-supply ducts-outlets-return outlets. Heat Pump-different heat pump circuits- Applications.

TEXT BOOKS:

1. Refrigeration and Air Conditioning, CP Arora, Tata McGraw-Hill Education.
2. A Course In Refrigeration And Air Conditioning, SC Arora & Domkundwar, Dhanpatrai & Co. Ltd.
3. Refrigeration And Air Conditioning, R.S. Khurmi & J.K Gupta,S.Chand Eurasia Publishing House (P)Ltd.

REFERENCES:

1. Refrigeration and Air Conditioning , Manohar Prasad , New Age Publishers.
2. Principles of Refrigeration, Dossat, Pearson Education.
3. Refrigeration and Air Conditioning, P.L. Bellaney.
4. Basic Refrigeration and Air Conditioning, Ananthanarayanan, TataMcGraw-Hill Publishing Company Ltd.
5. Refrigeration Tables with Charts, R.S. Khurmi & J.K Gupta, S.Chand, Eurasia Publishing House (P) Ltd.

NOTE: REFRIGERATION TABLES WITH CHARTS IS PERMITTED

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OPERATIONS RESEARCH
(Humanity and Social Sciences including Management Courses)

PRE REQUISITE: Mathematics – I and Mathematics – II

Course Objectives:

The objectives of this course are to:

1. Know a short history of OR and be able to explain the term OR and Appreciate the nature of Linear programming problem.
2. Understand replacement of depreciable assets
3. Introduce a suitable method when the problem is to maximize the objective function instead of minimizing it.
4. Know processing of n-jobs through two machines ,3 machines &etc
5. Examine the functions that inventory performs and its importance in managerial.

Course Outcome:

After completion of this course the students will be able to:

1. Construct mathematical models for linear programming problem.
2. Use simplex methods for linear programming problem.
3. Identify minimum transportation and efficient assignment of work.
4. Use queuing models for service station establishment.
5. Apply network model in project management.

Unit I

Introduction to Operation Research: Definition, Scope, Objectives, Phases, Models and limitations of Operation Research. Linear Programming Problem- Formulation, Graphical Solution of LPP, Simplex Method, Artificial Variable Technique (Big M and Two-Phase method) and Dual Simplex Method.

Unit II

Transportation Problem, Formulation, Solution, Unbalanced Transportation problem. Finding basic feasible solutions- Northwest corner rule, least cost method and Vogel's approximation method. Optimality test MODI method. Assignment model: Formulation, Hungarian method for optimal solution, solving unbalanced problem and Traveling salesman problem.

Unit III

Sequencing models: Solution of sequencing problem-Processing n x 2, n x 3, 2 x m and n x m. Game Theory: Competitive games, rectangular game with saddle point- minimax (maxmin) method of optimal strategies. Dominance principle, Rectangular games without saddle point – mixed strategy for 2 X 2 games. value of the game with Linear Programming. Methods

Unit IV

Inventory models: Inventory costs, Models with deterministic demand-model (a) demand rate uniform and production rate infinite, model (b) demand rate non-uniform and production rate infinite, model (c) demand rate uniform and production rate finite.

Unit V

Replacement models: Replacement of Items that deteriorate whose maintenance costs increase with time without change in the money value. Replacement of items that fail suddenly: individual replacement

policy, group replacement policy.

Text Book:

1. S. D. Sharma, Operations Research.

Reference Books:

1. Hamdy, A. Taha: Operation Research: An Introduction, PHI, 2007.
2. Hillier, F.S. Lieberman, G.J.: Introduction to operation research 8ed, Tata McGraw-Hill.
3. Gillett: Introduction to Operation Research, TMH.

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FINITE ELEMENT METHODS
(Professional Core Course)

PRE REQUISITES: Engineering Mechanics, Mechanics of Solids

COURSE OBJECTIVES:
The objectives of this course are to:
1. Implement the basics of FEM to relate stresses and strains.
2. Formulate the design and heat transfer problems with application of FEM.
3. Solve 1 D and 2D problems using finite element analysis approach.
4. Design the stiffness matrix of 1D and 2D elements with various methods.
5. Solve the dynamic problem of bar and beam problems.

COURSE OUTCOMES:
After completion of this course the students will be able to:
1. Determine the approximate solutions for various elements using numerical methods.
2. Evaluate the displacements, stresses and strains of a bar element.
3. Distinguish the stress strain displacement relations of various elements.
4. Solve the nodal displacements for two-dimensional elements.
5. Examine the dynamic analysis of bars and beams.

UNIT – I
Introduction to FEM: Basic concepts, Historical back ground, application of FEM, general description, comparison of FEM with other methods. Basic equations of elasticity, Stress – Strain and strain – displacement relations. Rayleigh – Ritz method, weighted residual methods.

UNIT – II
One Dimensional Problems: Stiffness equations for a axial bar element in local co-ordinates using Potential Energy approach and Virtual energy principle – Finite element analysis of uniform, stepped and tapered bars subjected to mechanical and thermal loads – Assembly of Global stiffness matrix and load vector – Quadratic shape functions – properties of stiffness matrix.

UNIT – III
Analysis of Trusses: Stiffness equations for a truss bar element oriented in 2D plane – Finite Element Analysis of Trusses – Plane Truss element – methods of assembly.
Analysis of Beams: Hermite shape functions – Element stiffness matrix – Load vector – Problems.

UNIT – IV
2-D Structural Problems: CST – Stiffness matrix and load vector – Isoparametric element representation – Shape functions – convergence requirements – problems.
Two dimensional four noded isoparametric elements – Numerical integration – Finite element modeling of Axisymmetric solids subjected to Axisymmetric loading with triangular elements.

UNIT – V
Analysis of Heat Transfer Problems: 1D Heat conduction – 1D fin elements – 2D heat conduction –

analysis of thin plates – Composite slabs – problems.

Dynamic Analysis: Dynamic equations – Lumped and consistent mass matrices – Eigen Values and Eigen Vectors – mode shapes – modal analysis for bars and beams.

TEXT BOOKS:

1. Introduction To Finite Elements In Engineering, Tirupathi K. Chandrupatla and Ashok D. Belagundu, Pearson Education Limited.
2. Introduction of Finite Element Analysis, S. Md. Jalaludeen ,Anuradh publications.
3. The Finite Element Methods In Engineering, S.S.Rao,Elsevier.

REFERENCESBOOKS:

1. Finite Element Methods, Alavala ,Tata McGraw-Hill Publishing Company Ltd.
2. An Introduction to Finite Element Methods, J.N. Reddy, McGraw Hill Education.
3. The Finite Element Method in Engineering Science, O.C. Zienkoitz, McGraw Hill Education.
4. Concepts and Applications of Finite Element Analysis, Robert Cook, Wiley-Interscience.
5. Finite Element Method-Its Application in Engineering, Y.M.Desai, T.I ElDHO, A.H.Shah, Pearson Publications.

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HEAT TRANSFER LAB
(Professional Core Course)

PREREQUISITES: Mathematics, Thermodynamics, Fluid Mechanics

COURSE OBJECTIVES:
The objectives of this course are to:
1. Understand the various modes of heat transfer.
2. Compare the heat transfer in parallel flow and counter flow heat exchanger
3. Understand the heat transfer during phase change

COURSE OUTCOMES:
After completion of this course the students will be able to:
1. Estimate the heat transfer in various systems.
2. Calculate the thermal conductivity and convection heat transfer coefficient in a given system.
3. Analyze the performance of parallel flow and counter flow heat exchangers.

LIST OF EXPERIMENTS:
1. Determination of overall heat transfer coefficient of a composite wall.
2. Determination of heat transfer coefficient and the rate of heat transfer by forced convection through a horizontal pipe.
3. Determination of heat transfer coefficient in a free convection on a vertical tube.
4. Determination of effectiveness on a metallic fin.
5. Determination of Stefan - Boltzmann's Constant
6. Determination of LMTD, effectiveness in a parallel flow and counter flow heat exchanger.
7. Determination of emissivity of a surface.
8. Determination of thermal conductivity of brass bar
9. Determination of approximate thermal conductivity of lagged pipe.
10. Determination of the experimental and theoretical value of critical heat flux in pool boiling of water.
11. Determination of the experimental and theoretical heat transfer coefficient for drop wise and film wise condensation.
12. Determination of the thermal conductivity of insulating powder at average temperature.
13. Study of the variation of heat sink temperature and longitudinal temperature distribution for heat pipe, stainless steel and copper pipe with comparison
14. Find the rate of cooling of the heated metal bar by transient heat transfer.

REFERENCE BOOKS:

1. Fundamentals of Engineering. Heat and Mass Transfer-R.C.Sachdeva, New age Publishers
2. Heat Transfer-P.K.Nag, Tata Mc-Graw Hill Publications.

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ADVANCED ENGLISH COMMUNICATION SKILLS LAB
(Humanity and Social Sciences including Management Courses)

1. INTRODUCTION

The introduction of the English Language Lab is considered essential at 3rd year level. At this stage the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be an integrated theory and lab course to enable students to use 'good' English and perform the following:

- Gather ideas and information, to organize ideas relevantly and coherently.
- Engage in debates.
- Participate in group discussions.
- Face interviews.
- Write project/research reports/technical reports.
- Make oral presentations.
- Write formal letters.
- Transfer information from non-verbal to verbal texts and vice versa.
- To take part in social and professional communication.

2. OBJECTIVES:

This Lab focuses on using computer-aided multimedia instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.

1. **Vocabulary Building** – synonyms and antonyms, Word Roots, One-Word Substitutes, Prefixes and Suffixes, Study of Word Origin, Analogy, Idioms and Phrases.
2. **Reading Comprehension –** Reading for Facts, Guessing meanings from context, Scanning, Skimming, Inferring Meaning, and Critical Reading.
3. **Writing Skills** –Structure and presentation of different types of writing - Resume Writing /E-Correspondence/Statement of Purpose.
4. **Technical Writing**- Technical Report Writing, Research Abilities/Data Collection/Organizing Data/Tools/Analysis.
5. **Group Discussion** – Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Coherence.
6. **Presentation Skills** – Oral presentations (individual and group) through JAM sessions/Seminars, Written Presentations through Projects/ PPTs/e-mails etc.
7. **Interview Skills** – Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Interview through Telephone and Video-Conferencing.

3 Minimum Requirement: The English language lab shall have two parts:

i) The computer aided language lab for 60 students with 60 sytems, one master console, LAN facility and engilish language software for self study by learners.

ii) The communications skills labs with movable chairs and audio-visual **aids with a P.A system, a digital steri- audio and video system.**

System Requirement(Hard ware component): Computer network lan with minimum 60 multi media systems with the following specifications.

i) P-IV Processor
a) Speed-2.8 GHZ
b) RAM-512M.B Minimum
c) Hard disc-80GB
ii) Head phones of High quality

4. SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and used.

Suggested Software:

- Clarity Pronunciation Power – part II
- Oxford Advanced Learner's Compass, 7th Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dreamtech.
- TOEFL & GRE(KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- The following software from train2success.com'
  i. Preparing for being Interviewed,
  ii. Positive Thinking,
  iii. Interviewing Skills,
  iv. Telephone Skills,
  v. Time Management
  vi. Team Building,
  vii. Decision making
- English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.

Books Recommended:

1. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
2. Advanced Communication Skills Laboratory Manual by Sudha Rani, D, Pearson Education 2011.
3. English Language Communication : A Reader cum Lab Manual Dr A Ramakrishna Rao, Dr G Natanam& Prof SA Sankaranarayanan, Anuradha Publications, Chennai 2008.
4. English Vocabulary in Use series, Cambridge University Press 2008.
5. Management Shapers Series by Universities Press(India)Pvt Ltd., Himayatnagar, Hyderabad 2008.
6. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
7. Handbook for Technical Writing by David A McMurrey& Joanne Buckely CENGAGE Learning 2008.
8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. Master Public Speaking by Anne Nicholls, JAICO Publishing House, 2006.

10. English for Technical Communication for Engineering Students, AyshaVishhwamohan, Tata Mc Graw-Hil 2009.
11. Books on TOEFL/GRE/GMAT/CAT/ IELTS by Barron‘s/DELTA/Cambridge University Press.
12. International English for Call Centres by Barry Tomalin and Suhashini Thomas, Macmillan Publishers, 2009.

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ROBOTICS
(Professional Core Course)

PRE REQUISITES: Theory of Machines-I and Theory of Machines-II

COURSE OBJECTIVES:
The objectives of this course are to:

1. Develop the student's knowledge in various robot structures and performing spatial transformations associated with rigid body motions.
2. Develop student's skills in performing kinematics analysis of robot systems using forward and inverse kinematics.
3. Develop student's skills in using Jacobians for analyzing velocities associated with different joints of manipulator.
4. Provide the student with some knowledge in robot dynamics and analysis skills associated with trajectory planning.
5. Provide the student with some knowledge and skills associated with robot actuation, sensing and control.

COURSE OUTCOMES:
After completion of this course the students will be able to:

1. Decide how to select a Gripper and End Effectors & their Design.
2. Analyze Robot motion using Forward and Inverse kinematics of Robots and D-H representation of Robot kinematics.
3. Solve differential kinematics problems using Jacobian matrix.
4. Analyze Robot dynamics and Forces using Lagrangian mechanics andunderstand the methods of path and trajectory planning.
5. Identify Internal and External sensors, encoders and different types of Robot Actuators and motors for different material handling applications.

UNIT – I
Introduction: Automation and Robotics – An overview of Robotics – Classification by coordinate system and control systems – Components of the industrial Robotics – Degrees of freedom – End effectors; Mechanical gripper – Magnetic – Vacuum cup and other types of grippers – General consideration on gripper selection and design.

UNIT – II
Motion Analysis: Basic rotation matrices – Composite rotation matrices – Euler Angles – Equivalent Angle and Axis – Homogeneous transformation – Problems.

Manipulator Kinematics: D-H notations – Joint coordinates and world coordinates – Forward and inverse kinematics – Problems.

UNIT – III
Differential Kinematics: Differential kinematics of planar and spherical manipulators – Jacobians – Problems.

UNIT – IV

Robot Dynamics: Lagrange – Euler formulations – Newton-Euler formulations – Problems on planar two link manipulators.

Trajectory Planning: Joint space scheme – Cubic polynomial fit – Avoidance of obstacles – Types of motion: Slew motion – Joint interpolated motion – Straight line motion – Problems.

UNIT – V

Robot Actuators and Feed Back Components: Actuators; Pneumatic and Hydraulic actuators, Electric Actuators: DC servo motors – Stepper motors.

Feed Back Components: Position sensors – Potentiometers, resolvers and encoders – Velocity sensors – Tactile sensors- Robot Application in Manufacturing: Material handling – Assembly inspection.

TEXT BOOKS:

1. Industrial Robotics, Groover M.P, Pearson Education Limited.
2. Introduction to Robotic Mechanics and Control, JJ Craig, Pearson Education Limited.
3. Robotics, Ashitava Ghoshal, Oxford.

REFERENCE BOOKS:

1. Robotics, Fu K.S, McGraw Hill Education.
2. Robotic Engineering, Richard D. Klafter, Prentice Hall India Learning Private Limited.
3. Robot Analysis and Intelligence, Asada and Slotine, Wiley InterScience.
4. Robot Dynamics & Control, Mark W. Spong and M.Vidyasagar, John Wiley & sons (ASIA) Pte. Ltd.
5. Robotics and Control, Mittal R.K &Nagrath I.J, McGraw Hill India.

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MECHANICAL VIBRATIONS
(Professional Elective Course-IV)

PREREQUISITES: Theory of Machines-I and Theory of Machines-II

COURSE OBJECTIVES:
The objectives of this course are to:
1. Learn the importance of vibration analysis in machine parts.
2. Calculate the Laplace transforms of linear vibratory system.
3. Analyze the vibratory responses of single and multi-degree of freedom systems to various excitations.
4. Draw the mode shapes of two degree of freedom system.
5. Calculate the critical speed of shafts subjected to without and with damping.

COURSE OUTCOMES:
After completion of this course, the student will be able to:
1. Identify the need and importance of vibration analysis in machine parts.
2. Analyze the mathematical model of a linear vibratory system to determine its response
3. Determine vibratory responses of single and multi-degree of freedom systems to various excitations.
4. Construct the mode shapes of free and forced vibrations of two degree of freedom systems.
5. Solve the critical speeds of shafts with and without damping.

UNIT I
Single Degree of Freedom Systems-I: Undamped and damped free vibrations, force vibration coulomb damping, response to extension, rotating unbalance and support extension, vibration isolation and transmissibility.

UNIT II
Single Degree of Freedom Systems-II: Response to non-periodic excitations – Unit impulse, unit step and unit ramp functions – Response to arbitrary excitations – The convolution integral, shock spectrum, system response by the Laplace Transformation method.

UNIT III
Vibration Measuring Instruments: Vibrometers, velocity meters and accelerometers.

UNIT IV
Two Degree Freedom System: Principal modes– Undamped and damped free and forced vibrations, undamped vibration absorbers.

UNIT-V
Critical Speed of Shafts: Critical speeds without and with damping, secondary critical speeds.
TEXT BOOKS:
1. Elements of Vibrations analysis, Meirovitch, McGraw Hill Education.

2. Mechanical Vibrations, G.K.Groover,Nem Chand and Brothers.
3. Mechanical Vibrations, V.P.Singh,Dhanpatrai& Co.

REFERENCE BOOKS:

1. Mechanical Vibrations, SS Rao, Pearson Education Limited.
2. Mechanical Vibrations, RaoV.Dukkipati and J.Srinivas, Prentice Hall India Learning Private Limited.
3. Mechanical Vibrations, J B K Das, Sapna Publications.
4. Vibration problems in Engineering, S.P.Timoshenko, John Wiley & Sons.
5. Mechanical Vibrations, S Graham Kellyk, Schaum's Outlines, McGraw Hill Education.

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MECHATRONICS SYSTEMS
(Professional Elective Course-IV)

PREREQUISITES: Mathematics, Mechanical Measurements.

COURSE OBJECTIVES:
The objectives of this course are to:
1. Identify the need for mechatronics and its applications.
2. Study various fluid power systems.
3. Design mechatronics systems.
4. Provide knowledge on electrical circuits and signal conditioning.
5. Make familiar about control system and digital electronics in designing Mechatronics system.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Explain the basics of sensors and transducers.
2. Apply the knowledge of Sensors and Transducers.
3. Discuss working of hydraulic and pneumatic drives and actuators.
4. Identify the types of Microcontrollers and microprocessors.
5. Evaluate the functioning of microsensors, microactuators and LIGA techniques.

UNIT-I
Introduction: Definition of Mechanical Systems–Philosophy and approach;
Solid state electronic Devices, PN junction diode, BJT, FET, Analog signal conditioning, amplifiers, filtering

UNIT-II
Sensors and Transducers: Types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors

UNIT-III
Hydraulic and Pneumatic Systems: Fluid systems –Hydraulic and pneumatic Actuators, components – Control valves –Electro-pneumatics.
Drives and Actuators: Hydraulic and Pneumatic drives –Electrical Actuators such as servomotor and Stepper motor –Drive circuits –open and closed loop control;

UNIT-IV
Digital Electronics and Systems: Digital logic control, 8051 Microcontroller –Microprocessor Structure, programming, Process controllers, Programmable Logic controllers –PLC's versus computers –Applications

UNIT-V

Micromechatronic Systems: Microsensors, Microactuators, Micro-fabrication techniques LIGA Process: Lithography, Etching, Micro-joining etc. Application examples; Case studies examples of mechatronic systems from Robotics Manufacturing, Machine Diagnostics, road vehicles and Medical Technology.

TEXT BOOKS:

1. Mechatronics System Design, DevdasShetty& Richard A. Kolk, PWS PublishingCompany (Thomson Learning Inc.).
2. A Textbook of Mechatronics ,R.K.Rajput, S. Chand & Company Ltd.
3. Advanced Microprocessor and Microcontrollers, B.P. Singh, New Age International Publisher.

REFERENCE BOOKS:

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall India Learning Private Limited.
2. Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education Limited.
3. Mechatronics, Dan Necsulescu, Pearson Education Limited.
4. Introduction to Mechatronics and Measurement systems, Michael B. Histandand David G. Alciatore, McGraw Hill Education.
5. Mechatronics, M.D.Singh, J.G.Joshi, Prentice Hall India Learning Private Limited.

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INTELLECTUAL PROPERTY RIGHTS
(Professional Elective Course-IV)

Course Objectives: After completing this course the student will be able

1. To understand the concepts of Intellectual Property Rights and related agencies.
2. To know about the purpose and functions of Trademarks in competitive environment
3. To explain the process of Patent and Copyrights and related procedures
4. To know the Trade Secret Law and its protection from Unfair practices.
5. To get knowledge on the overview of International Intellectual Property Scenario.

Unit I:

Introduction to Intellectual Property: Introduction, Types of Intellectual Property, International Organization, Agencies and Treaties, Importance of Intellectual Property Rights.

Unit II:

Trademarks: Purpose and Function of Trademarks, Acquisition of Trademarks Rights, Protectable Matter, Selecting and Evaluating Trade Mark, Trade Mark Registration Processes.

Unit III:

Law Of Copy Rights & Patents: Fundamental of Copy Rights Law, Originality of Material, Rights of Reproduction, Rights to Perform the Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice of Copy Right, International Copy Right law. Foundation of Patent Law, Patent Searching Process, Ownership Rights & Transfer.

Unit IV:

Trade Secrets & Unfair Competition: Trade Secret Law, Determination of Trade Secret Status, Liability for Misappropriation Right of Trade Secrets, Protection for Submission, Trade Secret Litigation. Misappropriation Right of Publicity, False Advertising.

Unit V:

New Development & International Overview On Intellectual Property: New Developments in Trade Mark Law, Copy Right Law, Patent Law, and Intellectual Property Audits. International Trade Mark Law, Copy Right Law, International Patent Law, International Development in Trade Secrets Law.

Course Outcomes: After completing this course the student will be able to

1. Explain the concepts of Intellectual Property Rights and related agencies.
2. Describe the purpose and functions of Trademarks in Competitive Environment
3. Analyze the process of Patent and Copyrights and related procedures
4. Explore the Trade secret law and its protection from Unfair practices
5. Explain the overview of International Intellectual Property Scenario

TEXT BOOKS:

1. Deborah. E. Bouchoux, Intellectual Property Rights, Cengage learning

2. Prabuddha Gangulli, Intellectual Property Rights Unleashing the knowledge economy, Tata Mc Graw Hill Publishing Company Ltd.

REFERENCES:

1. Khushdeep Dharni and Neeraj Pandey, Intellectual Property Rights, PHI Learning Pvt. Ltd.
2. Vivien Irish, Intellectual Property Rights for Engineers, 2nd edn, IET, 2005
3. Carlos Alberto Primo Braga, Carsten Fink, Claudia Paz Sepulveda, Intellectual Property Rights and Economic Development, World Bank Publications, 2000

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INTRODUCTION TO CNC
(Professional Elective Course-V)

PRE REQUISITES: Manufacturing Technology-II, Computer Aided Design and Manufacturing

COURSE OBJECTIVES:
The objectives of this course are to:
1. Learn the fundamentals of part programing required for manufacturing a product.
2. Implement CNC programs for turning, milling and grinding machining operations.
3. Explain Modern CNC systems and its importance in manufacturing.
4. Provide sufficient detailed knowledge of a microcontroller.
5. Discuss the benefits of PLCs over electromechanical relay logic systems.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Identify different axes, machine zero, home position, systems and controls CNC machines.
2. Select mount and set cutting tools and holders on CNC.
3. Develop part programmes for given simple components.
4. Explain the applications and programming of Micro Controllers.
5. Apply maintenance practices for CNC machines and Applications of PLC.

UNIT – I
Features Of NC Machines: Fundamentals of numerical control, advantage of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems, features of NC machine tools, design consideration of NC machine tool, methods of improving accuracy.

CNC Machines and Elements: Machine structure – Guide ways – Feed drives – Spindles – Spindle bearings – Measuring systems – Tool monitoring systems.

UNIT – II
Tooling for CNC Machines: Interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers.

NC Part Programming: Manual programming – Basic concepts, point to point contour programming, canned cycles, parametric programming.

UNIT – III
Computer Aided Programming: General information, APT programming, Examples APT programming problems (2D machining only) – NC programming on CAD/CAM systems, the design and implementation of post processors – Introduction to CAD/CAM software, Automatic Tool Path generation.

DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages and disadvantages of DNC – Adaptive control of optimization, Adaptive control with constraints, Adaptive

control of machining processes like turning and grinding.

UNIT – IV

Micro Controllers: Introduction, hardware components, I/O pins, ports external memory, counters, timers and serial data I/O interrupts – Selection of micro controllers, embedded controllers, applications and programming of micro controllers.

UNIT – V

Programming Logic Controllers (PLC'S): Introduction, hardware components of PLC, system, basic structure, principle of operations – Programming mnemonics timers – Internal relays and counters applications of PLC's in CNC Machines.

TEXT BOOKS:

1. Computer Control of Manufacturing Systems, Yoramkoren, Mc McGraw Hill Education.
2. CAD/CAM , Michel P.Groover, McGraw Hill Education.
3. Mechatronics, N/A HMT, McGraw Hill Education.

REFERENCE BOOKS:

1. Machining and CNC Technology, Michael Fitz Patrick, McGraw Hill Education.
2. Numerical Control and Computer Aided Manufacturing, T.K.Kundra, P.N.Rao, N.K. Tewari, Tata McGraw-Hill Publishing Company Ltd.
3. Introduction to Computer Numerical Control, James V Valentino, Joseph Goldenberg, Prentice Hall India Learning Private Limited.
4. CNC Machines - M.Adithan, B.S. Pabala, New Age International Publishers.
5. CNC Fundamentals and Programming, P.M.Agrawal, Charotar Publishers.

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POWER PLANT ENGINEERING
(Professional Elective Course-V)

PRE REQUISITES: Applied Thermodynamics-I, Applied Thermodynamics-II and Heat Transfer

COURSE OBJECTIVES:
The objectives of this course are to:
1. Understand the hydroelectric power plants and concept of power from non-conventional sources
2. Describe basic working principles of gas turbine and diesel engine power plants
3. Discuss the steam power plant and its equipment
4. Basic knowledge of different types of nuclear power plants
5. Understand the power plant economics and power distribution

COURSE OUTCOMES:
After completion of this course the students will be able to:
1. Appraise the importance of Hydro-electric power and solar energy.
2. Asses the lay-outs and auxiliaries of power plants.
3. Elaborate the components of steam power plants.
4. Build the knowledge of reactors.
5. Identify the estimation cost of Power plant.

UNIT – I
Introduction to the Sources of Energy – Resources and Development of Power in India.
Hydro Electric Power Plant: Water power –Hydrological cycle/flow measurement – Drainage area characteristics – Hydrographs – Load duration, curve-storage and Pondage – Classification of dam and spill ways.
Hydro Projects and Plant: Classification-Typical layouts-Plant auxiliaries – Plant operation pumped storage plant.
Power from Non-Conventional Sources: Utilization of Solar-Collectors – Principle of working, wind energy – Types – HAWT,VAWT – Tidal energy.

UNIT – II
Diesel Power Plant: Introduction- IC engine – Types – Construction – Plant layout – Different Systems of Diesel Power Plant.
Gas Turbine Power Plant: Introduction – Classification – Construction– Layout with auxiliaries – Principles of working of closed and open cycle gas turbine, combined cycle power plants and comparison.
Direct Energy Conversion: Solar energy, Fuel cells, Thermoelectric and Thermo ionic, MHD generation.

UNIT – III
Steam Power Plant: Plant Layout – Working of different Circuits – Fuel and handling equipments – types of coals, coal handling, choice of handling equipment, coal storage, ash handling systems.
Combustion : Properties of coal – Overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught

system – Cyclone furnace, design and construction – Dust collectors, Electrostatic precipitators – Cooling towers and heat rejection – Corrosion and feed water treatment.

UNIT – IV

Nuclear Power Station: Nuclear fuel – Breeding and fertile materials – Nuclear reactor, reactor operation, types of Reactors: Pressurized water reactor, Boiling water reactor (BWR), Sodium-graphite reactor, Fast Breeder Reactors (FBR),Homogeneous Reactors, Gas cooled Reactor, Radiation hazard and shielding – Radioactive disposal.

UNIT – V

Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution – Load curves, load duration curve, Definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related numerical exercises – Effluents from power plants and impact on environment – Methods of Power plant pollution control.

TEXT BOOKS:

1. A Text book of Power Plant Engineering, Rajput, Laxmi Publications.
2. A Course in Power Plant Engineering, Arora and S.Domkundwar, Dhanpatrai& Co.
3. Power Plant Engineering, P.K.Nag, Tata McGraw-Hill Publishing Company Ltd.

REFERENCESBOOKS:

1. Power Plant Engineering, P.C.Sharma, S.K.Kataria Publications.
2. Power plant Engineering, Ramalingam, Scietech Publishers.
3. An Introduction to Power Plant Technology, G.D. Rai, Kanna Publications.
4. Power plant Engineering, Elanchezhian, I.K International Publications.
5. An Introduction to Thermal Power Plant Engineering,P.K.Das, A.K.Das, Notion Press.

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TOOL DESIGN
(Professional Elective Course-V)

PRE REQUISITES: Manufacturing Technology- I and Manufacturing Technology-II.

COURSE OBJECTIVES:
The objectives of this course are to:

1. Introduce about tool design and its factors.
2. Understand the various locating and clamping methods.
3. Design of jigs for plate, box, channels.
4. Explain the design principles of fixtures for machine tools.
5. Analyze design of simple progressive and compound dies.

COURSE OUTCOMES:
After completion of this course the students will be able to:

1. Design of single point and multi point cutting tools.
2. Analyze the principles of clamping, clamping force analysis.
3. Identify the various considerations in design of jigs, their types.
4. Design of fixtures for milling, boring, lathe, grinding, welding machines.
5. Explain the principles of dies and design of simple progressive and compound die sets.

UNIT - I

Design of Cutting Tools: Metal cutting process - Selection of tool materials - Design of single point and multipoint cutting tool - Form tools, Drills, Milling cutters, broaches and chip breakers – Problems on design of single point cutting tools only.

UNIT - II
Locating and Clamping Methods: Basic Principles of Location - Locating methods and devices - Principles of clamping - Mechanical, Pneumatic and Hydraulic actuation - Clamping force analysis – Simple Design problems.

UNIT - III

Design of Jigs: Types of drill jigs - General considerations in the design of drill jigs - Drill bushings - Types, methods of construction - Simple designs of Plate, Channel, Boxes, Post, Angle plate, Turnovers and Pot Jigs.

UNIT - IV
Design of Fixtures: Design principles - Types of fixtures - Fixtures for machine tools: Lathe, Milling, Boring, Broaching and Grinding - Assembly fixtures - Inspection and Welding fixtures.

UNIT - V

Design of Dies: Press tools – Fundamentals of die–cutting operations – Cutting action in punch and die operations – Die clearance – Blanking and Piercing Die construction – Pilots – Strippers andPressure Pads – Press work materials - Strip layout – Design of simple progressive and compound die sets – Forging Die – Flow lines, parting lines, open and close die forging; Materials for die block.

TEXT BOOKS:

1. Tool Design, Donaldson C., Lecain G.H. and Goold V.C., Tata McGraw-Hill Publishing Company Ltd., New Delhi.
2. A Text Book of Machine Tools and Tool Design, P.C.Sharma, S.Chand Publishers.
3. Machine Tool Design And Numerical Control,N.K.Mehta,Tata McGraw-Hill Publishing Company Ltd., New Delhi.

REFERENCE BOOKS:

1. Jigs and Fixtures, Joshi P. H., Tata McGraw-Hill Publishing Company Ltd.
2. Jigs and Fixtures Design, Edward G. Hoffman and Thomson, Delmar Learning series
3. Fundamentals of Tool Design, Jeff Lantrip, David A. Smith and John G, Society of Manufacturing Engineers.
4. Tool Design, Cyril Donaldson,George.S.Lecain,Tata McGraw-Hill Publishing Company Ltd.
5. Tool Engineering And Design,G.R.Nagpal,Khanna Publications

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JET PROPULSION AND ROCKET ENGINEERING
(Professional Elective Course-VI)

PREREQUISITES: Thermodynamics, Applied Thermodynamics-I, Applied Thermodynamics-II and Fluid Mechanics & Hydraulic Machinery

COURSE OBJECTIVES:
The objectives of this course are to:
1. Identify the thrust equations and their usage in jet aircraft and rocket propulsion in an effective way.
2. Illustrate various types of propulsion system with their merits and challenges.
3. Classify various types of chemical rocket propulsions and various parameters governing it.
4. Identify the working concept of nozzles with their applications in propulsion system.
5. Generate sufficient information about the thrust chamber and their associated parameters along with their significance in practical applications.

COURSE OUTCOMES:
After completion of this course, the student will be able to:
1. Analyze the thermodynamic cycles used in gas turbine applications.
2. Evaluate thrust power and efficiencies of Jet-Propulsion.
3. Asses the performance evaluation of turbo-propeller and jet propeller.
4. Contrast and compare the working principles of Ram-jet, rocket engines.
5. Build knowledge of rocket technology.

UNIT-I
Fundamentals of Gas Turbine: Theory–Thermodynamic Cycle, open, closed and semi–closed – Parameters of performances –Cycle modifications for improvement of performance.

UNIT-II
Jet Propulsion: Historical sketch – Reaction principle – Essential features of propulsion devices– Thermal Engines, Classification of – Energy flow thrust, Thrust power and propulsion efficiency–Need for Thermal Jet Engines and applications.

UNIT-III
Turboprop and Turbojet: Thermo dynamic cycles, plant layout, essential components, principle of operation – Performance evaluation, Thrust Augmentation and Thrust reversal–Contrasting with piston Engine Propeller plant.

UNIT-IV
Ramjet: Thermo dynamic Cycle – Plant lay-out – Essential components – Principle of operation – Performance evaluation – Comparison among atmospheric thermal jet engines – Ram jet and pulse jet, elementary treatment.

Rocket Engines: Need for – Applications – Basic principles of operation and parameters of performance – classification, solid and liquid propellant rocket engines – Advantages, domains of application –

Comparison of propulsion systems.

UNIT-V

Rocket Technology: Flight mechanics – Application of Thrust profiles – Acceleration –Staging of Rockets, need for Feed systems, injectors and expansion nozzles – Rocket heat transfer and ablative cooling.

TEXT BOOKS:

1. Gas Turbines and Propulsive Systems, P.Khajuria & S.P.Dubey, Dhanpatrai& Co publications.
2. Gas Dynamics & Space Propulsion, M.C.Ramaswamy, Jaico Publishing House.
3.GasTurbines, V Ganeshan, McGraw Hill Education.

REFERENCE BOOKS:

1. Rocket Propulsion Elements, Sutton, John Wiley & Sons.
2. Gas Turbines, Cohen Rogers & Sarvana Muttoo, Addision Wesley & Longman.
3. Elements of Gas Turbine Propulsion, Jock D Mattingly, McGraw Hill Education.
4.Aircraft Propulsion, Wiley, Wiley black well Publications.
5.Fundamentals of Aircraft and Rocket Propulsion, Ahmed F. El-Sayed, Springer Publications.

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MAINTENANCE AND SAFETY ENGINEERING
(Professional Elective Course-VI)

PREREQUISITES: Industrial Engineering and Management

COURSE OBJECTIVES:
The objectives of this course are to:
1. Impart knowledge in maintenance engineering
2. Know the types of maintenance and applications
3. Solve the inventory control model problems
4. Impart knowledge on industrial and safety engineering
5. Achieve a certain value of reliability.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Survey the need for Maintenance Management & Control Methods.
2. Distinguish & Use the different types of Maintenance
3. Choose Inventory control models based on applications.
4. Elaborate the Industrial Maintenance, safety measurements in Engineering.
5. Assess reliability, reliability centered maintenance, RCM, maintainability.

UNIT – I
Introduction: Need for Maintenance – Facts and Figures – Modern Maintenance – Problem and Maintenance strategy for the 21st Century Engineering Maintenance – Objectives and Maintenance in Equipment Life cycle – Terms and Definitions.

Maintenance Management and Control: Manual Maintenance – Facility Evaluation – Functions of Effective Maintenance Management – Maintenance Project Control Methods –Maintenance Management Control indices.

UNIT – II
Types of Maintenance: Preventive Maintenance, Elements of Preventive, Maintenance Program, Establishing Preventive Maintenance Program, PM Program Evaluation and improvement, PM Measures, PM Models – Corrective Maintenance, Corrective Maintenance Types, Corrective Maintenance Steps and downtime components – Corrective Maintenance Measures, Corrective Maintenance Models.

UNIT – III
Inventory Control in Maintenance: Inventory control objectives and Basic inventory decisions, ABC inventory Control Models, Two – Bin inventory Control and Safety Stock, spares determination factors, spares calculation methods.

UNIT – IV

Quality and Safety in Maintenance: Needs for Quality Maintenance Processes – Maintenance Work Quality – Use of Quality Control Charts in Maintenance – Work Sampling – Post Maintenance Testing – Reasons for Safety Problems in Maintenance – Guidelines to improve Safety in Maintenance Work – Safety Officer's Role in Maintenance Work – Protection of Maintenance Workers.

Maintenance Costing: Reasons for Maintenance Costing –Maintenance Budget Preparation Methods and steps – Maintenance Labor Cost Estimation – Material Cost Estimation, Equipment life cycle Maintenance Cost Estimation – Maintenance Cost Estimation Models.

UNIT – V

Reliability, Reliability Centered Maintenance, RCM: Goals and Principles – RCM Process and Associated Questions, RCM Program Components – Effectiveness Measurement indicators – RCM Benefits and Reasons for its Failures, Reliability Versus Maintenance and Reliability Measures and Formulae – Reliability Networks – Reliability Analysis Techniques.

Maintainability: Maintainability importance and Objective – Maintainability in Systems Life Cycle – Maintainability Design Characteristics – Maintainability Functions and Measures – Common Maintainability Design Errors.

TEXT BOOKS:

1. Reliability, Maintenance and Safety Engineering, Dr. A.K Gupta, Laxmi Publications.
2. Safety Engineering, Ganguly and Changeria.M, Chetan publication.
3. Introduction To Maintenance Engineering, Mohammed Ben-Daya, Udaykumar,D.N. Prabhakar Murthy, WILEY Publication

REFERENCE BOOKS:

1. Maintenance Engineering & Management, R.C.Mishra, Prentice Hall India Learning Private Limited.
2. Reliability Engineering, Elsayed and Pearson,WILEY Publication.
3. Engineering Maintenance a Modern Approach, B.S.Dhallon, C.R.R Publishers.
4. Industrial Maintenance, Er.H.P. Garg, S. Chand & Company ltd.
5. Industrial Safety Management, L.M.Deshmukh, McGraw Hill Education

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COMPUTATIONAL FLUID DYNAMICS
(Professional Elective Course-VI)

PREREQUISITES: Engineering Mechanics, Fluid Mechanics & Hydraulic Machinery and Finite Element Methods

COURSE OBJECTIVES:
The objectives of this course are to:

1. Perceive the students with the knowledge base essential for application of computational fluid dynamics to engineering flow problems and Provide the essential numerical background for solving the partial differential equations governing the fluid flow
2. Develop students' skills in implementing concepts of FDM and solve problems in explicit and implicit methods.
3. Calculate errors and stability by hyperbolic and elliptic equations
4. Analyze steam flow and can formulate vorticity, boundary layer theory and buoyancy.
5. Develop the concepts of space marching relocation, the alternating direction implicit techniques etc.

COURSE OUTCOMES:
After completion of this course, the student will be able to:

1. Solve a physical problem by numerical methods, the graduate will be able to differentiate between FDM, FEM, FVM and understand the concept of CFD.
2. Implement concepts of finite difference equations and solve problems by explicit and implicit methods
3. Analyze errors and find the stability by hyperbolic and elliptic equations. The student will do a detailed review of equations governing fluid flow and heat transfer.
4. Analyze about steam flow and can formulate vorticity, boundary layer theory, buoyancy.
5. Solve simple CFD problems by techniques like space marching relocation, the alternating direction implicit techniques, pressure correction technique and computer graphic techniques.

UNIT I
Introduction: Methods to solve a physical problem – numerical methods – brief comparison between FDM, FEM & FVM – Applied numerical methods – Finite difference applications in heat conduction and convention, heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction – Finite difference application in convective heat transfer.

UNIT II
Finite Differences: Discretization, consistency, stability and fundamentals of fluid flow modeling – Introduction to elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

UNIT III

Errors and Stability Analysis: Introduction – First order wave equation, stability of hyperbolic and elliptic equations – Fundamentals of fluid flow modeling – Conservative property – The upwind scheme.
Review of Equations Governing Fluid Flow and Heat Transfer: Introduction – Conservation of mass Newton's second law of motion – Expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier stokes equations.

UNIT IV

Steady Flow: Dimensional form of momentum and energy equations, Navier stokes equation, and conservative body force fields – Stream function – Vorticity formulation – Boundary layer theory, buoyancy, driven convection and stability.

UNIT V

Simple CFD Techniques: Viscous flows – Conservation from space marching relocation techniques – Artificial viscosity – The alternating direction implicit techniques, pressure correction technique, computer graphic techniques used in CFD – Quasi one dimensional flow through a nozzle, turbulence models, standard and high Reynolds number models and their applications.

TEXT BOOKS:

1. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Versteeg. H.K., and Malalasekera W, Longman Publications.
2. Computational Fluid Flow and Heat Transfer, Muralidhar.K and Sundararajan T, Narosa Publishing House, New Delhi.
3. Computational Fluid Dynamics, J Chung, Cambridge, University Press India.

REFERENCE BOOKS:

1. Numerical Heat Transfer and Fluid Flow, Patankar. S.V. Taylor and Francis.
2. Computational Fluid Mechanics and Heat Transfer, Ronnie Anderson, CRC Press.
3. Computational Aerodynamics And Fluid Dynamics An Introduction, Jean-Jacques Chattot Springer.
4. Essential Computational Fluid Dynamics, Olegzikanov, Wiley Publications India.
5. Introduction to Computational Fluid Dynamics, Pradip, Niyogi S.K. Chakrabartty, M.K. Laha, Pearson Education Limited.

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MECHANICAL MEASUREMENTS
(Professional Core Course)

PRE REQUISITES: Metrology and Surface Engineering

COURSE OBJECTIVES:
The objectives of this course are to:
1. Develop the knowledge of basic measurement systems and measuring devices.
2. Imparting principles of measurement.
3. Develop competence in sensors, transducers and terminating devices.
4. Develop competence in sensors, transducers and transmitting devices with associated parameters.
5. Learn the principle and method to measure various physical parameters.

COURSE OUTCOMES:
After completion of this course, the students will be able to:

1. Make use of basic principles of measurements and Methods of measuring displacement.
2. Apply the concepts and methods of Measuring Temperature and Pressure
3. Identify different methods and instruments to Measure Speed and levels of Fluids
4. Select different simple instruments for measurement of stress, strain – Principles of Seismic instruments.
5. Examine the moisture content of gases and able to Measure the force, Torque and Power.

UNIT – I
Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments – Examples – Dynamic performance characteristics – Sources of error, Classification and elimination of error.
Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, inductive capacitance, resistance, ionization and Photo electric transducers Calibration procedures.

UNIT – II
Measurement of Temperature: Classification – Ranges – Various Principles of measurement – Expansion, Electrical Resistance Thermistor – Thermocouple – Pyrometers – Temperature indicators.
Measurement of Pressure: Units – Classification – Different principles used, Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges – Low pressure measurement – Thermal conductivity gauges – Ionization pressure gauges, Mcleod pressure gauge.

UNIT – III
Measurement of Level: Direct method – Indirect methods – Capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – Bubbler level indicators.

Flow Measurement: Rotameter, magnetic, ultrasonic, turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).
Measurement of Speed: Mechanical Tachometers, Electrical tachometers, Stroboscope, Non – contact

type of tachometer.

UNIT – IV

Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle.

Stress Strain Measurements: Various types of stress and strain measurements – Electrical strain gauge, gauge factor – Method of usage of resistance strain gauge for bending compressive and tensile strains – Usage for measuring torque, strain gauge Rosettes.

UNIT – V

Measurement of Humidity: Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter.

Measurement of Force, Torque and Power: Elastic force meters, load cells, Torsion meters, Dynamometers.

TEXT BOOKS:

1. Measurement Systems: Applications & Design, D.S Kumar, Anuradha Agencies.
2. Instrumentation Measurement & Analysis, B.C.Nakra & K.K.Choudhary, McGraw Hill Education.
3. Mechanical Measurement and Instrumentation, Er.R.K.Rajput, Katson Books, 2013.

REFERENCE BOOKS:

1. Instrumentation and Control systems, S.Bhaskar, Anuradha Agencies.
2. Experimental Methods for Engineers, J.P.Holman, McGraw Hill Education.
3. Mechanical and Industrial Measurements, R.K Jain, Khanna Publishers.
4. Mechanical Measurements, Sirohi and Radhakrishna, New Age International Publisher.
5. Instrumentation & Mechanical Measurements, A.K.Tayal, Galotia Publications.

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COMPUTER AIDED DESIGN AND MANUFACTURING
(Professional Core Course)

PRE REQUISITES: Engineering Graphics & Design and Machine Drawing& Drafting lab

COURSE OBJECTIVES:

The objectives of this course are to:

1. Gain knowledge of Product cycle, CAD system structure and components of computer.
2. Write equation for Bezier curve, B-spline curve and understand visual realism.
3. Solve NC programming and understand different Part families.
4. Know the importance of computer in QC, Contact Inspection methods, Non-ContactInspection methods.
5. Understand CAD standards and Computer Integrated manufacturing systems.

COURSE OUTCOMES:

After completion of this course, the student will be able to:

1. Explain the Basic Structure of Computer & Geometric Transformations.
2. Model a component using solid and surface modeling softwares.
3. Develop CNC part Programme for manufacturing.
4. Discuss the concepts of Computer Aided Quality Control, Contact & Non-contact methods of Inspection.
5. Classify the types of CAD standards, Computer Integrated Manufacturing systems, Machine tools and material handling systems.

UNIT – I

Introduction: Fundamentals of Computer Graphics –Computers in Industrial Manufacturing, Product cycle – Computer Aided Design – CAD system Architecture – Sequential and concurrent. Engineering - Basic structure, CPU, Memory types, Input devices, display devices, hard copy devices, storage devices.

Computer Graphics: Raster scan graphics – Coordinate system – Database structure for graphics modeling – Transformation of geometry, 2D and 3D Transformations – Viewing Transformation , mathematics of projections, clipping, hidden surface removal.

UNIT – II

Geometric Modeling: Geometric Modeling– Representation of curves, Bezier curves – Techniques of surface Modeling, surface patch, Coons, Solid modeling techniques –CSG and B-rep.

Visual Realism: Hidden Line-surface-solid removal algorithms, shading, coloring, computer animation.

UNIT – III

Numerical Control: NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, Features of Machining center, turning center.

Group Technology: Part Family, coding and classification, production flow analysis, advantages and limitations –Computer Aided Processes Planning, retrieval type and generative type.

UNIT – IV

Computer Aided Quality Control: Terminology in Quality control – The computer in QC, contact Inspection methods, Noncontact inspection methods – optical, noncontact, inspection methods – non

optical, computer aided testing, integration of CAQC with CAD/CAM.

UNIT – V

CAD Standards: Graphical Kernel System (GKS), standards for exchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc.**Computer Integrated Manufacturing Systems:** Types of Manufacturing systems, Machine tools and related equipment, computer control systems, human labor in the manufacturing systems, CIMS benefits.

TEXT BOOKS:

1. CAD / CAM, A Zimmers & P.Groover, Prentice Hall India Learning Private Limited.
2. CAD / CAM Theory and Practice, Ibrahim Zeid, McGraw Hill Education.
3. Computer Numerical Control Operations and Programming, Jon Stenerson and Kelly Curronpul, New age Publication.

REFERENCE BOOKS:

1. CAD/CAM, Principles and Applications, Rao, McGraw Hill Education.
2. Automation, Production Systems & Computer Integrated Manufacturing, Mikell P. Groover, Pearson Education Limited.
3. Computer Aided Design and Manufacturing, Lalit Narayan, Prentice Hall India Learning Private Limited.
4. CAD / CAM / CIM / Radhakrishnan and Subramanian, New Age Publications.
5. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson Education Limited.

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MECHANICAL MEASUREMENTS AND ROBOTICS LAB
(Professional Core Course)

PRE REQUISITES: Mechanical Measurements and Robotics

COURSE OBJECTIVES:
The objectives of this course are to:
1. Develop the knowledge of basic measurement systems and measuring devices.
2. Imparting principles of measurement.
3. Learn the principle and method to measure various physical parameters.
4. Demonstration and identification of parts in robotic arm.
5. Perform operations like palletizing by using simple programmes.

COURSE OUTCOMES:
After completion of this course, the student will be able to:
1. Apply the concepts & methods of Measuring Temperature & Pressure.
2. Identify different methods and instruments to Measure Speed.
3. Test for different instrument for measurement of flow, stress, and vibrations.
4. Compare the direct and indirect kinematic analysis of robotic arm.
5. Compile pick and place and palletizing operation.

(A) MECHANICAL MEASUREMENTS LAB
1. Calibration of pressure gauges
2. Calibration of transducer for temperature measurement.
3. Study and Calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for load measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotameter for flow measurement.
10. Study and use of a seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of McLeod gauge for low pressure.

(B) ROBOTICS LAB
1. Direct Kinematics analysis of a robot.
2. Inverse Kinematics analysis of a robot.
3. Trajectory planning of robotic arm in joint space scheme.
4. Robot programming for palletizing operation.
5.

REFERENCE BOOKS:
1 Instrumentation and control system, S.Bhaskar, Anuradha Agencies.
2 Mechanical and industrial measurements, R. K. Jain, Khanna publishers.

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COMPUTER AIDED DESIGN AND MANUFACTURING LAB
(Professional Core Course)

PREREQUISITES: Computer Aided Design and Manufacturing**,** Machine Drawing and Drafting lab, Manufacturing Technology-I

COURSE OBJECTIVES:
The objectives of this course are to:
1. Impart the knowledge of drafting 2D and 3D models.
2. Draft solid models associated with all the necessary dimensions, tolerances and annotations.
3. Analyze 2D trusses and beams through ANSYS software.
4. Apply the Knowledge of Finite element analysis for plane components.
5. Perform different operations on CNC Turning and Milling machine for various components based on tooling Machines.

COURSE OUTCOMES:
After completion of this course, the students will be able to:
1. Draft the 2D components in Auto Cad software.
2. Model the components by using various software's.
3. Analyze the shear force and bending moment diagrams for beams.
4. Analyze the 2D components both statically and dynamically.
5. Develop the simulation of NC programming for doing milling and turning operation.

LIST OF EXPERIMENTS

1. **Drafting:** Development of part drawings for various components in the form of orthographic and isometric, Representation of dimensioning and tolerances scanning and plotting, study of script DXE AND IGES FILES-3Exercises.

2. **Part Modeling**: Generation of various 3D Models through protrusion revolve, shell sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling surface and assembly modeling, study of various standard translators, Design simple components-2Exercises.

3. (a) Determination of deflection and stresses for 2D trusses -1Exercise.
   (b) Determination of deflections and stresses for 2D beams - 1Exercise.
   (c) Determination of deflections and stresses for axisymmetric components -1Exercise.
   (d) Steady state heat transfer analysis of plane components - 1Exercise.

4. (a) Determination of CNC part program for turning components - 1Exercise
   (d) Determination of CNC part program for milling components - 1Exercise.
   (e) Determination of CNC part program for facing of simple components - 1Exercise.

Any three Software Packages can be used from the following:
1. Auto CAD

2. Pro-E
3. Solid Works
4. ANSYS
5. Master CAM

TEXT BOOKS:

1. CAD / CAM Theory and Practice, Ibrahim Zeid, Tata McGraw Hill Education (P) Ltd, New Delhi, India.
2. Computer Numerical Control Operations and Programming, Jon Stenerson and Kelly Curronpul New age Publication.
3. CAD/CAM (Theory & Concepts) : Theory and Concept Paperback SareenKuldeep, Grewal Chandandeep, S. Chand & Company Ltd.

REFERENCE BOOKS:

1. Computer Numerical Control Concepts and Programming, Warren S Seames, Thomson N.Y Delmar Publishers.
2. CAD / CAM / CIM Theory and Practice, Radhakrishnan, Subramanian (2009), New Age Inetrnational Pvt. Ltd, New Delhi, India.
3. Engineering Analysis with ANSYS Software Paperback, TadeuszStolarski, Y.Nakasone, S. Yoshimoto**.**
4. SOLIDWORKS 2018: A Power Guide for Beginners and Intermediate Users Paperback, CADARTEFIX.
5. Pro/Engineer Wildfire 5.0 for Designers Text Book CAD CIM Technologies.

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LANGUAGE AND LIFE SKILLS
(Open Elective-II)

Introduction:

In today's global world, language is the weapon for success in both personal and professional life. It is highly essential to master the language for survival and to improve quality of life.

Objective:

The course helps to train the students to attain the skills set to manage life and career

Course Outcomes:

The students will be able to:

1. evaluate and accept the self for all positive changes
2. demonstrate assertiveness
3. manage emotions
4. develop emotional intelligence
5. depicting the positive thought process

Prescribed Textbook:

Life Skills for Success by Alka Wadkar. Sage Publications India Pvt Ltd. 2016.

Unit I:

Respecting Oneself

Self-esteem - Being Assertive - Recognising and Overcoming various Behavioural Traits - Self Management - Consequences of Being Disorganized

Unit II:

Understanding the World Around

Fallacies, Misconceptions - Paradoxes - Cultural Apathies - Distortions - Attributions - Conflict Resolution - Anger Management

Unit III:

Positive and Pro-Active Thinking

Nature and Significance - Being Pro-Active - Effective Thought Patterns - Logical Thinking - Flexibility & Adaptability

Unit IV:

Emotions and Emotional Development

Nature & Biology of Emotions - Expression of Emotions - Gender & Emotions - Emotional Abuse - Emotional Competence

Unit V:

Social Skills

Decency in Social Media - Limit Realization in Public and Social Networking - Relating to Others in Virtual World - Constructive Criticism - Awareness of Legal Issues

References:

1. **Developmental psychology** by Hurlock,E.B. New Delhi: McGrawHill. 1979.
2. **Explorations in Personality** by Murry, H.A. New York: Oxford University Press. 1938.
3. **Social Learning Theory** by Bandora. A. Englewood Cliffs, NJ: Prentice Hall. 1977.
4. **Step by Step: Learning Language Life Skills** by K.Nirupa Rani, Jayashree Mohanraj, B. Indira, B. Sai Lakshmi. Pearson.2012.
5. **Real English: A Multi-Skill Language Course with Values and Life skills** by Viva Education Publication.2013.

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TOTAL QUALITY MANAGEMENT
(Open Elective-II)

PRE REQUISITES: Production Planning and Control, Industrial Engineering and Management

COURSE OBJECTIVES:

The objectives of this course are to:

1. Overview the quality and explaining the salient contributions of Quality Gurus like Deming, Juran and Crosby. General barriers in implementing and concepts like customer Focus, Employee Focus in TQM.
2. Impart knowledge of continuous process improvement and Supplier Management in industry.
3. Provide exposure to students on the basic and new seven management tools, Quality concepts like Six Sigma, Failure mode effect analysis.
4. Explore industrial applications of Quality function deployment, Taguchi quality concepts and TPM.
5. Impart detailed exposure to students on various quality systems like ISO and its standards.

COURSE OUTCOMES:

After the completion of this course students will be able to:

1. Explain the basic concepts of TQM, TQM framework and quality statements with respect to customers.
2. Adapt the TQM principles, quality circles, 5S, Kaizen and PDCE cycles.
3. Analyze tools of quality, concept of six sigma with application in manufacturing and FMEA.
4. Identify different TQM tools and techniques, control charts and QFD.
5. Distinguish different quality systems used in industries and TQM implementation in industries.

UNIT – I

Introduction: Need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby – Barriers to TQM – Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

UNIT – II

TQM principles; leadership, strategic quality planning; Quality councils – employee involvement, motivation, Empowerment, Team and Teamwork, Quality circles, recognition and reward, performance appraisal, Continuous process improvement, PDCE cycle, 5S, Kaizen, Supplier partnership, Partnering, Supplier rating & selection.

UNIT – III

The Seven Traditional Tools of Quality: New management tools; Six sigma – concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

UNIT – IV

TQM Tools and Techniques: Control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM concepts, improvement needs, performance measures.

UNIT – V

Quality Systems: need for ISO 9000, ISO 9001-9008; Quality system – Elements, documentation; Quality auditing, QS 9000, ISO 14000 – Concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

TEXT BOOKS:

1. Total Quality Management, Besterfield D.H., Pearson Education Asia, 2006.
2. The management and Control of Quality, Evans J.R. and Lindsay W.M., South-Western College Pub.
3. Total Quality Management, Girish Pathak, MacMillan publishers India Ltd.

REFERENCE BOOKS:

1. Total Quality Management, Suganthi.L and Anand Samuel, Prentice Hall India Learning Private Limited.
2. Total Quality Management – Text and Cases, Janakiraman.B and Gopal.R.K, Prentice Hall India Learning Private Limited.
3. Quality Management, KanishkaBedi, Oxford Higher Education.
4. Total Quality Management Dr. V. Jayakumar, Lakshmi Publications.
5. Total Quality Management, Subbaraju Ramaswamy, McGraw Hill Education.

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NanoScience and NanoTechnology
(Open Elective – II)

Course Objectives:

1. To provide the most exciting and novel properties at nanoscale regime
2. To explain the interdisciplinary issues in nanoscale science and technology.
3. To discuss about the basics of nanotechnology
4. To classify and explain the various properties of nanomaterials
5. To describe the various methods for synthesis of nanomaterials and their applications

Unit I: Introduction:
History and Scope, Can Small Things Make a Big Difference?
Quantum confinement, Surface area to Volume ratio, Classification of Nano structured Materials, Fascinating Nanostructures, Applications of Nano materials, Nature: The Best of Nanotechnologist, Challenges and Future Prospects.

Unit II: Unique Properties of Nano materials: Microstructure and Defects in Nano crystalline Materials:
Dislocations, Twins ,stacking faults and voids, Grain Boundaries, triple and disclinations. **Effect of Nano-dimensions on Materials Behavior:** Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility.
Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

Unit III: Synthesis Routes: Bottom up approaches:
Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly,
Top down approaches: Mechanical alloying, Nano-lithography.
Consolidation of Nano powders: Shock wave consolidation, Hot isostatic pressing and Coldisostatic pressing Spark plasma sintering.

Unit IV: Tools to Characterize nano materials:
X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nano indentation.

Unit V: Applications of Nano materials:
Nano-electronics, Micro- and Nano-electro mechanical systems (MEMS/NEMS), Nanosensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water-Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications, Concerns and challenges of Nanotechnology.

Text Books:

Text Book of NanoScience and NanoTechnology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

References Books:

1. Nano: The Essentials by T.Pradeep, McGraw- Hill Education.
2. Nano materials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L.Schodek
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact– Ed. Challa S.,S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

Course Outcomes:

At the end of this course, students must have knowledge and ability to

1. Explain the concepts and applications of nanotechnology and the growth techniques of nanomaterials.
2. Apply the materials in the nanoscale.
3. Discuss about Synthesis Techniques of nanomaterials.
4. Classify the different characterization techniques of nanomaterials
5. Explain the applications in the fields of automobiles, textiles and energy.

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ENGLISH FOR PROFESSIONALS
(Open Elective-III)

Introduction:

The course aims at preparing the students with the tools needed for successful communication at the professional front. It is designed to improve students' academic and professional skills which the employers are currently looking for.

Objective:

To prepare the students to use the language effectively in all professional pursuits

Course Outcomes:

The students will be able to:

1. analyze the language use in communicative process
2. describe the process and product
3. interpret the ideas in group activities
4. apply different approaches to comprehend the written text
5. write any technical and official correspondence within the framework

UNIT-I

Essentials of Communication:

Essentials of Grammar **-** Rudiments of Communication Skills (Listening, Speaking, Reading, and Writing) - Applied Grammar and Usage - Non-Verbal Communication

UNIT-II

Listening Skills:

Art of Listening - Developing Effective Listening Skills - Process of Listening, Intensive & Extensive Listening
Podcasts, Vodcasts (ICT enabled) - Five steps to Active Listening - Effective and Ineffective Listening Skills -Listening & Note-Taking

UNIT-III

Speaking Skills:

Dynamics of Effective Speaking - Group Discussion - Simulated Presentations, Process & Product Descriptions - Proxemics, Paralinguistic Features

UNIT-IV

Reading Skills:

The Art of Effective Reading - Basic steps to Effective Reading - Extensive and Intensive Reading - Approaches to Efficient Reading - Reading Comprehension

UNIT-V

Writing Skills:

Art of Condensation - Descriptive Writing Techniques - Writing & Answering Memos, Circulars -

Inter & Intra Official Communication - Writing Minutes of Meeting - Netiquette - E-mail & Blog Writing - Note-Making

Prescribed Textbook:

1. **Business Communication (Second Edition)** by Meenakshi Raman & Prakash Singh. Oxford University Press. 2012.

References:

1. **Communicating at Work** (Seventh edition) by Adlar, Ronarld.B. McGrawHill. 2004.
2. **Cambridge English for Engineering Professionals** by Mark Ibbotson. Cambridge University. 2008.
3. **Professional Communication** by Aruna Koneru. McGrawHill. 2017.
4. **The Effective Communicator** by Adair John. Jaico Publishing House. 1995.
5. **Oxford English for Careers** by Oxford University Press.

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INDUSTRIAL SAFETY AND HAZARD MANAGEMENT
(Open Elective-III)

Prerequisite: Environmental Studies

COURSE OBJECTIVES:
This course will provide

1. Effective use of chemical industry utilities.
2. Emphasis on the knowledge of loss prevention
3. Knowledge about personal safety and industrial safety.
4. To determine the hazard analysis and the toxicology.
5. A importance of Personal proactive equipment's used in industries

UNIT I
Introduction:
Safety program, Engineering ethics, Accident and loss statistics, Acceptable risk, Public perception, Toxicology: How toxicants enter biological organisms, how toxicants are eliminated from biological organisms.

UNIT II
Industrial Hygiene:
Government regulations, Identification: material safety data sheets, Evaluation: evaluating exposures to volatile, Control: respirators, ventilation.

UNIT III
Fires and Explosions:
The fire triangle, Distinction between fire and explosions: Definitions, Flammability characteristics of liquids and vapors, MOC and inerting, ignition energy, Auto ignition, Auto oxidation, adiabatic compression, Explosions.
Designs to prevent fires and Explosions:
Inerting, Explosion proof equipment and instruments, Ventilations, Sprinkler systems.Hazards Identification: Process hazards checklists, Hazard surveys, and Hazop safety reviews.

UNIT IV
Introduction to Reliefs: Relief concepts: Definitions, Location of reliefs, Relief types, Data for sizing reliefs, Relief systems. **Relief Sizing**: Conventional spring operated reliefs in liquids, Conventional spring operated relief's in vapor or gas service, Rupture disc relief's in liquid, vapor or gas service.

UNIT V
Chemical Process Safety: Introduction, Chemical process in Hazardous operations, chemical reactors, Reaction Hazards, Operational Deviations and Technical Report.
Personal Protective Equipment: Introduction ,Legal Requirements , Selection guide lines, Head Protection, Eye and Face Protection , Hand Protection ,Foot and Leg Protection, Body Protection, Indian standards on Personal Protective Equipment.

COURSE OUTCOMES: Students will able to

1. Understanding of Safety principles and toxicology
2. Identify and evaluate the different types of Hazard analysis.
3. Analyse and take preventive measure of Fire & explosions industrial hazards and accidents.
4. Apply the relief system for different types of valves in industries and statistical analysis of accidents.
5. Acquire knowledge of accident investigation and Personal Protective Equipments.

TEXT BOOKS:

1. Chemical Process Safety – (Fundamentals with applications), D.A.Crowl & J.F.Louvar Prentice Hall, New Jersey, 1990.
2. Industrial Hygiene and Chemical safety –M.H.Faulekar, I.K. International, 2006.

REFERENCES:

1. Safety and Accident Prevention in Chemical Operations, H.H.Fawcett and W.S.Wood, 2nd Edition, John Wiley and sons, New York, 1982.
2. Coulson and Richardson's – Chemical engineering – R.K.Sinnot, Vol.6, Butterworth-Heinmann Limited, 1996.

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IV Year B.Tech.Mech – IISem	**L**	**T / P / D**	**C**
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ENTRPERNEURSHIP DEVELOPMENT
(Open Elective-III)

Course Objectives:

1. To provide insights into basic characteristics and process of entrepreneurship
2. To develop a business idea and prepare a bankable project report
3. To identify the methods to initiate ventures and the sources of finance
4. To create awareness about the legal challenges of entrepreneurship and IPR
5. To know and apply the various strategic and managerial concerns in the growth stage of the firms

Course Outcomes: At the end of the course, students will be able to

1. Interpret concepts and process of entrepreneurship.
2. Apply idea development strategies and prepare a bankable project report
3. Analyse various opportunities towards initiating ventures.
4. Recognize legal challenges of entrepreneurship.
5. Assess the strategic perspectives of entrepreneurship.

UNIT I :
Introduction:
Introduction to Entrepreneurship – Characteristics, Qualities, Key Elements and Skills of an Entrepreneur, entrepreneurial stress, Corporate entrepreneurship, Entrepreneurial process.

UNIT II:
Business Plan Preparation:
Search for business idea, project identification, project formulation and development, contents of business plan and Preparation of a Bankable Project Report.

UNIT III:
Launching Entrepreneurial Venture:
Opportunities identification, Methods to initiate Ventures, Creating new ventures, Acquiring existing ventures, Franchising. Sources of finance, Forms of capital requirements, funding agencies and supporting institutions.

UNIT IV:
Legal challenges of Entrepreneurship:
Intellectual Property Protection – Patents, Copyrights, Trademarks and Trade Secrets. The challenges of new Venture Startups- Poor financial understanding, critical factors for new venture development, Evaluation process, Feasibility criteria approach.

UNIT V:
Strategic perspectives in Entrepreneurship:
Strategic planning- Strategic Action, Strategic Positioning, Business Stabilization, Building the adaptive firms, understanding the growth stage, unique managerial concern of growing ventures.

Text Books:

1. D F Kuratko and T V Rao “Entrepreneurship- A South-Asian Perspective “Cengage Learning, 2012
2. Vasant Desai, Small Scale Industries and Entrepreneurship, HPH, 2012.

Reference Books:

1. Rajeev Roy, Entrepreneurship, 2e, Oxford, 2012.
2. B.Janakiram and M.Rizwana, Entrepreneurship Development:Text& Cases, Excel Books,2011.
2. Stuart Read, Effectual Entrepreneurship, Routledge, 2013.
3. Robert Hisrich et al, Entrepreneurship, 6e, TMH, 2012.
4. Nandan H, Fundamentals of Entrepreneurship, PHI, 2013
5. Shejwalkar, Entrepreneurship Development, Everest, 2011
6. Khanka, Entrepreneurship Development, S.Chand, 2012