T K R COLLEGE OF ENGINEERING &TECHNOLOGY

(Autonomous)

B.TECH. MECHANICAL ENGINEERING -R18

COURSE STRUCTURE& SYLLABUS

B.Tech. VSemester

S. No.	**Code**	Course Title	L	T	P	Credits
1	**B35PC1**	Design of Machine members-I	**3**	**1**	**0**	**3**
2	**B35PC2**	Thermal Engineering-I	**3**	**1**	**0**	**3**
3	**B35PC3**	Machine tools	**3**	**1**	**0**	**3**
4	**B35PC4**	Automobile Engineering	**3**	**1**	**0**	**3**
5	**B35HS5**	Fundamentals of Management	**3**	**1**	**0**	**3**
6	**B35PE6**	Professional Elective-II **B35PE5A:** Finite Element Methods **B35PE5B:** Engineering Metrology **B35PE5C:** I.C. Engines and Gas Turbines Methods	**3**	**1**	**0**	**3**
7	**B35PC7**	Thermal engineering Lab	**0**	**0**	**3**	**1.5**
8	**B35PC8**	Machine tools lab	**0**	**0**	**3**	**1.5**
9	**B35PC9**	Engineering Metrology Lab.	**0**	**0**	**3**	**1.5**
10	**B35MC10**	*Professional Ethics and Group discussion	**3**	**0**	**0**	**0**
Total Credits						**22.5**

* MC--Mandatory course, Satisfactory/Unsatisfactory

B.Tech. VI Semester

S. No.	Code	Course Title	L	T	P	**Credits**
1	**B36PE1**	Professional Elective-III **B36PE1A:** Fundamentals of Engineering Materials **B36PE1B:** Thermal Engineering-2 **B36PE1C:** Power Plant Engineering	**3**	**1**	**0**	**3**
2	**B36PC2**	Design of machine members –II	**4**	**1**	**0**	**4**
3	**B36PC3**	Heat Transfer	**3**	**1**	**0**	**3**
4	**B36OE4**	Open Elective -II **B36OE4A:** World Class Manufacturing **B36OE4B:** Science and Technology of Nano Materials **B36OE4C:** Nuclear Power generation and supply	**2**	**1**	**0**	**2**
5	**B36OE5**	Open Elective-III **B36OE5A:**SOLAR ENERGY APPLIANCES **B36OE5B:** Rural Technology and Community development **B36OE5C:** Theory of Combustion and Emission	**3**	**1**	**0**	**3**
6	**B36PC6**	Heat transfer Lab	**0**	**0**	**3**	**1.5**
7	**B36PC7**	Production drawing Practices and Instrumentation Lab	**0**	**0**	**3**	**1.5**
8	**BE23**	Advanced Communications skill lab	**0**	**0**	**3**	**1.5**
Total Credits						**19.5**

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

DESIGN OF MACHINE MEMBERS – I - B35PC1

B.Tech. V Semester. **L/T/P/C**

3/1/0/3

Note: Design Data books are not permitted in the Examinations. The design must not only satisfy strength criteria but also rigidity criteria.

PRE-REQUISITES: Engineering mechanics, mechanics of solids, manufacturing processes, metallurgy and material science.

COURSE OBJECTIVES:

1. To understand the general design procedures and principles in the design of machine elements.
2. To study different materials of construction and their properties and factors determining the selection of material for variousapplications.
3. To determine stresses under different loadingconditions.
4. To learn the design procedure of different fasteners, joints, shafts andcouplings.

COURSE OUTCOMES:

1. The student acquires the knowledge about the principles of design, material selection, component behavior subjected to loads, and criteria offailure.
2. Understands the concepts of principal stresses, stress concentration in machine members and fatigueloading.
3. Design on the basis of strength and rigidity and analyze the stresses and strains inducedin a machineelement.

UNIT – I:

Introduction: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design. Tolerances and fits –BIS codes ofsteels.

Design for Static Strength: Simple stresses – Combined stresses – Torsional and Bending stresses – Impact stresses – Stress strain relation – Various theories of failure – Factor of

safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combinedsituations.

UNIT – II:

Design for Fatigue Strength: Stress concentration–Theoretical stress Concentration factor– Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Gerber's curve– Modified Goodman's line– Soderberg's line.

UNIT – III:

Riveted, Welded and Bolted Joints: Riveted joints- methods of failure of riveted joints-strength equations-efficiency of riveted joints-eccentrically loaded riveted joints.

Welded joints-Design of fillet welds-axial loads-circular fillet welds under bending, torsion. Welded joints under eccentric loading.

Bolted joints – Design of bolts with pre-stresses – Design of joints under eccentric loading – locking devices – bolts of uniform strength.

UNIT – IV:

Keys, Cotters and Knuckle Joints: Design of keys-stresses in keys-cottered joints-spigot andsocket, sleeve and cotter, jib and cotter joints-Knucklejoints.

UNIT – V:

Shafts: Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending and axial loads – Shaft sizes – BIS code. Use of internal and external circlips, Gaskets and seals (stationary &rotary)

Shaft Couplings: Rigid couplings – Muff, Split muff and Flangecouplings.Flexible couplings – Flange coupling(Modified).

TEXT BOOKS

1. Design of Machine Elements / V. Bhandari / Mc GrawHill
2. Machine Design / Jindal /Pearson

REFERENCE BOOKS

1. Design of Machine Elements / V. M. Faires /Macmillan
2. Design of Machine Elements-I / Annaiah, M.H / NewAge

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

THERMAL ENGINEERING – I - B35PC2

B.Tech: V Semester. **L / T/P/ C**

3/1/0/3

PRE-REQUISITE: Thermodynamics

COURSE OBJECTIVE: To apply the laws of Thermodynamics to analyze air standard cycles and to understand and evaluate the perform analysis of the major components and systems of IC engines, refrigeration cycles and their applications.

COURSE OUTCOMES: At the end of the course, the student should be able

1. To evaluate the performance of IC engines and compressors under the given operating conditions.
2. Apply the laws of Thermodynamics to evaluate the performance of Refrigeration and air-conditioning cycles.
3. Understand the functionality of the major components of the IC Engines and effects of operating conditions on their performance.

UNIT – I:

I.C. Engines: Classification - Working principles of Four & Two stroke engine, SI & CI engines, Valve and Port Timing Diagrams, Air – Standard, air-fuel and actual cycles - Engine systems – Carburetor and Fuel Injection Systems for SI engines, Fuel injection systems for CI engines, Ignition, Cooling and Lubrication system, Fuel properties and Combustion Stoichiometry.

UNIT – II:

Normal Combustion and abnormal combustion in SI engines – Importance of flame speed and effect of engine variables – Abnormal combustion, pre-ignition and knocking in SI Engines – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types of SI engines.

Four stages of combustion in CI engines – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence in Diesel engine – open and divided combustion chambers and fuel injection– Diesel fuel requirements and fuel rating

UNIT - III:

Testing and Performance: 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 Classification of compressors – Fans, blowers and compressors – positive displacement and dynamic types – reciprocating and rotary types.

Reciprocating Compressors: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance volume, staged compression, under cooling, saving of work, minimum work condition for staged compression

UNIT – IV:

Rotary Compressor (Positive displacement type): Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.

Dynamic Compressors: Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

Axial Flow Compressors: Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency-pressure rise calculations – Polytropic efficiency.

UNIT – V:

Refrigeration: Mechanical Refrigeration and types – units of refrigeration – Air Refrigeration system, details and principle of operation – applications of air refrigeration, Vapour compression refrigeration systems – calculation of COP – effect of superheating and sub cooling, desired properties of refrigerants and common refrigerants- Vapour absorption system – mechanical details – working principle, Use of p-h charts for calculations

Air-Conditioning: Concepts of Psychrometry – Properties of moist air – Usage of Psychrometric Chart – Calculation of moist air properties.

Types of air – conditioning systems – Requirements - schematic layout of a typical plant.

TEXT BOOKS

1. I.C. Engines / V. Ganesan / Mc Graw Hill
2. Thermal Engineering / Mahesh M Rathore / Mc Graw Hill

REFERENCE BOOKS

1. Applied Thermodynamics for Engineering Technologists / Eastop / Pearson.
2. Fundamentals of Classical Thermodynamics / Vanwylen G.J., Sonntag R.E. / Wiley Eastern.

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B.TECH. MECHANICAL ENGINEERING -R18

MACHINE TOOLS - B35PC3

B.Tech. V Semester. **L/T/P/C**

3/1/0/3

PRE REQUISITES: Physics, Kinematics of Machines, Production Technology, Manufacturing Process

COURSE OBJECTIVE:

1. A source of power is always needed in various workshop processes particularly in cutting and forming of metal in a machine tool. In the metal-working industry work pieces of most different shapes and dimensions and of different materials are worked.
2. In every industry we need shaping of materials. This shaping of materials is done by either non-cutting process or cutting process.
3. After completion of the machine tools course, students should able to identify the utilization of different tools. Differentiate various machining operations on same and different machinery Solve industrial problems related to machine tools.
4. Gain knowledge on various kinematics involved in machines. Design various machines & tools for various applications

COURSE OUTCOMES:

1. Brief exposure to various production technologies, how a product can be produced. Capable of facing challenges and requirements in industries for mechanizing the plant.
2. Apply the principles and techniques of production and control of the production and service systems to optimize/make best use of resources.
3. Course outcomes deliver a complete knowledge and exposure for manufacturing technologies to Control and command over production rates

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 and tool holding devices, Taper turning, Thread turning - Lathe attachements. Turret and capstan lathe - Principle features of automatic lathes - classification: Single spindle and multi-spindle automatic lathes - tool layouts.

UNIT - III:

Shapping, slotting and planning machines - Principles of working - principal parts - specification, classification, operations performed. Kinematic scheme of shaping, slotting and planning machines, 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. Kinematics scheme of the drilling and boring machines

UNIT - IV:

Milling machine - Principles of working - specifications - classifications of milling machines - Principal features of horizontal, vertical and universal milling machines - machining operations Geometry of milling cutters - methods of indexing - Accessories to milling machines, kinematic scheme of milling machines

UNIT - V:

Finishing Processes: Grinding - fundamentals - theory of grinding - classification of grinding machines - cylindrical and surface grinding machine - Tool and cutter grinding machine - special types of grinding machines, Diffrent types of abrasives - bonds specification of a grinding wheel and selection of a grinding wheel, Kinematic.Scheme of grinding machines.

TEXT BOOKS

1. Production Technology / HMT / Tata Mc Graw Hill.
2. Production Technology / R. K. Jain and S. C. Gupta / Khanna Pulishers.

REFERENCE BOOKS

1. Principles of Machine Tools / Bhattacharya A and Sen. G. C / New Central Book Agency.
2. Workshop Technology - Vol. - II / B. S. Raghuvamsi.
3. Elements of Work Shop Technology - Vol. II / HajraChoudary / Media Promoters.
4. Fundamentals of Metal Machining and Machine Tools / GeofreyBoothroyd / Mc Graw Hill.
5. Manufacturing Processes / JP Kaushish / Prentice Hall / 2nd Edition.
6. Machine Tools / C Elanchezhian& M. Vijayan / Anuradha Publications.

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

AUTOMOBILE ENGINEERING - B35PC4

B.Tech. V Semester. **L/T/P/C**

3/1/0/3

PRE REQUISITES: Thermal Engineering

COURSE OBJECTIVES: The student will be made to learn

1. The anatomy of the automobile in general
2. The location and importance of each part
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels
4. Suspension, frame, springs and other connections
5. Emissions, ignition, controls, electrical systems and ventilation

COURSE OUTCOMES: The student will be able to

1. Identify the different parts of the automobile.
2. Explain the working of various parts like engine, transmission, clutch, brakes.
3. Describe how the steering and the suspension systems operate.
4. Understand the environmental implications of automobile emissions.
5. Develop a strong base for understanding future developments in the automobile industry.

UNIT – I:

Introduction: Layout of automobile – introduction chassis and body components .types of Automobile engines. – power unit – Introduction to engine lubrication – engine servicing **Fuel System:** S.I. Engine : Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introductionto MPFI and GDI Systems. **C.I. Engines:** Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction CRDI and TDI Systems.

UNIT - II:

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling – pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

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, constantt mesh, synchro mesh gear boxes, epicyclic gear box , over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

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

UNIT - IV:

Braking System: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

Steering System: Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT - V:

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG,CNG, liquid Fuels and gaseous fuels, Hydrogen as a fuel for IC Engines. - their merits and demerits. Standard Vehicle maintenance practice.

TEXT BOOKS

1. Automobile Engineering / William H Crouse
2. A Text Book Automobile Engineering–Manzoor,.Nawazish Mehdi & .Yosuf Ali, Frontline Publications.

REFERENCES

1. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner
3. Automotive Engineering / Newton Steeds & Garrett
4. Automotive Engines / Srinivasan
5. A Text Book of Automobile Engineering By Khalil U Siddiqui New Age International

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B.TECH. MECHANICAL ENGINEERING -R18

FUNDAMENTALS OF MANAGEMENT - B35HS5

B.Tech. V Semester. **L/T/P/C**

3/1/0/3

COURSE OBJECTIVE:

To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills.

COURSE OUTCOME:

The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation and Control aspects are learnt in this course. The students can explore the Management Practices in their domain area.

UNIT – I:

Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, ITApproach.

UNIT - II:

Planning and Decision Making: General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Development of Business Strategy. Decision making and Problem Solving - Programmed and Non Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making; Group Problem Solving and Decision Making, Creativity and Innovation in ManagerialWork.

UNIT - III:

Organization and HRM: Principles of Organization: OrganizationalDesign&

Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization; Organizational Culture; Organizational Climate and OrganizationalChange.

Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; PerformanceAppraisal.

UNIT - IV:

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Leadership.

Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT - V:

Controlling: Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems, Control frequency andMethods.

TEXT BOOKS

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning,2013.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education,2009.

REFERENCES

1. Essentials of Management, Koontz Kleihrich, Tata McGrawHilL.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning,2012.

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B.TECH. MECHANICAL ENGINEERING -R18

FINITE ELEMENT METHODS - B35PE5A3

B.Tech. V Semester. **L/T/P/C**

3/1/0/3

PRE-REQUISITES: Mechanics ofSolids.

COURSE OBJECTIVE: The aim of the course is to provide the participants an overview on Finite Element Method, Material models, and Applications in Mechanical Engineering.

COURSE OUTCOMES: At the end of the course, the student will be able to, Apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer. Formulate andsolve problems in one dimensional structures including trusses, beams and frames. Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi-symmetric and plate bending problems. Implement and solve the finite element formulations usingMATLAB.

UNIT – I:

Introduction to Finite Element Method for solving field problems.Stress and Equilibrium.Boundary conditions. Strain – Displacement relations. Stress – strain relations.

One Dimensional Problems : Finite element modeling coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT – II:

Analysis of Trusses: Stiffness Matrix for Plane Truss and Space Truss Elements, Stress Calculations.

Analysis of Beams: Element stiffness matrix for two node, two degrees of freedom per node beam element, Load Vector, Deflection, Stresses

UNIT – III:

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of Load Vector, Stresses. Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular

elements. Two dimensional four nodedIsoparametric elements and numerical integration.

UNIT – IV:

Steady State Heat Transfer Analysis: one dimensional analysis of Slab, fin and two dimensional analysis of thin plate.Analysis of a uniform shaft subjected to torsion.

UNIT – V:

Dynamic Analysis: Formulation of finite element model, element - Mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar, trussand beam.Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation.techniques such as semi automatic and fully Automatic use of softwares such as ANSYS, NISA, NASTRAN,etc.

TEXT BOOKS

1. Finite Element Methods: Basic Concepts andapplications/Alavala/PHI
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu/Pearson

REFERENCE BOOKS

1. An Introduction to the Finite Element Method / J.N.Reddy/ Mc GrawHill
2. Finite Element Analysis / SS Bhavikatti / NewAge
3. Finite Element Method/Dixit/Cengage

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B.TECH. MECHANICAL ENGINEERING -R18

ENGINEERING METROLOGY - B35PE5B

B.Tech. V Semester. **L/T/P/C**

3/1/0/3

PRE REQUISITES: Object identification and description, material properties.

COURSE OBJECTIVE:

1. To educate students on different measurement systems and on common types of errors. And introduce measuring equipment's used for linear and angular measurements.
2. To familiarize students with surface roughness measurements on machine components and develop an understanding of the basics of Metrology, how the principles and applications of different areas of measurement.
3. Maintenance of the accuracies of measurement. This is achieved by periodical calibration of the metrological instruments used in the plant.
4. To determine the measuring instrument capabilities and ensure that these are adequate for their respective measurements.

COURSE OUTCOMES:

1. Graduates will demonstrate an understanding of their professional and ethical responsibilities, and use technology for the benefit of mankind.
2. Understand the basics of Metrology and different methods of measurement.
3. Understand the concepts of limits, fit and tolerance and know the shaft basis system and hole basis system.
4. To be able to select and use the appropriate measuring instrument according to a specific requirement (in terms of accuracy, etc.)

UNIT - I:

Systems of Limits and Fits: Introduction, normal size, tolerance limits, deviations, allowance, fits and their types - unilateral and bilateral tolerance system, hole and shaft basis systems - interchangebility and selective assembly. Indian standard Institution system - International Standard system for plane and screwed work.

UNIT - II:

Linear Measurement: Length standard: line and end standard, slip gauges - calibration of slip gauges, Dial indicator, micrometers.

Measurement of Angles and Tapers: Different methods - Bevel protractor - angle slip gauges - spirit levels - single bar - Sine plate used to determine the tappers.

Limit Gauges: Taylor's principle - Design of GO and NO GO gauge, plug, ring, snap, 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.

UNIT - IV:

Surface Roughness Measurement: Difference between surface roughness and surface waviness - Numerical assessment of surface finish: CLA, R.M.S Values, R_2 Values, R_{10} value - Methods of measurement of surface finish: profilograph, Talysurf - ISI symbol for indication of surface finish.

UNIT - V:

Measurement Through Comparators: Comparators: Mechanical, Electrical and Electronic Comparators, pneumatic comparators and their uses in mass production.

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

Machine Tool Alignment Tests: Requirement of Machine Tool Alignment Tests, Alignment tests on lathe, milling, drilling machine tools, Preparation of acceptance charts.

Gear Measurement: Gear measuring instruments, Gear tooth profile measurement, Measurement of diameter, pitch pressure angle and tooth thickness.

Coordinate Measuring Machines: Types of CMM, Role of CMM, and Applications of CMM.

TEXT BOOKS

1. Engineering Metrology / R. K. Jain / Khanna Publishers
2. Engineering Metrology / I C Gupta / Dhanpath Rai

REFERENCE BOOKS

1. Dimensional Metrology / Connie Dotson / Thamson 4th Edition.
2. BIS Standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.
3. Fundamentals of Dimensional Metrology / Connie Dotson / Thamson / 4th Edition.
4. Engineering Metrology / Kenneth John Hume / Mc Donald.
5. Engineering Metrology / D. M Anthony / Pergamon Press.
6. Principles of Engineering Metrology / RegaRajendra / Jaico Publications.

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B.TECH. MECHANICAL ENGINEERING -R18

IC ENGINES AND GAS TURBINES - B35PE5C

B.Tech. V Semester. **L/T/P/C**

3/1/0/3

PRE-REQUISITES: Basic Thermodynamics

COURSE OBJECTIVES:

1. Acquire knowledge about the IC engine cycles, classification and working Principles.
2. Describe the testing and performance parameters along with heat balance Sheet.
3. Explain different alternate fuels, gas turbines and about jet propulsion.

COURSE OUTCOMES:

1. Explain basic concepts of actual cycles with analysis and to describe the fundamentalconcepts of IC engines along with its working principles.
2. Describe the combustion phenomenon in SI and CI engines.
3. Evaluate the performance of IC engines and the importance of alternate fuels.
4. Classify the essential components of gas turbine along with its performanceImproving methods.
5. Illustrate the working principle of different types of Jet propulsive engines andRockets.

UNIT – I:

Introduction: Basic Engine components and Nomenclature, Classification of Engines, The working principle of Engines, Comparison of 2-Stroke and 4-Stroke Engines; CI, and SI Engines, Ideal and Actual Working Cycles and their analysis, Valve timing Diagram.

Fuels: Fossil fuels, Chemical structure of Petroleum, Properties of SI and CI Engine Fuels, Fuel Ratings; Octane Number, Cetane Number.

UNIT – II:

Carburetors & Fuel Injection: Air Fuel Mixture Requirements, Construction and Working of Simple Carburetor, Calculation of Air-Fuel Ratio, Parts of Carburetor. Requirement of

Injection Systems, Classification of Injection Systems, Fuel Feed pump, Injection Pumps, Working principles of Governors, Nozzles and Fuel Injector, Injection in SI and CI Engines.
Combustion and Ignition Systems in SI and CI Engines: Normal and Abnormal Combustion in SI and CI Engines, Stages of Combustion, Detonation and Knocking.

UNIT – III:

Performance parameters for IC Engines: Engine Power, Engine Efficiencies, Performance Characteristics, Variables Effecting Performance Characteristics, Methods of Improving Engine Performance, Heat Balance.
Modern Automotive Engines*:* Changes in Fuel injection Methods in S.I and C.I engines, Common Rail Direct Injection System, Gasoline Direct Injection, Variable Valve Technology, A brief review of Design changes to achieve high efficiency.

UNIT – IV:

Gas Turbine: Introduction to Gas Turbines, Development, Classification and Application of Gas Turbines, Ideal and Actual Cycles; Effect of Inter cooling, Reheating, Regeneration, Combined cycle, and Cogeneration.

UNIT – V:

Gas Turbine Cycles for Aircraft Propulsion: Criteria of performance, Intake, and propelling nozzle efficiencies, Simple Turbojet Cycle, The turboprop engine, Thrust augmentation, Gas turbine combustion systems, Combustion chamber designs, Gas Turbine Emissions.

TEXT BOOKS

1. I.C. Engines/ Gas Turbines / V. Ganesan- Mc Graw Hill
2. Internal Combustion Engines /Colin R. Ferguson /Wiley

REFERENCE BOOKS

1. Fundamentals of Internal Combustion Engines / H.N Gupta / PHI
2. Gas Turbine Theory/ HIH Saravanamuttoo, Cohen, Rogers/ Pearson

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B.TECH. MECHANICAL ENGINEERING -R18

THERMAL ENGINEERING LAB - B35PC7

B.Tech. V Semester. **L/T/P/C**

0/0/3/ 1.5

PRE-REQUISITE: Thermodynamics & Thermal Engineering – I

OBJECTIVE: To understand the working principles of IC Engines, Compressors.

LIST OF EXPERIMENTS:

1. I.C. Engines Valve / Port Timing Diagrams
2. I.C. Engines Performance Test for 4 Stroke SI engines
3. I.C. Engines Performance Test for 2 Stroke SI engines
4. I.C. Engines Morse, Retardation, Motoring Tests
5. I.C. Engine Heat Balance – CI/SI Engines.
6. I.C. Engines Economical speed Test on a SI engine.
7. I.C. Engines effect of A/F Ratio in a SIengine.
8. Performance Test on Variable Compression Ratio Engine.
9. IC engine Performance Test on a 4S CI Engine at constant speed.
10. Volumetric efficiency of Air – CompressorUnit
11. Dis-assembly / Assembly of Engines
12. Study of Boilers.

Perform any 10 out of the 12 Exercises.

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

(Autonomous)

B.TECH. MECHANICAL ENGINEERING -R18

MACHINE TOOLS LAB - B35PC8

B.Tech. V Semester. **L/T/P/C**

0/0/3/ 1.5

COURSE OBJECTIVE:

1. To import practical exposure to the machine tools.
2. To conduct experiments and understand the working of the same.

COURSE OUTCOMES:

1. Get the basic techniques of machining processes. Along with the thermal aspects of orthogonal cutting mechanics,
2. Identify lathe cutting tool materials such as high speed steel, carbide, cutting tools, shapes, and tool geometry
3. Knew the various working principles of metal cutting machines, types and uses of the vertical/horizontal milling machines.
4. Select and install proper grade of wheel for grinding material and understand the major components of a single and production type fixture or jig.

LIST OF EXPERIMENTS:

1. Introduction of general purpose machines -Lathe, Drilling machine, Milling machine, Shaper,
2. Planing machine, slotting machine, Cylindrical Grinder, surface grinder and tool and cuttergrinder.
3. Step turning and taper turning on lathemachine
4. Thread cutting and knurling on -lathemachine.
5. Drilling andTapping
6. Shaping andPlanning
7. Slotting
8. Milling
9. Cylindrical SurfaceGrinding
10. Grinding of Toolangles.

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

(Autonomous)

B.TECH. MECHANICAL ENGINEERING -R18

ENGINEERING METROLOGY LAB - B35PC90

B.Tech. V Semester. **L/T/P/ C**

0/3/1.5

PRE REQUISITES: Object identification and description, material properties.

COURSE OBJECTIVE:

1. To educate students on different measurement systems and on common types of errors, and introduce measuring equipment's used for linear and angular measurements.
2. To familiarize students with surface roughness measurements on machine components and develop an understanding of the basics of Metrology, how the principles and applications of different areas of measurement.
3. Maintenance of the accuracies of measurement. This is achieved by periodical calibration of the metrological instruments used in the plant.
4. To determine the measuring instrument capabilities and ensure that these are adequate for their respective measurements.

COURSE OUTCOMES:

1. Graduates will demonstrate an understanding of their professional and ethical responsibilities, and use technology for the benefit of mankind.
2. Understand the basics of Metrology and different methods of measurement.
3. Understand the concepts of limits, fit and tolerance and know the shaft basis system and hole basis system.
4. To be able to select and use the appropriate measuring instrument according to a specific requirement (in terms of accuracy, etc.)

LIST OF EXPERIMENTS:

1. Use of gear teeth vernier calipers for checking the chordal addendum and chordalheight of the spurgear.
2. Machine tool alignment of test on thelathe.
3. Tool makers microscope and its application
4. Angle and taper measurements by bevel protractor and sinebars.

5. Use of spirit level and optical flats in finding the flatness of surfaceplate.
6. Thread measurement by 2-wire and 3-wiremethods.

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

PROFESSIONAL ETHICS AND GROUP DISCUSSION - B35MC10

B.Tech. V Semester.	**L**	**T/P/C**
	3	**0/0/0**

Course Objective: To enable the students to imbibe and internalize the values and ethical behavior in the personal and Professional lives.

Course Outcome: The students will understand the importance of Values and Ethics in their personal lives and professional careers. The students will learn the rights and responsibilities as an employee, team member and a global citizen.

UNIT – I:

Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT – II:

Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT – III:

Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession.

Central Responsibilities of Engineers - The Centrality of Responsibilities of Professional

Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walkaway Collapse.

UNIT – IV:

Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the HanfordNuclear Reservation.

Ethics in changing domains of research - The US government wide definition of research misconduct, research misconduct distinguished from mistakes and errors, recent history of attention to research misconduct, the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing & editing.

UNIT – V:

Global issues in Professional Ethics: Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual PropertyRights.

TEXT BOOKS

1. Professional Ethics: R. Subramanian, Oxford University Press,2015.
2. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press2015.

REFERENCES

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard , Michael J Rabins, 4e , Cengage learning,2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI,2008.

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

FUNDAMENTALS OF ENGINEERING MATERIALS - B36PE1A

B.Tech. VI Semester. **L/T/P/C**

3/1/0/3

UNIT – I:

Structure of Metals: Crystallography, Miller's indices, Packing Efficiency, Density calculations. Grains and Grain Boundaries. Effect of grain size on the properties. Determination of grain size by different methods. Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume – Rothery rules, Intermediate alloy phases.

UNIT –II:

Phase Diagrams: Construction and interpretation of phase diagrams, Phase rule. Lever rule. Binary phase Diagrams, Isomorphous, Eutectic and Eutectoid transformations with examples.

UNIT – III:

Steels: Iron-Carbon Phase Diagram and Heat Treatment: Study of Fe-Fe3C phase diagram. Construction of TTT diagrams. Annealing, Normalizing, Hardening and Tempering of steels, Hardenability. Alloy steels.

UNIT – IV:

Cast Irons: Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron. Engineering Materials-III: Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys.

UNIT – V:

Ceramics, Polymers and Composites: Crystalline ceramics, glasses, cermets: structure, properties and applications. Classification, properties and applications of composites. Classification, Properties and applications of Polymers.

TEXT BOOKS

- Material Science and Metallurgy/ Kodgire
- Essentials of Materials Science and engineering / Donald R. Askeland / Thomson.

REFERENCE BOOKS

- Introduction to Physical Metallurgy / Sidney H. Avner.
- Materials Science and engineering / William and callister.
- Elements of Material science / V. Rahghavan

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B.TECH. MECHANICAL ENGINEERING -R18

THERMAL ENGINEERING-II -B36PE1B

B.Tech. VI Semester. **L/T/P/C**

3/1/0/3

NOTE: Steam Table book Permitted.

PRE-REQUISITE: Thermodynamics

COURSE OBJECTIVE: To apply the laws of Thermodynamics to analyze steam and gas turbine cycles and to perform analysis of the major components of steam and gas turbine plants and their applications.

COURSE OUTCOMES: At the end of the course, the student should be ableto

- Develop state – space diagrams based on the schematic diagrams of process flow of steam and gas turbine plants
- Apply the laws of Thermodynamics to analyze thermos dynamic cycles
- Differentiate between vapour power cycles and gas power cycles
- Infer from property charts and tables and to apply the data for the evaluation of performance parameters of the steam and gas turbine plants
- Understand the functionality of major components of steam and gas turbine plants and to do the analysis of these components

UNIT – I:

Steam Power Plant: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating.

Boilers – Classification – Working principles with sketches including H.P.Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification – Height of chimney for givendraughtanddischarge-Conditionformaximumdischarge-Efficiencyofchimney.

UNIT – II:

Steam Nozzles : Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge-

Critical pressure ratio- Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilsonline.

UNIT – III:

Steam Turbines: Classification – Impulse turbine; Mechanical details – Velocity diagram – Effect of friction – Power developed, Axial thrust, Blade or diagram efficiency – Condition for maximum efficiency. De-Laval Turbine - its features- Methods to reduce rotor speed- Velocity compounding and Pressure compounding- Velocity and Pressure variation along the flow – Combined velocity diagram for a velocity compounded impulseturbine.

Reaction Turbine: Mechanical details – Principle of operation, Thermodynamic analysis of a stage, Degree of reaction –Velocity diagram – Parson's reaction turbine – Condition for maximumefficiency.

UNIT – IV:

Steam Condensers: Requirements of steam condensing plant – Classification of condensers –Working principle of different types – Vacuum efficiency and Condenser efficiency – Air leakage, sources and its affects, Air pump- Cooling waterrequirement.

Gas Turbines: Simple gas turbine plant – Ideal cycle, essential components – Parameters of performance – Actual cycle – Regeneration, Inter cooling and Reheating –Closed and Semi-closed cycles – Merits and Demerits- Combustion chambers and turbines of Gas Turbine Plant- BriefConcepts.

UNIT – V:

Jet Propulsion : Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Needs andDemands met by Turbo jet - SchematicDiagram,ThermodynamicCycle,PerformanceEvaluationThrustAugmentation - Methods.

Rockets: Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency – Specific Impulse – Solid and Liquid propellant RocketEngines.

TEXT BOOKS

1. Thermal Engineering / Mahesh M Rathore/ Mc GrawHill
2. Gas Turbines – V.Ganesan /Mc GrawHill

REFERENCE BOOKS

1. Gas Turbine Theory/ Saravanamuttoo, Cohen, Rogers/Pearson
2. Fundamentals of Engineering Thermodynamics / Rathakrishnan/PHI

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

(Autonomous)

B.TECH. MECHANICAL ENGINEERING -R18

POWER PLANT ENGINEERING - B36PE1C

B.Tech. VI Semester. **L/T/P/C**

3/1/0/ 3

PRE-REQUISITES: None.

COURSE OBJECTIVE: The goal of this course is to become prepared for professional engineering design of conventional and alternative power-generation plants. The learning objectives include.

- Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cycle power plants.
- A working knowledge of the basic design principles of nuclear, gas turbine, combined cycle, hydro, wind, geothermal, solar, and alternate power plants.
- Awareness of the economic, environmental, and regulatory issues related to power generation.

COURSE OUTCOMES: At the end of the course students are able to:

- Understand the concept of Rankine cycle.
- Understand working of boilers including water tube, fire tube and high pressure boilers
  and determine efficiencies.
- Analyze the flow of steam through nozzles.
- Evaluate the performance of condensers and steam turbines
- Evaluate the performance of gas turbines.

UNIT—I:

Introduction to the Sources of Energy: — Resources and Development of Power in India. Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipment, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems. Combustion Process: 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 drought system, cyclone furnace, design and

construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT—II:

Internal Combustion Engine Plant: DIESEL POWER PLANT: Introduction — IC Engines, types, construction— Plant layout with auxiliaries — fuel supply system, air starting equipment,

Lubrication and cooling system — super charging. Gas Turbine Plant: Introduction — classification – construction — Layout with auxiliaries — Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison. Direct Energy Conversion: Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.

UNIT—III:

Hydro Electric Power Plant: Water power — Hydro logical cycle / flow measurement — drainage area characteristics — Hydro graphs — storage and Poundage — classification of dams and spill ways.

Hydro Projects And Plant: Classification — Typical layouts — plant auxiliaries — plant operation pumped storage plants. Power From Non-Conventional Sources: Utilization of Solar- Collectors- Principle of Working, Wind Energy — types — HAWT, VAWT Tidal Energy.

UNIT —IV:

Nuclear Power Station: Nuclear fuel — breeding and fertile materials — Nuclear reactor — reactor operation. Types of Reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding radioactive waste 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 exercises. Effluents from power plants and Impact on environment — pollutants and pollution standards — Methods of Pollution control.

TEXT BOOKS

1. Power Plant Engineering! P.C.Sharma / S.K.Kataria Pub.
2. A Course in Power Plant Engineering: I Arora and S. Domkundwar.

REFERENCE BOOKS

1. A Text Book of Power Plant Engineering I Rajput I Laxmi Publications.
2. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
3. An Introduction to Power Plant Technology I G.D. Rai/Khanna Publishers.
4. Power plant Engg I Elanchezhian/ l.K. International Pub.

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

DESIGN OF MACHINE MEMBERS – II - B36PC2

B.Tech. VI Semester. **L/T/P/C**

4/1/0/4

NOTE: Design Data Book is permitted. Design of all components should include design for strength and rigidity apart from engineering performance requirements.

PRE-REQUISITES: Study of engineering mechanics, design of machine members-I and theory of machines.

COURSE OBJECTIVES:

1. To gain knowledge about designing the commonly used important machine members such as bearings, engine parts, springs , belts, gearsetc.
2. To design the components using the data available in design databooks.

COURSE OUTCOMES:

1. ----------

UNIT – I:

Sliding contact bearings: Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design.

UNIT – II:

Rolling contact bearings: Ball and roller bearings – Static load – dynamic load – equivalent radial load – design and selection of ball & roller bearings.

UNIT – III:

Engine Parts: Connecting Rod : Thrust in connecting rod – stress due to whipping action on connecting rod ends –Pistons, Forces acting on piston – Construction, Design and proportions of piston.

UNIT – IV:

Mechanical Springs: Stresses and deflections of helical springs – Extension and

compression springs – Design of springs for fatigue loading – natural frequency of helical springs – Energy storage capacity – helical torsion springs – Design of co-axial springs, Design of leaf springs.

Belts & Pulleys: Transmission of power by Belt and Rope ways, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives.

UNIT – V:

Gears : Spur gears& Helical gears- Brief introduction involving important concepts – Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

TEXT BOOKS

1. Design of Machine Elements / Spotts/Pearson
2. Machine tool design / V. Bhandari / Mc GrawHill

REFERENCE BOOKS

1. Design of Machine Elements-II / Annaiah / NewAge
2. Design of Machine Elements / Sharma andPurohit/PHI

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

HEAT TRANSFER - B36PC3

B.Tech. VISemester. **L/T/P/C**

3/1/0/3

NOTE: Heat Transfer Data Book is permitted.

PRE-REQUISITE: Thermodynamics.

COURSE OBJECTIVES: To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications

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

1. Understand the basic modes of heat transfer
2. Compute one dimensional steady state heat transfer with and without heat generation
3. Understand and analyze heat transfer through extended surfaces
4. Understand one dimensional transient conduction heat transfer
5. Understand concepts of continuity, momentum and energy equations
6. Interpret and analyze forced and free convective heat transfer
7. Understand the principles of boiling, condensation and radiation heat transfer
8. Design of heat exchangers using LMTD and NTU methods

UNIT – I:

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer – General discussion about applications of heat transfer.

Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady, and periodic heat transfer – Initial and boundary conditions

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders, and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius ofinsulation

UNIT – II:

One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity - systems with heat sources or Heat generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature **One Dimensional Transient Conduction Heat Transfer:** Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinitebody.

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 developingsemi–empiricalnon-dimensionalcorrelationforconvectionheattransfer–Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

UNIT – IV:

Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates andpipes.

Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT – V:

Heat Transfer with Phase Change:Boiling: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling. **Condensation:** Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empiricalcorrelations.

Radiation Heat Transfer : Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert,

Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

TEXT BOOKS

1. Heat and Mass Transfer – Dixit /Mc GrawHill
2. Heat and Mass Transfer / Altamush Siddiqui/Cengage

REFERENCE BOOKS

1. Essential Heat Transfer - Christopher A Long /Pearson
2. Heat Transfer –Ghoshdastida /Oxford

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

(Autonomous)

B.TECH. MECHANICAL ENGINEERING -R18

WORLD CLASS MANUFACTURING - B36OE4A

B.Tech. VI Semester. **L/T/P/C**

2//1/0/2

COURSE OBJECTIVES: To understand the concept of world class manufacturing, dynamics of material flow, OPT and Lean manufacturing.

COURSE OUTCOMES: Students should be able to compare the existing industry with WCM companies.

UNIT - I :

Information Age and Global Competitiveness: The Emergence of Information Age; Competition and Business Challenge; Operating Environment; Globalization and International Business; Global Competitiveness and Manufacturing Excellence; World Class Manufacturing and Information Age

Competition; Manufacturing Challenges, Problems in Manufacturing Industry.

UNIT – II:

Cutting Edge Technology: Value Added Engineer in - Hall's Framework; Schonberger's Framework of WCM; Gunn's Model; Maskell's Model. Philosophy of World Class Manufacturing: Evolution of WCM; Ohno's View on WCM; Principles and Practices; Quality in WCM; Deming's & Shingo's Approach to Quality Management; Culmination of WCM.

UNIT – III:

System and Tools for World Class Manufacturing: The Integration Imperative; Overview of Systems and Tools; Information Management Tools - Product and Process Design Tools, Bar Code Systems, Kanban: A Lean Production Tool, Statistical Quality Control (SQC), Material Processing, and Handling Tools; Assessment of Manufacturing Systems and Tools. Labor and HRD Practices in WCM: Human Resource Dimensions in WCM; Morale and Teamwork; High Employee Involvement; Cross Functional Teams; Work Study Methods; Human Integration Management.

UNIT – IV:

Competitive Indian Manufacturing: Manufacturing Performance and Competitiveness - Indian Firms: Manufacturing Objectives and Strategy; Usage of Management Tools and Technologies; Manufacturing Management Practices; IT Infrastructure and Practices; Strategic Intent Framework; Breadth and Integration of IT Infrastructure.

Globalization and World Class Manufacturing: Generic Manufacturing Strategies for Information Age; Planning Methodology and Issues in Strategic Planning of WCM; Performance Measurement - PO-P System, TOPP System and Ambite System.

UNIT – V:

The Future WCM: Manufacturing Strategy: Futile Search for an Elusive Link, Manufacturing Strategic Intent Classification, Translating Intent into Action. Case Studies: Accelerated Fermentation Process – Using World Class Enzymes; Birla Cellulosic Kharach.

TEXT BOOKS

1. World Class Manufacturing- A Strategic Perspective / BS Sahay, KBS Saxena& Ashish Kumar / Macmillan

2. Making Common Sense Common Practice – Models for Manufacturing Excellence / Ron Moore / Butter Worth Heinemann

REFERENCE BOOKS

1. Managing Technology and Innovation for Competitive Advantage / V. K. Narayanan/ Prentice Hall

2. World Class Manufacturing - The Lesson of Simplicity / Richard J Schonberger / Free Press

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

SCIENCE AND TECHNOLOGY OF NANO MATERIALS -B36OE4B

B.Tech. VI Semester. **L/T/P/C**

2/1/ 0/2

COURSE OBJECTIVES:

1. Beginners will be able to acquaint themselves with the excited subject though they arenovice, whereas advanced learners will equip themselves to solve the complicatedissues further.
2. To know the importances of the synthesis method addressed in the material properties and give practical experience of nanomaterials synthesis/properties andcharacterization; investigations into the various factors influence the properties ofnanomaterials, optimizing the procedures, and implementations to the new designs
3. To provide a sound understanding of the various concepts involved in fabrication ofdevice architectures' and able to evaluate them in advance

COURSE OUTCOME: The intended course covers the whole spectrum of nanomaterials rangingfrom introduction, classification, synthesis, properties, and characterization tools ofnanophase materials to application including some new developments in various aspects.

UNIT – I:

Introduction to Nano: Importance, Definition and scope, Nano size, challenges,applications. Electrons**,** Other Materials**,** Nano magnetism as a case study; Fundamental terms(Physics & Chemistry) in nano-science and technology; Feynman's perspective; Scaling lawspertaining to mechanics, optics, electromagnetism; Importance of Quantum mechanics,statistical mechanics and chemical kinetics in nano-science and technology;

UNIT – II:

Classification of nano materials: Scientific basis for top-down and bottom-up approaches tosynthesize Nanomaterials; How to characterize Nanomaterials.

UNIT – III:

Tools for Nanoscience and Technology: Tools for measuring properties of Nanostructures,Tools to Make Nanostructures. Nano scale Bio-structures, modelling

UNIT – IV:

Nano-Biotechnology: Bio-molecules; Biosensors; Nanomaterials in drug delivery; Workingin clean room environments; Safety and related aspects of Nanomaterials;

UNIT – V:

Carbon Nanomaterials and Applications: Carbon Nano structures and types of CarbonNano tubes, growth mechanisms of carbon nanotubes. Carbon clusters and Fullerenes,Lithium & Hydrogen adsorption & storages, Fuel cell applications and energy storage,Chemical Sensors applications of CNTs

TEXT BOOKS

1. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, BaldevRaj, B. B. Rath and James Murday, University Press-IIM Series in Metallurgy andMaterials Science.
2. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hilledition.

REFERENCES.

1. Nanotechnology Fundamentals and Applications- by ManasiKarkare I. KInternational.
2. Nanoscience and Nanotechnology in engineering – by Vijay K Varadan A Sivathanupillai Word scientific
3. Nanotechnology Applications To Telecommunications And Networking By DanielMinoli, Wiley Interscience
4. Nanotechnology Principles and Applications by Sulabha Kulkarni.

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

NUCLEAR POWER GENERATION AND SUPPLY - B36OE4C

B.Tech. VI Semester. **L/T/P/C**

2/1/0/2

COURSE OBJECTIVE: To introduce the students about the knowledge of nuclear power generation and supply, reactor design and nuclear power plant.

UNIT- I:

Introduction: Systems in nuclear reactor- Reactor fuels: Natural and enriched fuels, sources, merits and demerits of different fuels for reactor use, fabrication, handling of fuels and irradiated fuels, fuel management, storage, reprocessing of irradiated fuels. Reactor shutdown systems: Materials for reactor control and choices, liquid vs. solid shut down systems, design aspect- fall safe features, loading consideration, actuation methodology. Primary heat transport (cooling) system: Heat generation and distribution, Coolant characteristics, Selection of coolants, Coolant Circuit, Core thermal hydraulics, design aspects, radioactivity generation. Decay heat removal system: Functional requirements, cooling circuits, Design aspects, Loading considerations, Passive features.

UNIT- II:

Reactor structure: Core composition, Reflector, Reactor vessel, Safety vessel, Shielding. Thermal, biological, Shield cooling system, Neutron flux monitoring and control, instrumentations. Moderator system: Materials, Selection, Design consideration, Circuit, Radioactivity aspects. Cover gas system: Purpose, Selection of material, Design considerations, Circuit. Reactor regulating system: Purpose, Methodology, Design considerations, actuating mechanism. Auxiliary cooling circuit: Functions, Design considerations, cooling circuit. Containment and ventilation system: Functions, Types, Arrangement, Design considerations, loading, Testing.

UNIT- III :

ReactorDesign: Principles, Safety classifications, Seismic quality group, Loading considerations under normal operations, anticipated operational occurrences, design basis accidents such as earthquake, loss of coolant accident (LOCA),blackout, flood, missiles,

operator error, duel failures as applicable, Safety features for server accidents, standards, software, verifications etc.

UNIT- IV :

Nuclear power plants: Types .Thermal reactors: BWR, PWR, PHWR, GCR, APWR, AHWR etc. Fast reactors Breeders; Fusion power; Off-land NPPs:- space power unit, nuclear ships, submarines. Economics of NPPs: Various costs, ROI, Sizing, Operational characteristics.

UNIT- V :

Radiation protection and Radioactive Waste Management: Radiation hazard, Exposures, Exposure pathways, dose unit, measurement, and radiation protection. CRP and other guidance document etc. Radioactive Waste Management: Waste categorization, Generation, Handling of wastes, Liquid, gaseous and solid, Short term / long term storage / disposed.

Reactor Stages and Safety Assurances- Nuclear safety assurance.

TEXT BOOKS

1. P.K. Nag. Nuclear Power Plant, Power Plant Engg. (Steam & Nuclear)
2. A.K. Raja, A.P. Srivastava & M. Dwivedi, An Introduction on Nuclear Engineering,

REFERENCE BOOKS

1. Glasstone&Sesons- Nuclear Engineering
2. Arora &Domkundwar, A course in Power Plant Engg-

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

SOLAR ENERGY APPLIANCES - B36OE5A

B.Tech. VI Semester. **L/T/P/C**

3/1/0/3

COURSE OBJECTIVE:

1. To learn the fundamental concepts about solar energy systems and devices.
2. To study the performance of each system in detail along with practical case studies.
3. This course provides an elaborated study about solar energy devices, their working principles, materials and theories related to the same.

COURSE OUTCOME:

1. The fundamental concepts about solar energy systems and devices are incorporated.
2. The performance of the systems along with practical case studies were done.

UNIT I:

SOLAR LIGHTING- Solar cell – Working principle of a solar cell – Solar home lighting systems – Solar street lightingsystems - Solar lanterns – Applications - Rural electrification process – Case studies.

UNIT II:

SOLAR COOKING - Introduction – Types of solar cookers – Advantages and disadvantages - Box type – Parabolic dishcooker - Performance evaluation of solar cookers – Testing of a solar cooker Applications of solarcooking - Case studies.

UNIT III:

SOLAR DRYING - Introduction – Need for solar drying - Basics of solar drying – Types of solar dryers – Direct type solardryer – Mixed mode type solar dryer – Forced circulation type dryers – Hybrid dryer – Bin type dryer –Solar timber drying – Applications - Case studies.

UNIT IV:

SOLAR DESALINATION -Introduction – Necessity for desalination – Study on various desalination techniques – Comparisonbetween conventional and solar desalination – Basics of solar still - Simple solar still – Materialproblems in solar still – Solar disinfection and its methods – Case studies on various desalinationtechniques.

UNIT V:

SOLAR FURNACES -Introduction – Types of solar furnaces – Components of solar furnaces – Concentrator – Heliostat –Sun tracking – Typical solar furnace designs – Single concentrator furnace – Single heliostat solarfurnace - Multiple heliostats solar furnace - Case studies on solar furnaces.

REFERENCES

1. Suhatme and Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGrawHill, 2008.
2. HP Garg and J Prakash: Solar Energy: Fundamentals and Applications, Tata McGraw Hill, 2010.
3. Rai, G.D., Solar Energy Utilization, Khanna Publishers,Delhi, 2010.
4. Michael Grupp, Time to Shine: Applications of Solar Energy Technology, John Wiley & Sons,2012.
5. SM Sze, Kwok K Ng: Physics of semiconductor devices, third edition, John Wiley & Sons, 2007.
6. Daniel J. O'Connor, 101 patented solar energy uses,VanNostrand Reinhold Co., 2007.
7. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice- Hall, 2008.

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

(Autonomous)

B.TECH. MECHANICAL ENGINEERING -R18

RURAL TECHNOLOGY AND COMMUNITY DEVELOPMENT - B36OE5B

B.Tech. VI Semester. **L/T/P/C**

3/1/0/3

UNIT - I:

Data Analysis and Measures of Central Tendency- Meaning, nature, scope and limitations of statistics, collection of statistical data, classification, tabulation and diagrammatic representation of data, Measures of central tendency: Statistical averages Mean, Median, Mode.

UNIT - II:

Data, Information and Knowledge; concept of information, need of information (professional, educational, research), qualities of information, value of information, difference between data and information, properties of the needed information. Information and Management; planning, organizing, co-ordinating and controlling,

UNIT - III:

Concepts of marketing; difference between marketing selling and retailing; marketing mix, market-segmentation, marketing planning.Strategy and Approaches; modern concept of marketing.

UNIT - IV:

Community development; concept, definition, meaning, need, history, principles, objectives and scope. Community Building: Coming of Age, Regenerating Community, Community Model.

UNIT - V:

Consensus Organizing Model, What's Behind Building Healthy Communities.Participatory Democracy, The Role of various NGOs in Community Development.The Role of Business and Government in Community Development Initiatives How to Form a Non-profit Corporation Fund Raising and Grant Writing.

REFERENCE BOOKS

1. Rural Technology, (Paperback, Egnlish), by Punia Rd Roy, Publisher: Satya Prakashan (2009)
2. Rural Education And Technology, by S B Verma S K JilokaKannaki Das, Publisher: Deep & Deep Publications Pvt. Ltd. (2006)
3. Edwards, Allen David and Dorothy G. Jones. 1976. Community and Community Development. The Hague, Netherlands: Mouton.
4. Sustainable Rural Technology, by M.S. Virdi, Daya Publishing House, ISBN: 8170355656.

T K R COLLEGE OF ENGINEERING &TECHNOLOGY

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B.TECH. MECHANICAL ENGINEERING -R18

THEORY OF COMBUSTION AND EMISSION - B36OE5C

B.Tech. VI Semester. **L/T/P/C**

3/1/0/3

UNIT - I:

Combustion Principles- Combustion - Combustion equations, heat of combustion - Theoretical flame temperature, Chemical equilibrium and dissociation - Theories of Combustion - Pre-flame reactions, Reaction rates-Laminar and Turbulent, Flame Propagation in Engines.

UNIT - II:

Combustion in SI Engine- Initiation of combustion, stages of .combustion, normal and abnormal combustion, knocking combustion, pre-ignition, knock and engine variables, features and design consideration of combustion chambers.- Flame structure and speed, Cycle by cycle variations, Lean burn combustion, stratified charge combustion systems. Heat release correlations. After treatment devices for SI engines.

UNIT - III:

Combustion in CI Engine- Stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl measurement, knock and engine variables, features and design considerations of combustion chambers- delay period correlations, heat release correlations, and influence of the injection system on combustion. Direct and indirect injection systems. After treatment devices for diesel engines.

UNIT - IV:

Combustion in Gas Turbines- Flame stability, re-circulation zone and requirements – Combustion chamber configuration, materials.

UNIT - V:

Emissions- Main pollutants in engines, Kinetics of NO formation, NOx formation in SI and CI engines. Unburned-hydrocarbons, sources, formation in SI and CI engines, Soot formation

and oxidation, Particulates in diesel engines, Emission control measures for SI and CI engines, Effect of emissions on Environment and human beings.

REFERENCE BOOKS

1. V .Ganesan, Internal Combustion Engines, Tata McGraw Hill Book Co.

2. John B. Heywood, Internal Combustion Engine Fundamentals. Tata McGraw Hill New Delhi

3. Mathur, M. L, and Sharma. R. P., A Course in Internal Combustion Engines, Dhanpat Rai-Publications New Delhi

4. Obert, E. F., Internal Combustion Engine and Air Pollution, International Text Book Publishers.

5. K.K. Ramalingam, Internal Combustion Engines, Scitech Publications (India) Pvt. Ltd.

6. Cohen, H, Rogers, G. E. C, and Saravanamuttoo, H. I. H., Gas Turbine Theory, Longmans

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B.TECH. MECHANICAL ENGINEERING -R18

HEAT TRANSFER LAB - B36PC6

B.Tech. VI Semester. **L/T/P/C**

0/0/3/1.5

PRE-REQUISITE: Thermodynamics

COURSE OBJECTIVES: To enable the student to apply conduction, convection and radiation heat transfer concepts to practical applications.

COURSE OUTCOME: At the end of the lab sessions, the student will be able to

1. Perform steady state conduction experiments to estimate thermal conductivity of different materials
2. Perform transient heat conduction experiment
3. Estimate heat transfer coefficients in forced convection, free convection , condensation and correlate with theoreticalvalues
4. Obtain variation of temperature along the length of the pin fin under forced and free convection
5. Perform radiation experiments: Determine surface emissivity of a test plate and Stefan- Boltzmann's constant and compare with theoretical value

Minimum twelve experiments from the following:

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer inpin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Film and Drop wise condensation apparatus.

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B.TECH. MECHANICAL ENGINEERING -R18

PRODUCTION DRAWING PRACTICE AND INSTRUMENTATION LAB - B36PC7

B.Tech. VI Semester. **L/T/P/C**

0/0/3/ 1.5

PRE – REQUISITES: Engineering Drawing, Machine Drawing, Metrology.

COURSE OBJECTIVES:

1. Understanding of conventional representations of various materials and machine components.
2. Understanding limits, fits and tolerances and their representation in drawings.
3. Understanding the process of calibration of various instruments.

COURSE OUTCOMES: After completion of this course, the average student is expected to be able to:

1. Understand and prepare the drawing used in manufacturing process.
2. Calibrate the pressure, Strain and displacement measuring instruments.
3. Use the magnetic & speed pickups for the speed measurement.
4. Calibrate of flow measurement by rotameter.
5. Calibrate different instruments used for temperature measurement.

(A) PRODUCTION DRAWING PRACTICE

UNIT – I:

CONVENTIONAL REPRESENTATION OF MATERIALS: conventional representation of parts – screw joints, welded joints, springs, gears, electrical, hydraulic and pneumatic circuits – methods of indicating notes on drawings. **Limits, Fits and Tolerances:** Types of fits, exercises involving selection / interpretation of fits and estimation of limits from tables.

UNIT – II:

FORM AND POSITIONAL TOLERANCES: Introduction and indication of form and position tolerances on drawings, types of run out, total run out and their indication.

UNIT – III:

SURFACE ROUGHNESS AND ITS INDICATION: Definition, types of surface roughness indication – Surface roughness obtainable from various manufacturing processes, recommended surface roughness on mechanical components. Heat treatment and surface treatment symbols used on drawings.

UNIT – IV:

DETAILED AND PART DRAWINGS: Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors etc.

UNIT – V:

PRODUCTION DRAWING PRACTICE: Part drawings using computer aided drafting by CAD software.

TEXT BOOKS

1. Production and Drawing /K.L. Narayana & P. Kannaiah/ New Age.
2. Machine Drawing with Auto CAD/ Pohit and Ghosh, PE.

REFERENCES

1. Geometric dimensioning and tolerancing/James D. Meadows/ B.S Publications.
2. Engineering Metrology/ R.K. Jain/Khanna Publications.

(B) INSTRUMENTATION 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 temperature 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.

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B.TECH. MECHANICAL ENGINEERING -R18

ADVANCED COMMUNICATIONS SKILLS LAB - BE23

B.Tech.VISemester. **L/T/P/C**

0/ 0/3/1.5

COURSE OBJECTIVES: This Lab focuses on using multi-media instruction for language development to meet the following targets:

1. To improve students' fluency in spokenEnglish
2. To enable them to listen to English spoken at normal conversationalspeed
3. To help students develop theirvocabulary
4. To read and comprehend texts in differentcontexts
5. To communicate their ideas relevantly and coherently inwriting
6. To make studentsindustry-ready
7. To help students acquire behavioral skills for their personal and professionallife
8. To respond appropriately in different socio-cultural and professionalcontexts

COURSE OUTCOMES: Students will be able to:

1. Acquire vocabulary and use itcontextually
2. Listen and speakeffectively
3. Develop proficiency in academic reading andwriting
4. Increase possibilities of jobprospects
5. Communicate confidently in formal and informalcontexts

Syllabus

The following course activities will be conducted as part of the Advanced English Communication Skills (AECS) Lab:

1. **Inter-personal Communication and Building Vocabulary** - Starting a Conversation – Responding Appropriately and Relevantly – Using Appropriate Body Language – Role Play in Different Situations - Synonyms and Antonyms, One-word Substitutes, Prefixes and Suffixes, Idioms and Phrases and

Collocations.

2. **Reading Comprehension** –General Vs Local Comprehension, Reading for Facts, Guessing Meanings from Context, , Skimming, Scanning, Inferring Meaning.
3. **Writing Skills** – Structure and Presentation of Different Types of Writing – Letter Writing/Resume Writing/ e-correspondence/ Technical Report Writing.
4. **Presentation Skills** – Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs and Written Presentations through Posters/Projects/Reports/ e-mails/Assignments…etc.,
5. **Group Discussion and Interview Skills** – Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas and Rubrics of Evaluation- Concept and Process,
6. Pre-interview Planning, Opening Strategies, Answering Strategies, Interview through Tele-conference & Video-conference and Mock Interviews.

Minimum Hardware Requirement

Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- **Spacious room with appropriate eacoustics**
- **Eight round tables with five movable chairs for each table.**
- **Audio-visual aids**
- **LCD Projector**
- **Public Address system**
- **Computer with suitable configuration**

Suggested Software: The software consisting of the prescribed topics elaborated above should be procured andused.

- **Oxford Advanced Learner's Compass**, 8thEdition
- **DELTA's key to the Next Generation TOEFL Test: AdvancedSkill Practice.**

REFERENCES

1. Kumar, Sanjay and PushpLata. English for Effective Communication, Oxford University Press,2015.
2. Konar, Nira. English Language Laboratories – A Comprehensive Manual, PHI Learning Pvt. Ltd.,2011.