

GODAVARI INSTITUTE OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

COURSE STRUCTURE

B. Tech. Mechanical Engineering

III Year

I Semester

S. No.	Subject Title	Periods per week			C	Scheme of Examination Maximum Marks		
		T	P	D		Int.	Ext.	Total
1.	Dynamics of Machinery	4	-	-	3	30	70	100
2.	Operations Research	4	-	-	3	30	70	100
3.	Design of Machine Members-I	4	-	-	3	30	70	100
4.	Instrumentation & Control Systems	4	-	-	3	30	70	100
5.	Thermal Engineering -II	4	-	-	3	30	70	100
6.	Metal Cutting & Machine Tools	4	-	-	3	30	70	100
7.	Machine Tools Lab.	-	3	-	2	50	50	100
8.	Thermal Engineering Lab.	-	3	-	2	50	50	100
9.	Mini Project*	-	-	-	2	100	-	100
Total		24	6	-	24	-	-	900

T- THEORY P – PRACTICAL D- DRAWING C – CREDITS Int. – INTERNAL Ext. - EXTERNAL

* Student should carry **Mini Project** during summer vacation after II B.Tech. II Sem. Course work and it will be evaluated during III B.Tech. I Sem.

III Year**II Semester**

S. No	Subject Title	Periods per week			C	Scheme of Examination Maximum Marks		
		T	P	D		Int.	Ext.	Total
1.	Metrology	4	-	-	3	30	70	100
2.	Interactive Computer Graphics	4	-	-	3	30	70	100
3.	Design of Machine Members– II	4	-	-	3	30	70	100
4.	Robotics	4	-	-	3	30	70	100
5.	Heat Transfer	4	-	-	3	30	70	100
6.	Departmental Elective – I	4	-	-	3	30	70	100
7.	Heat Transfer Lab.	-	3	-	2	50	50	100
8.	Metrology & Instrumentation Lab.	-	3	-	2	50	50	100
9.	Soft Skills - 2	4	-	-	-	-	-	-
Total		28	6	-	22	-	-	800

T- THEORY P – PRACTICAL D- DRAWING C – CREDITS Int. – INTERNAL Ext. - EXTERNAL

III Year B.Tech. (ME) – I Sem.

4-0-0-3

DYNAMICS OF MACHINERY

Course Objectives:

1. To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.
2. Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses.
3. Develop understanding of vibrations and its significance on engineering design.
4. Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments.

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.

UNIT – II

FRICTION: Inclined plane, friction of screw and nuts, pivot and collar, uniform pressure, uniform wear, friction circle and friction axis: lubricated surfaces, boundary friction, film lubrication.

CLUTCHES: Friction clutches- single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch.

BRAKES AND DYNAMOMETERS: Simple block brakes, internal expanding brake, band brake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission,

UNIT – III

TURNING MOMENT DIAGRAMS: Dynamic force analysis of slider crank mechanism, inertia torque, angular velocity and acceleration of connecting rod, crank effort and turning moment diagrams – fluctuation of energy – fly wheels and their design.

UNIT-IV

GOVERNERS: Watt, porter and proell governors, spring loaded governors– Hartnell and Hartung with auxiliary springs. sensitiveness, isochronism and hunting.

UNIT – V

BALANCING: Balancing of rotating masses single and multiple – single and different planes, use of analytical and graphical methods. Primary, secondary, and higher balancing of reciprocating masses. analytical and graphical methods, unbalanced forces and couples – examination of “V” multi cylinder in line and radial engines for primary and secondary balancing, locomotive balancing, hammer blow, swaying couple, variation of tractive effort.

UNIT – VI

VIBRATIONS: Free Vibration of spring mass system – oscillation of pendulums, centers of oscillation and suspension, transverse loads, vibrations of beams with concentrated and distributed loads. Dunkerly’s methods, Raleigh’s method, whirling of shafts, critical speeds, torsional vibrations, two and three rotor systems. Introduction to damped and forced vibrations.

TEXT BOOKS :

1. Theory of Machines / S.S Ratan/ Mc. Graw Hill Publ.
2. Mechanism and machine theory by Ashok G. Ambedkar, PHI Publications.

REFERENCES :

1. Mechanism and Machine Theory / JS Rao and RV Dukkupati / NewAge.
2. Theory of Machines / Shiegly / MGH
3. Theory of Machines / Thomas Bevan / CBS Publishers
4. Theory of machines / Khurmi / S.Chand.

Course outcomes:

Upon successful completion of this course the student should be able to:

1. Analyze stabilization of sea vehicles, aircrafts and automobile vehicles.
2. Compute frictional losses, torque transmission of mechanical systems.
3. Analyze dynamic force analysis of slider crank mechanism and design of flywheel.
4. Understand how to determine the natural frequencies of continuous systems starting from the general equation of displacement.
5. Understand balancing of reciprocating and rotary masses..

Useful Web-links : <http://nptel.ac.in/courses.php>

<http://mit.espe.edu.ec/courses/mechanical-engineering/>

III Year B.Tech. (ME) – I Sem.

4-0-0-3

OPERATIONS RESEARCH

Course Objectives:

To learn the importance of Operations Research in the design, planning, scheduling, manufacturing and business applications and to use the various techniques of Operations Research in solving such problems.

UNIT – I

Development – definition– characteristics and phases – types of operation research models – applications.

ALLOCATION: Linear programming problem formulation – graphical solution – simplex method – artificial variables techniques -two–phase method, big-M method – duality principle.

UNIT – II

TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – degeneracy, assignment problem – formulation – optimal solution - variants of assignment problem- traveling salesman problem.

SEQUENCING – Introduction – flow –shop sequencing – n jobs through two machines – n jobs through three machines – job shop sequencing – two jobs through ‘m’ machines.

UNIT – III

REPLACEMENT: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

UNIT – IV

THEORY OF GAMES: Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

WAITING LINES: Introduction – single channel – poisson arrivals – exponential service times – with infinite population and finite population models– multichannel – poisson arrivals – exponential service times with infinite population single channel poisson arrivals.

UNIT – V

INVENTORY : Introduction – single item – deterministic models – purchase inventory models with one price break and multiple price breaks – shortages are not allowed – stochastic models – demand may be discrete variable or continuous variable – instantaneous production. Instantaneous demand and continuous demand and no set up cost. ABC & VED Analysis.

UNIT – VI

DYNAMIC PROGRAMMING: Introduction – Bellman’s principle of optimality – applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.

SIMULATION: Definition – types of simulation models – phases of simulation– applications of simulation – inventory and queuing problems – advantages and disadvantages – simulation languages.

TEXT BOOKS:

1. Operations Research / S.D.Sharma-Kedarnath

REFERENCES:

1. Introduction to O.R/Hiller & Libermann (TMH).
2. Operations Research / A.M.Natarajan, P. Balasubramani, A.Tamilarasi / Pearson Education.
3. Operations Research: Methods & Problems / Maurice Saseini, Arhur Yaspan & Lawrence Friedman.
4. Operations Research / R.Pannerselvam, PHI Publications.

Course Outcomes:

After completion of the course, the student will be able to: To solve the LP and DP problems. To solve the Transportation, assignment, game, inventory, replacement, sequencing, queuing problems

III Year B.Tech. (ME) – I Sem.

4-0-0-3

DESIGN OF MACHINE MEMBERS-1**Course Objectives:**

1. The student shall gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity
2. Selection of proper materials to different machine elements based on their physical and mechanical properties.
3. Learn and understanding of the different types of failure modes and criteria.
4. Procedure for the different machine elements such as fasteners, shafts, couplings, keys, axially loaded joints etc.

UNIT – I

INTRODUCTION: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design, tolerances and fits –BIS codes of steels.

STRESSES IN MACHINE MEMBERS: 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 combined situations – static strength design based on fracture toughness.

UNIT – II

STRENGTH OF MACHINE ELEMENTS: Stress concentration – theoretical stress concentration factor – fatigue stress concentration factor notch sensitivity – design for fluctuating stresses – endurance limit – estimation of endurance strength – Good man’s line – Soderberg’s line – modified Good man’s line.

UNIT – III

RIVETED AND WELDED JOINTS – Design of joints with initial stresses – eccentric loading.

BOLTED JOINTS – Design of bolts with pre-stresses – design of joints under eccentric loading – locking devices – both of uniform strength, different seals.

UNIT – IV

KEYS, COTTERS AND KNUCKLE JOINTS: Design of keys-stresses in keys-cotter joints- spigot and socket, sleeve and cotter, jib and cotter joints- knuckle joints.

SHAFT COUPLING: Rigid couplings – muff, split muff and flange couplings, flexible couplings – flange coupling (modified).

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).

UNIT – VI

MECHANICAL SPRINGS:

Stresses and deflections of helical springs – extension -compression springs – springs for fatigue loading, energy storage capacity – helical torsion springs – co-axial springs, leaf springs.

TEXT BOOKS:

1. Machine Design, V.Bandari, TMH Publishers
2. Machine design – Pandya & Shah
3. Machine Design PSG Data hand book

REFERENCES:

1. Design of Machine Elements / V.M. Faires
2. Machine design / Schaum Series.
3. Data books (1) PSG College of technology (2) Mahadevan

Course outcomes:

Upon successful completion of this course student should be able to:

1. Apply the design procedure to engineering problems, including the consideration of technical and manufacturing constraints.
2. Select suitable materials and significance of tolerances and fits in critical design applications.
3. Utilize design data hand book and design the elements for strength, stiffness and fatigue.
4. Identify the loads, the machine members subjected and calculate static and dynamic stresses and ensure safe design

INSTRUMENTATION & CONTROL SYSTEM**Course Objectives:**

The course focuses on imparting the principles of measurement which includes the working mechanism of various sensors and devices, that are in use to measure the important physical variables of various mechatronic systems.

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 – capacitive, 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, noncontact type of tachometer

Measurement of Acceleration and Vibration: Different simple instruments– principles of seismic instruments – vibrometer and accelerometer using this principle.

UNIT – IV

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.

UNIT – VI

ELEMENTS OF CONTROL SYSTEMS: Introduction, importance – classification – open and closed systems, servomechanisms–examples with block diagrams–temperature, speed & position control systems.

TEXT BOOKS:

1. Measurement Systems: Applications & design by D.S Kumar.
2. Mechanical Measurements / BeckWith, Marangoni,Linehard, PHI / PE.

REFERENCES:

1. Measurement systems: Application and design, Doebelin Earnest. O.Adaptation by Manik and Dhanesh/ TMH.
2. Experimental Methods for Engineers / Holman.
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Instrumentation, measurement & analysis by B.C.Nakra & K.K.Choudhary, TMH.

Course outcomes:

After undergoing the course the student can select appropriate device for the measurement of parameters like temperature, pressure, speed, stress, humidity, flow velocity etc., and justify its use through characteristics and performance.

III Year B.Tech. (ME) – I Sem.

4-0-0-3

THERMAL ENGINEERING -II

(Use of steam tables and Mollier chart is allowed)

Course objectives:

This course is intended to provide basic knowledge of components being used in steam and gas power plant cycles and to analyze the energy transfers and transformations in these components including individual performance evaluation.

UNIT – I

BASIC CONCEPTS: Rankine cycle - schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance – regeneration & reheating. combustion: fuels and combustion, concepts of heat of reaction, adiabatic flame temperature, stoichiometry, flue gas analysis.

UNIT II

BOILERS : Classification – working principles of water tube and fire tube boilers with sketches – mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance – draught, classification – height and diameter of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced.

UNIT – III

STEAM NOZZLES: Function of a nozzle – applications - types, flow through nozzles, thermodynamic analysis – assumptions -velocity of fluid at nozzle exit-Ideal and actual expansion in a 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 - Wilson line.

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 - methods to reduce rotor speed-velocity compounding, pressure compounding and velocity & pressure compounding, velocity and pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine, condition for maximum efficiency.

UNIT IV

REACTION TURBINE: Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson’s reaction turbine – condition for maximum efficiency – calculation of blade height.

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 water requirement.

UNIT – V

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, types of combustion chambers.

UNIT – VI

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 and demands met by turbo jet – schematic diagram, thermodynamic cycle, performance evaluation, thrust augmentation – methods.

Rockets : Application – working principle – classification – propellant type – thrust, propulsive efficiency – specific impulse – solid and liquid propellant rocket engines.

TEXT BOOKS:

1. Thermodynamics and Heat Engines, Volume 2 - R.Yadav- Central book depot.
2. Gas Turbines – V.Ganesan /TMH
3. Heat Engineering – V.P Vasandani and D.S Kumar- Metropolitan Book Company, New Delhi

REFERENCES:

1. Gas Turbines and Propulsive Systems – P.Khajuria & S.P.Dubey -/Dhanpatrai
2. Gas Turbines / Cohen, Rogers and Saravana Muttu / Addison Wesley– Longman
- 3 Thermal Engineering-R.S Khurmi/JS Gupta/S.Chand.
4. Thermal Engineering-P.L.Bellaney/ Khanna publishers.
5. Thermal Engineering-M.L.Marthur & Mehta/Jain bros

Course outcomes:

After undergoing this course the student is expected to understand the working of steam and gas power plant cycles and also should be able to analyze and evaluate the performance of individual components. The student also should be in a position to understand basic principles of Jet propulsion and rocket engineering.

III Year B.Tech. (ME) – I Sem.

4-0-0-3

METAL CUTTING & MACHINE TOOLS

Course objectives:

1. The course provides students with fundamental knowledge and principles in material removal processes.
2. In this course, the students apply the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, and drill presses, Computer Numerical Control etc.
3. To demonstrate the fundamentals of machining processes and machine tools.
4. To develop knowledge and importance of metal cutting parameters.
5. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
6. To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

UNIT – I

FUNDAMENTALS OF MACHINING:

Elementary treatment of metal cutting theory – element of cutting process – geometry of single point tool 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, metal removal rate, tool life, Heat generation in metal cutting, coolants, tool materials.

UNIT –II

LATHE MACHINES:

Engine lathe – principle of working, specification of lathe – types of lathe – work holders tool holders – box tools taper turning, thread turning – for lathes and attachments, constructional features of speed gear box and feed gear box. 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 – tool layout and cam design for automats.

UNIT – III

SHAPING, SLOTTING AND PLANING MACHINES: Principles of working – principal parts – specifications, operations performed, machining time calculations.

DRILLING & 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 – classification of milling Machines – Principle features of horizontal, vertical and universal milling Machine, machining operations, types of cutters, and geometry of milling cutters – methods of indexing, accessories to milling machines.

UNIT –V

FINISHING PROCESSES: Theory of grinding – classification of grinding machines, cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, bonds, specification and selection of a grinding wheel. Lapping, Honing & Broaching operations, comparison to grinding.

UNIT - VI

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

INTRODUCTION TO CNC MACHINES: Working principle and classification.

TEXT BOOKS:

1. Production Technology by R.K. Jain and S.C. Gupta.
2. Workshop Technology – B.S.Raghu Vamshi – Vol II

REFERENCES:

1. Metal cutting Principles by M.C. Shaw
2. Metal cutting and machine tools by Boothroyd
3. Production Technology by H.M.T. (Hindustan Machine Tools).
4. Production Engineering, K.C Jain & A.K Chitaley, PHI Publishers.
5. Manufacturing technology II, P.N Rao
6. Technology of machine tools, S.F.Krar, A.R. Gill, Peter SMID, TMH (I)

Course Outcomes:

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

- 1) Apply cutting mechanics to metal machining based on cutting force and power consumption.
- 2) Operate lathe, milling machines, drill press, grinding machines, etc.
- 3) Select cutting tool materials and tool geometries for different metals.
- 4) Select appropriate machining processes and conditions for different metals.
- 5) Learn machine tool structures and machining economics.
- 6) Write simple CNC programs and conduct CNC machining.

III Year B.Tech. (ME) – I Sem.

0-3-0-2

THERMAL ENGINEERING LAB

Objective: To impart practical exposure to the student on the performance evaluation methods of various types of internal combustion engines and compressors.

1. I.C. Engines valve / port timing diagrams.
2. I.C. Engines performance test (4 -stroke diesel engines)
3. I.C. Engines performance test on 2-stroke petrol.
4. Evaluation of engine friction by conducting morse test on 4-stroke multi cylinder petrol engine.
5. Determination of FHP by retardation and motoring test on IC engine.
6. I.C. Engines heat balance.
7. Economical speed test of an IC engine.
8. Performance test on variable compression ratio engines.
9. Performance test on reciprocating air compressor unit.
10. Study of boilers
11. Dis-assembly / assembly of Engines.
12. Find out properties of fuel (Flash point, Fire point, Viscosity, Calorific value etc).
13. Determine COP of Refrigeration test rig.
14. Determine COP and tonnage capacity of Air conditioning test rig.

Outcomes:

The student will be able to calculate the various efficiencies, various horse powers and energy balance for several types of Internal Combustions Engines and compressors.

III Year B.Tech. (ME) – I Sem.

0-3-0-2

MACHINE TOOLS LAB**Course objectives:**

The students are required to understand the parts of various machine tools and operate them. They are required to understand the different shapes of products that can be produced on these machine tools.

1. Introduction of general purpose machines -lathe, drilling machine, milling machine, shaper, planing machine, slotting machine, cylindrical grinder, surface grinder and tool and cutter grinder.
2. Step turning and taper turning on lathe machine
3. Thread cutting and knurling on -lathe machine.
4. Drilling and tapping
5. Shaping and planing
6. Slotting
7. Milling
8. Cylindrical surface grinding
9. Grinding of tool angles.

Course outcomes:

The students can operate different machine tools with understanding of work holders and operating principles to produce different part features to the desired quality.

METROLOGY

Course objectives:

The students will learn

1. Inspection of engineering parts with various precision instruments.
2. Design of part, tolerances and fits.
3. Principles of measuring instruments and gauges and their uses.
4. Evaluation and inspection of surface roughness.
5. Inspection of spur gear and thread elements.
6. Machine tool testing to evaluate machine tool quality.

UNIT-I

SYSTEMS OF LIMITS AND FITS: Introduction, nominal size, limits, tolerances, deviations, fits -Unilateral and bilateral tolerance system, hole and shaft basis systems- interchangeability, deterministic & statistical tolerancing, selective assembly. International standard system of tolerances, selection of limits and tolerances for correct functioning.

UNIT-II

LINEAR MEASUREMENT: Length standards, end standards, slip gauges- calibration of the slip gauges, dial indicators, micrometers.

MEASUREMENT OF ANGLES AND TAPERS:

Different methods – bevel protractor, angle slip gauges- angle dekkor- spirit levels- sine bar- sine table, rollers and spheres used to measure angles and 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: Tools maker's microscope and uses - autocollimators, optical projector, optical flats and their uses.

INTERFEROMETRY:

Interference of light, Michaleson's interferometer, NPL flatness interferometer, and NPL gauge interferometer.

UNIT-IV

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness –Numerical assessment of surface finish-CLA, Rt., R.M.S. Rz, R10 values, Method of measurement of surface finish – Profilograph, Talysurf, ISI symbols for indication of surface finish.

COMPARATORS: Types - mechanical, optical, electrical and electronic, pneumatic comparators and their uses.

UNIT – V

GEAR MEASUREMENT: Nomenclature of gear tooth, tooth thickness measurement with gear tooth vernier & flange micro meter, pitch measurement, total composite error and tooth to tooth composite errors, rolling gear tester, involute profile checking.

SCREW THREAD MEASUREMENT: Elements of measurement – errors in screw threads- concept of virtual effective diameter, measurement of effective diameter, angle of thread and thread pitch, and profile thread gauges.

UNIT – VI

FLATNESS MEASUREMENT:

Measurement of flatness of surfaces- instruments used- straight edges- surface plates – auto collimator.

MACHINE TOOL ALIGNMENT TESTS: Principles of machine tool alignment testing on lathe, drilling and milling machines.

TEXT BOOKS:

1. Engineering Metrology by R.K.Jain / Khanna Publishers
2. Engineering Metrology by Mahajan / Dhanpat Rai Publishers

REFERENCE BOOKS:

1. Dimensional Metrology, Connie Dotson, Cengage Learning.
2. Engineering Metrology by I.C.Gupta / Dhanpat Rai Publishers.
3. Precision Engineering in Manufacturing by R.L.Murthy / New Age.
4. Engineering Metrology and Measurements by NV Raghavendra, L Krishna murthy, Oxford publishers.
5. Engineering Metrology by KL Narayana, Scitech publishers.

Course outcomes:

Students will be able to design tolerances and fits for selected product quality. They can choose appropriate method and instruments for inspection of various gear elements and thread elements. They can understand the standards of length, angles, they can understand the evaluation of surface finish and measure the parts with various comparators. The quality of the machine tool with alignment test can be evaluated by them.

INTERACTIVE COMPUTER GRAPHICS

Course objectives:

This course allows the students to:

1. Understand the fundamental concepts and theory of computer graphics.
2. Understand modeling, and interactive control of 3D computer graphics applications.
3. The underlying parametric surface concepts be understood.
4. Learn multimedia authoring tools.

UNIT-I

INTRODUCTION: Application areas of computer graphics, overview of graphic system, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices.

UNIT-II

OUTPUT PRIMITIVES: Points and lines, line drawing algorithms, mid- point circle algorithm,

Filled area primitives: scan-line polygon fill algorithm, boundary-fill and flood-fill algorithm.

2-D GEOMETRICAL TRANSFORMATIONS: Translation, scaling, rotation, reflection and shear transformation matrix representations and homogeneous co-ordinates, composite transformations, transformations between coordinates.

UNIT –III

2-D VIEWING : The viewing pipe-line, viewing coordinate reference frame, window to view-port co-ordinate transformations, viewing function, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland- Hodgeman polygon clipping algorithm.

UNIT –IV

3-D OBJECT REPRESENTATION: spline representation, Hermite curve, Bezier curve and B-spline curve, Polygon surfaces, quadric surfaces, Solid modeling Scalars – wire frame, CSG, B-rep. Bezier and B-spline surfaces, Basic illumination models, shading algorithms.

UNIT –V

3-D GEOMETRIC TRANSFORMATIONS: Translation, rotation, scaling, reflection and shear transformation and composite transformations. Visible surface detection methods: Classification, back-face detection, depth-buffer, scan-line, depth sorting.

UNIT-VI

COMPUTER ANIMATION: Design of animation sequence, general computer animation functions, raster animation, computer animation language, key frame system, motion specification.

TEXT BOOKS:

1. “Computer Graphics C version” Donald Hearn and M. Pauline Baker, Pearson/PHI
2. “Computer Graphics Principles & practice”, second edition in C, Foley, VanDam, Feiner and Hughes, Pearson Education.

REFERENCES:

1. “Computer Graphics Second edition”, Zhigand xiang, Roy Plastock, Schaum’s outlines, Tata Mc-Graw hill edition.
2. Procedural elements for Computer Graphics, David F Rogers, Tata Mc Graw hill, 2nd edition.
3. “Principles of Interactive Computer Graphics”, Neuman and Sproul, TMH.
4. Computer Graphics, Steven Harrington, TMH.

Course outcomes:

Upon successful completion of the course, students will be able to:

1. Use the principles and commonly used paradigms and techniques of computer graphics.
2. Write basic graphics application programs including animation.
3. Design programs to display graphic images to given specifications.
4. Possess in-depth knowledge of display systems, image synthesis, shape modeling, and interactive control of 3D computer graphics applications.

DESIGN OF MACHINE MEMBERS-II
(Design Data Book Allowed)

Course Objectives:

- This course gives the insight of slider and roller bearings and the life prediction.
- Learn to design I.C engine parts.
- Design the mechanical systems for power transmission elements such as gears, belts, ropes, chains, keys and levers.

UNIT – I

BEARINGS: Classification of bearings- applications, types of journal bearings – lubrication – bearing modulus – full and partial bearings – clearance ratio – heat dissipation of bearings, bearing materials – journal bearing design – ball and roller bearings – static loading of ball & roller bearings, bearing life.

UNIT – II

DESIGN OF ENGINE PARTS: Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends – cranks and crank shafts, strength and proportions of over hung and center cranks – crank pins, crank shafts.

Pistons, forces acting on piston – construction design and proportions of piston, cylinder, cylinder liners.

UNIT –III

DESIGN OF CURVED BEAMS: introduction, stresses in curved beams, expression for radius of neutral axis for rectangular, circular, trapezoidal and t-section, design of crane hooks, c –clamps.

UNIT – IV

POWER TRANSMISSIONS SYSTEMS, PULLEYS: 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

DESIGN OF POWER SCREWS: Design of screw, square ACME, buttress screws, design of nut, compound screw, difference screw, ball screw – possible failures.

UNIT – V

SPUR & HELICAL GEAR DRIVES: Spur gears- helical gears – load concentration factor – dynamic load factor, surface compressive strength – bending strength – design analysis of spur gears – estimation of centre distance, module and face width, check for plastic deformation, check for dynamic and wear considerations.

UNIT – VI

MACHINE TOOL ELEMENTS: Levers and brackets: design of levers – hand levers-foot lever – cranked lever – lever of a lever loaded safety valve- rocker arm straight – angular- design of a crank pin – brackets- hangers- wall boxes.

TEXT BOOKS:

1. Machine Design, V.Bandari, TMH Publishers
2. Machine Design, Pandya & Shaw, Charotar publishers

REFERENCES:

1. Machine Design / R.N. Norton
2. Data Books : (I) P.S.G. College of Technology (ii) Mahadevan
3. Mech. Engg. Design / JE Shigley

Course outcomes:

At the end of the course

1. The student will able to select the suitable bearing based on the application of the loads and predict the life of the bearing.
2. Design power transmission elements such as gears, belts, chains, pulleys, ropes, levers and power screws.
3. Design of IC Engines parts.

III Year B.Tech. (ME) – II Sem.

4-0-0-3

ROBOTICS**Course Objectives:**

1. To give students practice in applying their knowledge of mathematics, science, and Engineering and to expand this knowledge into the vast area of robotics.
2. The students will be exposed to the concepts of robot kinematics, Dynamics, Trajectory planning.
3. Mathematical approach to explain how the robotic arm motion can be described.
4. The students will understand the functioning of sensors and actuators.

UNIT-I

INTRODUCTION: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system.

UNIT – II

COMPONENTS OF THE INDUSTRIAL ROBOTICS: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

UNIT – III

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation – problems.

MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

UNIT – IV

Differential transformation and manipulators, Jacobians – problems, Dynamics: Lagrange – Euler and Newton – Euler formulations – Problems.

UNIT - V

General considerations in path description and generation. Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages-description of paths with a robot programming language.

UNIT – VI

ROBOT ACTUATORS AND FEED BACK COMPONENTS:

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors.

Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

ROBOT APPLICATIONS IN MANUFACTURING: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K & Nagrath I J / TMH.

REFERENCES:

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall.
3. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter- Science.
4. Introduction to Robotics / John J Craig / Pearson Edu.

Course outcomes:

Upon successful completion of this course you should be able to:

1. Identify various robot configuration and components.
2. Select appropriate actuators and sensors for a robot based on specific application.
3. Carry out kinematic and dynamic analysis for simple serial kinematic chains.
4. Perform trajectory planning for a manipulator by avoiding obstacles.

HEAT TRANSFER
(Heat transfer data book allowed)

Course Objectives:

This course is intended to impart knowledge of principles of heat transfer and analyze the heat exchange process in various modes for the evaluation of rate of heat transfer and the temperature distribution in different configurations.

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. Steady, unsteady and periodic heat transfer – initial and boundary conditions.

ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER: Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – critical radius of insulation- Variable thermal conductivity – systems with heat sources or heat generation.

UNIT – II

ONE DIMENSIONAL TRANSIENT CONDUCTION HEAT TRANSFER: Systems with negligible internal resistance – significance of biot and fourier numbers - chart solutions of transient conduction systems. Extended surface (fins) heat Transfer – long fin, fin with insulated tip and short fin, application to error measurement of temperature

UNIT – III

CONVECTIVE HEAT TRANSFER: Classification of convective heat transfer – dimensional analysis as a tool for experimental investigation – Buckingham Pi Theorem for forced and free convection, application for developing semi – empirical non- dimensional correlation for convective heat transfer – Significance of non-dimensional numbers – concepts of continuity, momentum and Energy Equations.

UNIT –IV

FREE CONVECTION: Development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for vertical plates and pipes.

FORCED CONVECTION

EXTERNAL FLOWS: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer-flat plates and cylinders.

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.

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 empirical correlations.

HEAT EXCHANGERS:

Classification of heat exchangers – overall heat transfer coefficient and fouling factor – concepts of LMTD and NTU methods – Problems.

UNIT – VI

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 Transfer - HOLMAN/TMH
2. Heat Transfer – P.K.Nag/ TMH
3. Principles of Heat Transfer – Frank Kreith, RM Manglik & MS Bohn, Cengage learning publishers.

REFERENCE BOOKS:

1. Heat and Mass Transfer – Arora and Domkundwar, Dhanpatrai & sons.
2. Fundamentals of Engg. Heat and Mass Transfer / R.C.SACHDEVA / New Age International.
3. Heat and Mass Transfer –Cengel- McGraw Hill.
4. Heat and Mass Transfer – D.S.Kumar / S.K.Kataria & Sons.

Course outcomes:

The student after undergoing this course is expected to know the principles of heat transfer and be able to apply to practical situations where in heat exchange takes place through various modes of heat transfer including phase change.

**AUTOMOBILE ENGINEERING
(DEPARTMENTAL ELECTIVE-I)**

Course Objectives:

The course imparts the principles of automobile systems and provides the salient features of safety, emission and service of automobiles.

UNIT – I

INTRODUCTION: Components of four wheeler automobile – chassis and body – power unit – power transmission – 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 – crank case ventilation – engine service, reboaring, decarburization, Nitriding of crank shaft.

UNIT – II

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, over drive torque converter. propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles
– types – wheels and tyres.

UNIT – III

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 – IV

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

BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder tandem master cylinder requirement of brake fluid, pneumatic and vacuum brakes.

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 – V

ENGINE SPECIFICATION AND SAFETY SYSTEMS: Introduction- engine specifications with regard to power, speed, torque, no. of cylinders and arrangement, lubrication and cooling etc.

Safety: Introduction, safety systems - seat belt, air bags, bumper, anti lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control.

UNIT – VI

ENGINE EMISSION CONTROL: Introduction – types of pollutants, mechanism of formation, concentration measurement, methods of controlling-engine modification, exhaust gas treatment-thermal and catalytic converters-use of alternative fuels for emission control – National and International pollution standards

ENGINE SERVICE: Introduction, service details of engine cylinder head, valves and valve mechanism, piston-connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly-precautions.

TEXT BOOKS:

1. Automotive Mechanics – Vol. 1 & Vol. 2 / Kripal Sing, standard publishers.
2. Automobile Engineering / William Crouse, TMH Distributors .
3. Automobile Engineering- P.S Gill, S.K. Kataria & Sons, New Delhi.

REFERENCES:

1. Automotive Engines Theory and Servicing, James D. Halderman and Chase D. Mitchell Jr., Pearson education inc.
2. Automotive Engineering / Newton Steeds & Garrett.
3. Automotive Mechanics / Heitner.

Course Outcomes:

The student after undergoing the course, shall visualize the layout of an automobile and its systems like transmission, steering, suspension, braking, safety etc and should know the vehicle troubleshooting.

**METHODS ENGINEERING AND WORK DESIGN
(DEPARTMENTAL ELECTIVE-I)**

UNIT- I

Work study: Concept of work and productivity - Possibility guides - Methods study - Charting techniques - Concept of standard time and bench mark jobs - Timing techniques and work sampling - Elemental motions, THERBLIGS and principles of motion - Economy - Introduction to predetermined motion time standards.

UNIT- II

Human factors engineering: Introduction to ergonomics and human factors - Engineering physiological basis of human performance - Biomechanics - Psychology of work and work load perception - Physical work environment - Basis of ergonomic problem identification - Safety.

UNIT- III

Integration of methods and time - Learning theory implications on standard time - Work study applications in production, maintenance, quality and other service functions - Synthetic time standards - MTM system and its application to production and maintenance.

UNIT- IV

Organization and methods: Procedure analysis and developing office standards - MTM application to office work - Forms design and control - Records management.

UNIT-V

Value engineering: VE concepts, Principles, Methodologies and standards - Methods of functional analysis - Creativity - VE case studies/project work.

UNIT- VI

Job evaluation and incentive scheme: Job description and job analysis - Job evaluation-different methods - Individual and group incentive concepts and implications - Different types of incentive schemes - Suggestion schemes.

TEXT BOOKS :

1. Introduction to Work Study, I.L.O., 3rd Revised Edn., 1986.
2. Methods, Standards and Work Design, Benjamin W. Niebel and Andris Freivalds, WCB Mc Graw Hill(1999)
3. Improving Productivity and Effectiveness by Mundel, Marvin, E., Prentice Hall, 1983.
4. Human Factors Engineering & Design by Sounders, M.S. and McCornic, E.J., McGraw Hill, 1983.

REFERENCES :

1. Fitting the Task to the Man by Grandjean, E., Taylor and Francis, London, 1989.
2. Measuring and Enhancing Productivity of Service and Government Organizations by Mundel Marvin, E., Asian Productivity Organization, Tokyo.
3. Compendium on Value Engineering by Tufty, H.G., The Indo-American Society, Bombay, 1983.
4. Compensation Administration by Belchar, David, W., Prentice Hall, N.J.

III Year B.Tech. (ME) – II Sem.

4-0-0-3

QUALITY AND RELIABILITY ENGINEERING (DEPARTMENTAL ELECTIVE-I)

Course objectives:

1. The aim of this course is to provide students with a basic understanding of the approaches and techniques to assess and improve process and/or product quality and reliability.
2. The objectives are to introduce the principles and techniques of Statistical Quality Control and their practical uses in product and/or process design and monitoring.
3. To understand techniques of modern reliability engineering tools.

UNIT-I

Quality value and engineering – quality systems – quality engineering in product design and production process – system design – parameter design – tolerance design, quality costs – quality improvement.

UNIT-II

Statistical process control \bar{X} , R, p, c charts, other types of control charts, process capability, process capability analysis, process capability index. (SQC tables can be used in the examination).

UNIT-III

Acceptance sampling by variables and attributes, design of sampling plans, single, double, sequential and continuous sampling plans, design of various sampling plans.

UNIT-IV

Loss function, tolerance design – N type, L type, S type; determination of tolerance for these types. online quality control – variable characteristics, attribute characteristics, parameter design.

Quality function deployment – house of quality, QFD matrix, total quality management concepts. quality information systems, quality circles, introduction to ISO 9000 standards.

UNIT-V

Reliability – Evaluation of design by tests - Hazard Models, Linear, Releigh, Weibull. Failure Data Analysis, reliability prediction based on weibull distribution, Reliability improvement.

UNIT-VI

Complex system, reliability, reliability of series, parallel & standby systems & complex systems & reliability prediction and system effectiveness. Maintainability, availability, economics of reliability engineering, replacement of items, maintenance costing and budgeting, reliability testing.

TEXT BOOKS:

1. G Taguchi, 'Quality Engineering in Production Systems - Mc GrawHill.
2. E. Bala Guruswamy, 'Reliability Engineering', Tata McGraw Hill.
3. Montgomery "Statistical Quality Control : A Modern Introduction" Wiley.

REFERENCE BOOKS:

1. Frank.M.Gryna Jr. "Jurans Quality planning & Analysis", McGrawHill.
2. Philippos, 'Taguchi Techniques for Quality Engineering', Mc Graw Hill.
3. LS Srinath, 'Reliability Engineering', Affiliated East West Pvt. Ltd..
4. Eugene Grant, Richard Leavenworth "Statistical Process Control", McGraw Hill.
5. W.A. Taylor, 'Optimization & Variation Reduction in Quality', TataMc Graw Hill.
6. Quality and Performance Excellence: James R Evans, Cengage learning.

Course outcome:

Upon successful completion of this course, students should be able to:

1. Understand quality and reliability concept, beware of some basic techniques for quality improvement, and acquire fundamental knowledge of statistics and probability.
2. Apply control charts to analyze and improve the process quality.
3. Design a simple sampling plan, construct its OC curve and evaluate its effectiveness on a given sampling process.
4. Acquire the concepts of the reliability, *and* calculate the system reliability based on the given component connection; *calculate* the reliability based on the given failure model.

III Year B.Tech. (ME) – II Sem.

4-0-0-3

ADVANCED FOUNDRY AND WELDING TECHNOLOGY
(DEPARTMENTAL ELECTIVE-I)

UNIT – I

Moulding: Development of metal castings- Materials for moulding- Foundry sand control- Different types of cores- Core making processes- Materials for core making- Moulding and core making machines. Recent developments in cores and mould making- Cold set process- Investment process. Shell moulding- Hot box method, Shaw process. Vacuum moulding for mass production.

UNIT – II

Melting and Solidification: Furnaces used in foundry for melting ferrous and nonferrous metals- Design of cupola and its charge calculations. Family of cast irons- Production of malleable and S.G. Irons- Methods of alloying and inoculants and their effects on the structure and properties of cast iron.

UNIT – III

Principles of Solidification: Nucleation- Crystal growth- Morphology and structure of cast metals and alloys- Pure metals- Single phase alloys and eutectics. Solidification in sand and chill moulds.

UNIT – IV

Foundry Mechanization: Layout for ferrous and nonferrous foundries- Description of equipment used for mechanization- Sand conditioners- Conveyors- Cranes- Equipment for handling moulds, Cores and molten metal- Knock out of moulds- Fettling equipment.

UNIT – V

Special Welding Processes: Forge welding- Resistance welding processes- Spot, Seam, Projection, Flash butt welding- Cold pressure welding- Machine cycle for resistance welding- Parameters in resistance welding- Friction welding, Friction stir welding.

UNIT –VI

Welding Design: Factors influencing weld ability of metals - Welding of carbon steels, Stainless steels and cast iron. Weldability of Cu, Al, and its alloys- Ni and its alloys - Temperature changes in welding and their effects on mechanical properties. Absorption of gases by welds and their effects- Residual stresses and distortion- Heat treatment of welded parts. Design of Gas welding and arc welding processes.

TEXT BOOKS:

1. Foundry Technology : Jain P.L.
2. Welding and Welding Technology : Little

REFERENCES:

1. Foundry Engineering : Agarwal.

HEAT TRANSFER LAB

Objectives:

The laboratory course is aimed to provide the practical exposure to the students with regard to the determination of amount of heat exchange in various modes of heat transfer including condensation & boiling for several geometries.

1. Determination of overall heat transfer co-efficient of a composite slab.
2. Determination of heat transfer rate through a lagged pipe.
3. Determination of heat transfer rate through a concentric sphere.
4. Determination of thermal conductivity of a metal rod.
5. Determination of efficiency of a pin-fin.
6. Determination of heat transfer coefficient in natural convection.
7. Determination of heat transfer coefficient in forced convection .
8. Determination of effectiveness of parallel and counter flow heat exchangers.
9. Determination of emissivity of a given surface.
10. Determination of Stefan Boltzman constant.
11. Determination of heat transfer rate in drop and film wise condensation.
12. Determination of critical heat flux.
13. Demonstration of heat pipe.
14. Study of two – phase flow.
15. Drop wise and Film wise condensation.

Outcomes: The student should be able to evaluate the amount of heat exchange for plane, cylindrical & spherical geometries and should be able to compare the performance of extended surfaces and heat exchangers.

METROLOGY & INSTRUMENTATION LAB

COURSE OBJECTIVES:

The Metrology and instrumentation Laboratory course is designed for measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements. The student can learn the measurements with and calibration of instruments. They also understand the machine tool alignment test. Instrumentation lab introduces the students with the theory and methods for conducting experimental work in the laboratory and calibration of various instruments for measuring pressure, temperature, displacement, speed, vibration etc.

Note: The students have to conduct at least 8 experiments from each lab.

METROLOGY LAB

1. Measurement of lengths, heights, diameters by vernier calipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Machine tool alignment test on the lathe.
4. Machine tool alignment test on drilling machine.
5. Machine tool alignment test on milling machine.
6. Angle and taper measurements with bevel protractor, Sine bars, rollers and balls.
7. Use of spirit level in finding the straightness of a bed and flatness of a surface.

INSTRUMENTATION LAB

1. Calibration of transducer for temperature measurement.
2. Study and calibration of LVDT transducer for displacement measurement.
3. Calibration of strain gauge.
4. Calibration of thermocouple.
5. Calibration of capacitive transducer.
6. Study and calibration of photo and magnetic speed pickups.
7. Calibration of resistance temperature detector.
8. Study and calibration of a rotameter.
9. Study and calibration of Mcleod gauge for low pressure.

Course outcomes:

Metrology Lab:

Student will become familiar with the different instruments that are available for linear, angular, roundness and roughness measurements they will be able to select and use the appropriate measuring instrument according to a specific requirement (in terms of accuracy, etc).

Instrumentation Lab:

Students will be able to select proper measuring instrument and know requirement of calibration, errors in measurement etc. They can perform accurate measurements.