



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY - GURAJADA - VIZIANAGARAM
VIZIANAGARAM – 535 003 Andhra Pradesh (India)
 (Established by Andhra Pradesh Act No.22 of 2021)

B.Tech. – III Year I Semester

B.Tech. – III Year I Semester

S.No.	Category	Title	L	T	P	Credits
1	PC	Machine Tools and Metrology	3	0	0	3
2	PC	Thermal Engineering	3	0	0	3
3	PC	Theory of Machines	3	1	0	3
4	PCE-1	Professional Elective – I	3	0	0	3
5	OE-1	1. Sustainable Energy Technologies 2. Applied operation Research 3. Industrial safety 4. Energy Conservation Management	3	0	0	3
6	PC Lab-1	Thermal Engineering Lab	0	0	3	1.5
7	PC Lab-2	Theory of Machines Lab	0	0	3	1.5
8	SEC	Machine Tools & Metrology Lab Mechatronics Lab	0	0	4	2
9	ES	Computational Fluid Dynamics Lab	0	0	2	1.0
10	Evaluation of Community Service Internship	Community Service Internship	-	-	-	2
Total			15	0	12	23

Professional Elective - I

1. Instrumentation & Control Systems
2. Nano Technology
3. Design for manufacturing
4. Thermal management of Electronic Systems
5. Joining Processes



VIZIANAGARAM – 535 003 Andhra Pradesh (India)

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B.Tech. III Year II Semester

Mandatory Industry Internship of 08 weeks duration during summer vacation

1. Industrial robotics
2. Supply chain management
3. Additive manufacturing
4. UnConventional Machining Processes
5. Refrigeration and Air conditioning

1. Automobile Engineering
2. Computer Integrated Manufacturing
3. Smart manufacturing
4. Mechanical Vibrations
5. Composite materials

III Year I Semester	Professional Core	L	T	P	C
		3	0	0	3
MACHINE TOOLS AND METROLOGY					

Course Objectives:

The students will acquire the knowledge

- To interpret the fundamental principles in material removal processes.
- To apply the fundamentals and principles of metal cutting to machining process using lathes, milling machines, grinding machines, drill presses, Computer Numerical Control machines etc
- To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
- To develop knowledge and importance of metal cutting parameters and demonstrate the fundamentals of machining processes and machine tools.
- To analyze the concepts of finishing processes and the system of limits and fits.
- To illustrate the concepts of surface roughness and optical measuring instruments

UNIT-1

FUNDAMENTALS OF MACHINING: Elementary treatment of metal cutting theory – element of cutting process – Single point cutting tools, nomenclature of single point cutting tool, tool signature, tool angles, mechanism of metal cutting, types of chips and chip formation – built up edge and its effects, chip breakers, mechanics of orthogonal and oblique cutting – Merchant's force diagram, cutting forces, velocity ratio, cutting speeds, feed, depth of cut, tool life, Taylor's tool life equation, simple problems – Tool wear, tool wear mechanisms, heat generation in metal cutting, coolants, machinability, economics of machining, tool materials and properties

UNIT-2

LATHE MACHINES: Introduction- types of lathe – Engine lathe – principle of working – construction – specification of lathe – work holders and tool holders – accessories and attachments – lathe operations – taper turning methods and thread cutting – drilling on lathes – cutting speed and feed-depth of cut.

SHAPING, SLOTTING AND PLANNING MACHINES: Introduction – principle of working – principle parts – specifications – operations performed – slider crank mechanism – machining time calculations.

UNIT-3

DRILLING & BORING MACHINES: Introduction – construction of drilling machines – types of drilling machines – principles of working – specifications – types of drills – geometry of twist drill – operations performed – cutting speed and feed – machining time calculations – Boring Machines – fine Boring Machines – jig boring machines – deep hole Drilling Machines.

MILLING MACHINES: Introduction – principle of working – specifications – milling methods – classification of Milling Machines – types of cutters – geometry of milling cutters – methods of indexing, accessories to milling machines – cutting speed and feed – machining time calculations

UNIT-4

FINISHING PROCESSES: Introduction – 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.

SYSTEMS OF LIMITS AND FITS: Introduction, nominal size, tolerance, limits, deviations, different types of fits -Unilateral and bilateral tolerance system, hole and shaft basis systems interchangeability, deterministic & statistical tolerances, selective assembly- International standard system of tolerances, selection of limits and tolerances for correct functioning, simple problems related to limits and fits, Taylor's principle – design of go and no go gauges; plug, ring, snap, gap, taper, profile and position gauges – inspection of gauges

UNIT-5

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

OPTICAL MEASURING INSTRUMENTS: Tools maker's microscope, Autocollimators, Optical projector, Optical flats-working principle, construction, merits, demerits and their uses. optical comparators

TEXT BOOKS:

1. Manufacturing Processes / JP Kaushish/ PHI Publishers-2 nd Edition
2. Manufacturing Technology Vol-II/P.N Rao/Tata McGraw Hill
3. Engineering Metrology – R.K. Jain/Khanna Publishers

REFERENCE BOOKS:

1. Metal cutting and machine tools /Geoffrey Boothroyd, Winston A.Knight/ Taylor & Francis
2. Production Technology / H.M.T. Hand Book (Hindustan Machine Tools).
3. Production Engineering/K.C Jain & A.K Chitale/PHI Publishers
4. Technology of machine tools/S.F.Krar, A.R. Gill, Peter SMID/ TMH
5. Manufacturing Processes for Engineering Materials-Kalpak Jian S & Steven R Schmid/Pearson Publications 5 th Edition

Course Outcomes:

- CO1: Interpret the concepts of machining processes.
- CO2: Apply the principles of lathe, shaping, slotting and planning machines.
- CO3: Apply the principles of drilling, milling and boring processes.
- CO4: Analyze the concepts of finishing processes and the system of limits and fits.
- CO5: Illustrate the concepts of surface roughness and optical measuring instruments.

III Year I Semester	Professional Core	L	T	P	C
		3	0	0	3
THERMAL ENGINEERING					

Course Objectives:

The students will acquire the knowledge

1. To interpret the different processes in air-standard cycles and differences between Air Standard and Actual Cycles
2. To interpret the basic principles of vapour power cycles
3. To illustrate combustion phenomenon and identify the functions of boilers and draught systems and evaluate their performance.
4. To demonstrate the performance of an IC engine and gas turbine based on the performance parameters.
5. To summarize the classification and basic principles of compressors.

UNIT – I

Air standard Cycles: Power Cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles, Brayton cycle

Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down -Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

UNIT – II

I. C. ENGINES: Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems – Fuel, Carburettor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of Wankle engine, principles of supercharging and turbo charging.

Measurement, 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

UNIT III

VAPOUR POWER CYCLES: Carnot, 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.

BOILERS: Classification – working principles of L.P & H.P boilers with sketches – mountings and accessories – working principles, boiler horse power, equivalent

evaporation, efficiency and heat balance – Draught: classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced.

UNIT – IV

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.

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 – combined velocity diagram for a velocity impulse and reaction turbine.

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

COMPRESSORS – Classification – fan, blower and compressor - positive displacement and non-positive displacement type – reciprocating and rotary types.

Reciprocating: Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, saving of work, minimum work condition for two stage compression.

Rotary (Positive displacement type)

Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.

Rotary (non positive displacement type)

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.

Text Books:

1. I.C. Engines - V. Ganesan- Tata McGraw Hill Publishers
2. Gas Turbines – V.Ganesan – Tata McGraw Hill Publishers

References:

1. Thermal Engineering - Mahesh Rathore- McGraw Hill publishers

2. I.C.Engines–AppliedThermosciences–C.R.Ferguson&A.T.Kirkpatrick-2ndEdition-Wiley Publishers

3. I.C. Engines - J.B.Heywood /McGrawHill.

4. Heat engines, Vasandani & Kumar - Thermal publications

5. Gas Turbine Theory – HHH Saravanamuttoo, Cohen, Rogers –Pearson Publishers

Course Outcomes:

The students will be able to

1. Interpret the different processes in air-standard cycles and differences between Air Standard and Actual Cycles
2. Analyze the basic principles of vapour power cycles
3. Illustrate the combustion phenomenon and identify the functions of boilers and draught systems and evaluate their performance.
4. Analyze the performance of an IC engine and gas turbine based on the performance parameters.
5. Illustrate the classification and basic principles of compressors.

III Year I Semester	Professional Core	L	T	P	C
		3	1	0	3
THEORY OF MACHINES					

Course Objectives: The students will acquire the knowledge

1. To interpret the nature and role of the kinematics of machinery, mechanisms and machines
2. The course includes velocity and acceleration diagrams, analysis of mechanisms joints, it exposes the students to various kinds of power transmission devices like belt, rope, chain and gear drives and their working principles and their merits and demerits.
3. To analyze dynamic forces of slider, crank mechanism and design of flywheel
4. To analyze the methods of balancing reciprocating and rotary masses.
5. To illustrate the concept of vibrations and its significance on engineering design

UNIT – I

MECHANISMS: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained.

Grashoff's law, Degrees of freedom, Kutzbach criterion for planar mechanisms, Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversions of quadric cycle chain – single and double slider crank chains.

LOWER PAIR MECHANISM: Exact and approximate copiers and generated types – Peaucellier, Hart and Scott Russel – Grasshopper – Watt T. Chebicheff and Robert Mechanisms and straight-line motion, Pantograph. Conditions for correct steering – Davis Steering gear, Ackermans steering gear – velocity ratio; Hooke's Joint: Single and double – Universal coupling–application–problems.

UNIT – II

KINEMATICS: Velocity and acceleration – Motion of a link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain. Velocity and acceleration analysis of for a given mechanism, Klein's construction, determination of Coriolis component of acceleration.

POWER TRANSMISSION (BELT, CHAIN AND GEAR):

Belt Drive: Type of belts, flat belt, V-belt & its applications, material for flat and V-belt, Selection of belts, Angle of lap, length of belt (No derivation), Slip and creep, Determination of velocity ratio of tight side and slack side tension, Power transmitted by belt. (numerical on power transmission by belt)

Chain Drives: Types of chains and sprockets, Advantages & Disadvantages of chain drive over other drives (No numerical on Chain drive).

Gear Drives: Classification of gears, Law of gearing, Concept of Conjugate profile (Involute only) Spur gear terminology. Types of gear trains, Train value & velocity ratio for simple, compound, reverted and epicyclic gear trains. (No numerical on Gear drive). Comparison between Belt drive, Chain drive and Gear drive

Unit – III

CAMS

Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases. Analysis of motion of followers: Roller follower – circular cam with straight, concave and convex flanks.

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

BALANCING: Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. Primary, secondary, and higher balancing of reciprocating masses.

UNIT – V

VIBRATIONS: Free Vibration of spring mass system – Natural frequency-types of damping – damped free vibration, Simple problems on forced damped vibration, vibration isolation and transmissibility 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.

TEXT BOOKS:

1. "Theory of Machines", Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd Ed-2009
2. "Theory of Machines", Sadhu Singh, Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Ed 2006/

REFERENCE BOOKS

1. "Theory of Machines & Mechanisms", J.J. Uicker, , G.R. Pennock, J.E. Shigley, OXFORD 3rd Ed. 2009.
2. "Theory of Machines" by Thomas Bevan, CBS Publication 1984.
3. "Design of Machinery" by Robert L. Norton, McGraw Hill, 2001.
4. "Mechanisms and Dynamics" of Machinery by J. Srinivas, Scitech Publications, Chennai, 2002.
5. "Dynamics of machinery" by J. B. K. Das & P. L. S. Murthy.

Course outcomes:

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

1. Interpret a mechanism for a given plane motion. analyze motion of different planar mechanisms with lower and higher pairs
2. Select a power transmission system for a given application and analyze different transmission systems.
3. Analyze dynamic forces of slider crank mechanism and design of flywheel
4. Analyze the methods of balancing reciprocating and rotary masses.
5. Illustrate the concept of vibrations and its significance on engineering design

III Year-I Semester	Professional Elective-I	L	T	P	C
		3	0	0	3
INSTRUMENTATION & CONTROL SYSTEMS					

Course Objectives:

The students will acquire the knowledge

1. To learn basic principles of measurement systems, errors occurred in measurement systems and measurement of displacement
2. To learn the operating principles and working of different instruments used for temperature and pressure measurement
3. To learn the operating principles and working of different instruments used for level, flow and speed measurement
4. To learn the operating principles and working of different instruments used for acceleration, strain and humidity measurement
5. To learn the operating principles and working of different instruments used for force, torque and power and concepts of control 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.

MEASUREMENT OF PRESSURE: Units – classification – different principles used. Manometers, 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

UNIT – IV

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

STRESS STRAIN MEASUREMENTS:

Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes.

MEASUREMENT OF HUMIDITY – Moisture content of gases, sling psychrometer, absorption psychrometer, dew point meter.

UNIT – V

MEASUREMENT OF FORCE, TORQUE AND POWER- Elastic force meters, load cells, torsion meters, dynamometers.

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 / D.S Kumar/
2. Mechanical Measurements / BeckWith, Marangoni,Linehard, Pearson

References:

1. Measurement systems: Application and design/Doeblin Earnest. O. Adaptation/ TMH
2. Experimental Methods for Engineers / J.P.Holman/McGraw Hill
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
- 4.Instrumentation, measurement & analysis / B.C.Nakra&K.K.Choudhary/TMH

Course outcomes:

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

1. Build the principles of measurement systems and construction of various transducers for displacement measurement
2. Classify and study the different types of temperature and pressure measuring devices

3. Interpret the working principles of level, flow and speed measuring instruments
4. Utilize the principles of various types of acceleration and vibration, stress and strain and humidity measuring instruments
5. Illustrate the operating principles of force, torque and power measurements and different types of control systems and application of servo mechanisms

III Year-I Semester	Professional Elective-I	L	T	P	C
		3	0	0	3
NANO TECHNOLOGY					

Course Objectives:

The students will acquire the knowledge:

1. To interpret the classification of nano structured Materials
2. To describe the unique properties of nano materials
3. To interpret the Synthesis Routes - Bottom up and Top-down approaches
4. To identify the tools to characterize nano materials
5. To illustrate the applications of nano materials

Unit I

Introduction: History and Scope, Classification of Nano structured Materials, Fascinating Nanostructures, applications of nanomaterials, challenges and future prospects.

Unit II

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

Unit III

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

UNIT –IV

Tools to Characterize nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM),

Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nano indentation

UNIT – V

Applications of Nano materials: Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water-Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology

TEXT BOOKS:

1. Introduction to Nano Technology by Charles. P. Poole Jr& Frank J. Owens.Wiley India Pvt. Ltd.
2. Nano Materials- A.K.Bandyopadhyay/ New Age Publishers.
3. Nano Essentials- T.Pradeep/TMH

REFERENCE BOOKS:

1. Solid State physics by Pillai, Wiley Eastern Ltd.
2. Introduction to solid state physics 7th edition by Kittel. John Wiley & sons (Asia) Pvt Ltd.

Course Outcomes:

The students will be able to:

1. Interpret the classification of nano structured Materials
2. Describe the unique properties of nano materials
3. Interpret the Synthesis Routes - Bottom up and Top-down approaches
4. Identify the tools to characterize nano materials
5. Illustrate the applications of nano materials

III Year-I Semester	Professional Elective-I	L	T	P	C
		3	0	0	3
DESIGN FOR MANUFACTURING					

Course Objectives:

The students will acquire the knowledge:

1. To analyze the basic concepts of design for manual assembly
2. To interpret basic design procedure of machining processes
3. To analyze design considerations metal casting, extrusion and sheet metal work
4. To interpret the design considerations of various metal joining process.
5. To interpret the basic design concepts involved in the assembly automation

UNIT – I

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design? Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, Weight on Handling Time, Effects of Combinations of Factors, Application of the DFA Methodology.

UNIT - II

Machining processes: Overview of various machining processes-general design rules for machining dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT - III

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

UNIT - IV

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld

joints-design of brazed joints. Forging: Design factors for forging – closed die forging design – parting lines of dies –drop forging die design – general design recommendations.

UNIT – V

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, single station assembly lines.

TEXT BOOKS:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
1. Design for Manufacture by Boothroyd,
2. Design for manufacture, James Bralla

REFERENCE:

ASM Hand book Vol.20

Course Outcomes:

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

The students will acquire the knowledge:

1. Analyze the basic concepts of design for manual assembly
2. Interpret basic design procedure of machining processes
3. Analyze design considerations metal casting, extrusion and sheet metal work
4. Interpret the design considerations of various metal joining process.
5. Interpret the basic design concepts involved in the assembly automation

III Year-I Semester	Professional Elective-I	L	T	P	C
		3	0	0	3
THERMAL MANAGEMENT OF ELECTRONIC SYSTEMS					

Course objectives:

- 1) To interpret the basics of heat transfer and analyze heat transfer through fins
- 2) To analyze the basics of convection and radiation modes of heat transfer.
- 3) To illustrate concepts the thermal analysis of printed circuit boards and their cooling.
- 4) To analyze the principles of two-phase cooling and heat pipes.
- 5) To interpret knowledge about the thermoelectric coolers.

UNIT– I

Introduction of Heat Transfer and Conduction: Modes – Conduction, Convection and Radiation – Basic Laws – Applications of Heat Transfer Basics of Conduction –Conduction equation – Thermal analogy – Lumped heat capacity analysis - Heat conduction with phase change - Thermal Resistance – Extended Surfaces – Uniform cross section fins – Fin efficiency – Selection and design of fins.

UNIT– II:

Convection and Radiation: Forced and Free Convection – Heat transfer coefficient - Parameters effecting heat transfer – Thermal Properties of fluids - Combined Modes, Radiation– Stefan- Boltzmann Law – Kirchoff’s law and Emissivity – Radiation between Black Isothermal Surfaces – Radiation between Grey Isothermal Surfaces – Extreme Climatic conditions - Radiation at normal ambient. Temperature measurement and its Instrumentation.

UNIT– III:

Printed Circuit Boards and Cooling – Chip packaging – thermal Resistance – Board Cooling methods – Board thermal Analysis – Equivalent thermal Conductivity Air Cooling – Fans – Heat transfer Enhancement – Air handling systems – Blowers. Single Phase Cooling – Coolant Selection – Natural Convection – Forced Convection - Air Cooling - Convective cooling in small systems – Forced cooling in medium and large systems – Liquid cooling in high power modules – Case Studies.

UNIT– IV:

Two Phase Cooling and Heat pipes – Direct Immersion Cooling – Basics of Pool Boiling – Enhancement of Pool Boiling – Flow Boiling Heat Pipes – Operation Principles – Useful Characteristics – Operating Limits and Temperatures – Operation Methods – Applications – Micro Heat Pipes.

UNIT– V:

Thermo Electric coolers: Basics theories – Thermo electric effect – Operation Principles Phase change materials, Thermal Interface materials, Heat Spreaders and Heat Sinks – Working Principles, Mini and Micro Channels. Use of nano fluids in electronic cooling.

Text Books:

1. Thermal Analysis and Control of Electronic Equipment – Allan D. Kraus and Avram BarCohen, McGraw Hill, New York, NY, 1983.
2. Fundamentals of Microelectronics Packaging – Ed: Rao Tummala, McGraw Hill, New York, NY, 2001.

Reference Books

- 1) Packaging of Electronic Systems – James W. Dally, McGraw Hill, New York, NY, 1990.

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

- 1) Interpret the basics of heat transfer and analyze heat transfer through fins
- 2) Analyze the basics of convection and radiation modes of heat transfer.
- 3) Illustrate concepts the thermal analysis of printed circuit boards and their cooling.
- 4) Analyze the principles of two-phase cooling and heat pipes.
- 5) Interpret knowledge about the thermoelectric coolers.

III Year I Semester	Professional Elective-I	L	T	P	C
		3	0	0	3
JOINING PROCESSES					

Course Objectives:

The students will acquire the knowledge

1. To describe basic principles of metal joining process
2. To interpret the theory and procedure involved in the fusion welding process
3. To analyze the basic concepts of the pressure welding
4. To analyze the basic steps of soldering operational steps of brazing.
5. To illustrate the concepts of modern welding processes

Unit-I:

Metal Joining Processes: Joining process as a manufacturing route, relevance of joining process to metallurgy. Different types of joining process, classification of joining process, safety aspects in Metal joining processes, types of joints used in welding.

Unit – II:

Fusion Welding Process: Classification of welding process, gas welding, arc welding process (equipment, fluxes, electrodes, procedures, limitations and advantages of various arc welding process), relative advantages and limitations and applications of gas welding and arc welding, thermit welding.

Unit – III:

Pressure Welding: Resistance welding, cold welding, forge welding. relative advantages, limitation and applications of pressure welding. spot welding, explosion welding, flash welding.

Unit – IV: Soldering and Brazing: Basic operational steps of Soldering, Basic operational steps of Brazing, flux and its role in joining process, different types of fluxes, metallurgical aspects of soldering and brazing, applications of soldering and brazing, soldering and Brazing Alloys, adhesive joining.

Unit – V: Modern Welding Processes: Electron beam welding, Laser beam welding, Submerged arc welding, Ultrasonic welding, Under water welding, Magnetic pulse welding.

Text Books:

1. Welding Technology O.P.Khanna Dhanpat Rai Publications Ltd. New Delhi
2. Soldering, welding and brazing Lankester George Allen and Unwin, London.
3. Modern arc welding techniques S.V. Nadkarni Oxford IBH Publishers.

References:

1. Engineering Metallurgy I and II R.A.Higgins The English University Press Ltd.
2. Welding Technology R.S.Parmar Khanna Publishers, New Delhi
3. Welding Engineering Richard little Tata McGraw Hill, New Delhi

Course Outcomes

At the end of the course the students shall be able to:

1. Describe basic principles of metal joining process
2. Interpret the theory and procedure involved in the fusion welding process
3. Analyze the basic concepts of the pressure welding
4. Analyze the basic steps of soldering operational steps of brazing.
5. Discuss the concepts of modern welding processes

III Year-I Semester	Open Elective -I	L	T	P	C
		3	0	0	3
SUSTAINABLE ENERGY TECHNOLOGIES					

Course Objectives:

The students will acquire the knowledge:

1. To demonstrate the importance and solar radiation, solar energy collection and storage
2. To analyze the energy sources and potential from wind energy, bio-mass, geothermal energy and ocean energy
3. To interpret energy efficient electrical and mechanical systems
4. To develop energy efficient processes
5. To illustrate features and benefits of green buildings

UNIT-I

SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on tilted surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems. Photo voltaic energy conversion – types of PV cells.

SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

UNIT – II

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, betz criteria, types of winds, wind data measurement.

BIO-MASS: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy.

OCEAN ENERGY: OTEC, Principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques.

UNIT –III

ENERGY EFFICIENT SYSTEMS:

(A) ELECTRICAL SYSTEMS: Energy efficient motors, energy efficient lighting and control, selection of luminaire, variable voltage variable frequency drives (adjustable speed drives), controls for HVAC (heating, ventilation and air conditioning), demand site management.

(B) MECHANICAL SYSTEMS: Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmental friendly and Energy efficient compressors and pumps.

UNIT-IV

ENERGY EFFICIENT PROCESSES: Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of efficient and sustainable green production systems with examples like environmental friendly machining, vegetable based cutting fluids, alternate casting and joining techniques, zero waste manufacturing.

UNIT – V

GREEN BUILDINGS: Definition, features and benefits. Sustainable site selection and planning of buildings for maximum comfort. Environmental friendly building materials like bamboo, timber, rammed earth, hollow blocks, lime & lime pozzolana cement, agro materials and industrial waste, Ferro cement and Ferro-concrete, alternate roofing systems, paints to reduce heat gain of the buildings. Energy management.

Text Books:

1. Solar Energy – Principles of Thermal Collection and Storage/Sukhatme S.P. and J.K.Nayak/TMH
2. Non-Conventional Energy Resources- Khan B.H/ Tata McGraw Hill, New Delhi, 2006
3. Green Manufacturing Processes and Systems - J. Paulo Davim/Springer 2013

References:

1. Alternative Building Materials and Technologies - K.S Jagadeesh, B.V Venkata Rama Reddy and K.S Nanjunda Rao/New age international
2. Principles of Solar Engineering - D.Yogi Goswami, Frank Krieth& John F Kreider / Taylor &Francis
3. Non-Conventional Energy - Ashok V Desai /New Age International (P) Ltd
4. Renewable Energy Technologies -Ramesh & Kumar /Narosa

5. Non-conventional Energy Source- G.D Roy/Standard Publishers
6. Renewable Energy Resources-2nd Edition/ J.Twidell and T. Weir/ BSP Books Pvt.Ltd
7. Fuel Cell Technology -Hand Book / Gregor Hoogers / BSP Books Pvt. Ltd

Course Outcomes:

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

1. Demonstrate the importance and solar radiation, solar energy collection and storage
2. Analyze the energy sources and potential from wind energy, bio-mass, geothermal energy and ocean energy
3. Interpret energy efficient electrical and mechanical systems
4. Develop energy efficient processes
5. Illustrate features and benefits of green buildings

III Year-I Semester	Open Elective –I	L	T	P	C
		3	0	0	3
APPLIED OPERATIONS RESEARCH					

Course Objectives:

The students will acquire the knowledge:

1. To illustrate classification of optimization problem and apply classical optimization techniques
2. To apply unconstrained optimization techniques using various methods
3. To analyze the characteristics and approaches of constrained optimization techniques
4. To interpret optimized solutions using constrained and unconstrained geometric programming
5. To illustrate integer programming methods

UNIT I

INTRODUCTION TO OPTIMIZATION: Engineering applications of optimization- statement of an optimization problem- classification of optimization problem- optimization techniques.

CLASSICAL OPTIMIZATION TECHNIQUES: Single variable optimization- multivariable optimization with equality constraints- multivariable optimization with inequality constraints.

UNIT-II

UNCONSTRAINED OPTIMIZATION TECHNIQUES: Pattern search method- Rosenbrock's method of rotating coordinates- Simplex method- Descent methods- Gradient of function- Steepest Descent method.

UNIT-III

CONSTRAINED OPTIMIZATION TECHNIQUES: Characteristics of constrained problem methods of feasible directions - basic approach in the penalty function method- interior penalty function method- convex programming problem- exterior penalty function method.

UNIT-IV

GEOMETRIC PROGRAMMING (G.P): Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. primal dual relationship and sufficiency conditions.

Solution of a constrained geometric programming problem (G.P.P). Complimentary geometric programming (C.G.P)

UNIT-V

INTEGER PROGRAMMING (I.P): Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem. Integer nonlinear programming.

TEXT BOOK:

1. Optimization Theory and Applications/ S.S.Rao/Wiley Eastern Limited, New Delhi.

REFERENCES:

1. Engineering Optimization / Kalyanmanai Deb/Prentice Hall of India, New Delhi.
2. Optimization Techniques-Theory and applications/C.Mohan&Kusum Deep/New Age International
3. Operations Research /S.D.Sharma / MacMillan Publishers

Course Outcomes:

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

1. Illustrate classification of optimization problem and apply classical optimization techniques
2. Apply unconstrained optimization techniques using various methods
3. Analyze the characteristics and approaches of constrained optimization techniques
4. Interpret optimized solutions using constrained and unconstrained geometric programming
5. Illustrate integer programming methods

III Year-I Semester	Open Elective –I	L	T	P	C
		3	0	0	3
INDUSTRIAL SAFETY					

Course Objectives:

1. To provide information regarding different elements of industrial water pollution and Methods of treatment.
2. To expose to the various industrial applications, maintenance, preventive measures taken against wear and tear.

UNIT- I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT- II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT- III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication Side feed lubrication, Ring lubrication

Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT- IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like,

- i. Any one machine tool,
- ii. Pump
- iii. Air compressor
- iv. Internal combustion engine,
- v. Boiler
- vi. Electrical motors,

Types of faults in machine tools and their general causes.

UNIT- V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of:

- i. Machine tools
- ii. Pumps,
- iii. Air compressors,
- iv. Diesel generating (DG) sets,

Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance

REFERENCE BOOKS:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Outcomes:

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

1. Know how to take safety measures in executing works
2. Identify the need for maintenance (or) replacement of equipment
3. Illustrate the need for periodic and preventive maintenance

III Year-I Semester	Open Elective –I	L	T	P	C
		3	0	0	3
ENERGY CONSERVATION MANAGEMENT					

Course Objectives:

- To illustrate energy efficiency, scope, conservation and technologies.
- To design energy efficient lighting systems.
- To analyze power factor of systems and propose suitable compensation techniques.
- To interpret energy conservation in HVAC systems.
- To analyze life cycle costing analysis and return on investment on energy efficient technologies.

UNIT-I

Basic Principles of Energy Audit and management Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Pie charts – Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems – Principles of energy management – Initiating, planning, controlling, promoting, monitoring, reporting – Energy manager – Qualities and functions – Language – Questionnaire – Check list for top management.

UNIT-II

Lighting Modification of existing systems – Replacement of existing systems – Priorities: Definition of terms and units – Luminous efficiency – Polar curve – Calculation of illumination level – Illumination of inclined surface to beam – Luminance or brightness – Types of lamps – Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers – Energy conservation measures.

UNIT-III

Power Factor and energy instruments Power factor – Methods of improvement – Location of capacitors – Power factor with non linear loads – Effect of harmonics on Power factor – Numerical problems. Energy Instruments – Watt-hour meter – Data loggers – Thermocouples – Pyrometers – Lux meters – Tong testers – Power analyzer.

UNIT-IV

Space Heating and Ventilation – Air-Conditioning (HVAC) and Water Heating: Introduction – Heating of buildings – Transfer of Heat-Space heating methods – Ventilation and air-conditioning – Insulation-Cooling load – Electric water heating systems – Energy conservation methods.

UNIT-V

Economic Aspects and Financial Analysis Understanding energy cost – Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis – Energy efficient motors (basic concepts) – Economics of energy efficient motors and system

Computation of Economic Aspects Need of investment, appraisal and criteria – Calculation of simple payback period–Return on investment – Net present value – Internal rate of return – numerical examples – Power factor correction – Lighting – Applications of life cycle costing analysis – Return on investment – Numerical examples

TEXT BOOKS:

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd–2nd edition, 1995

REFERENCE BOOKS:

1. Energy management by W.R. Murphy & G. McKay Butter worth, Elsevier publications. 2012
2. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
3. Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition, 1998.
4. Energy management hand book by W.C.Turner, John wiley and sons.
5. Energy management and conservation –k v Sharma and pvenkatasessaiah-I K International Publishing House pvt.ltd,2011.
6. Hand Book of Energy Audit by Sonal Desai- Tata McGraw hill

Course Outcomes:

- Illustrate energy efficiency, scope, conservation and technologies.
- Design energy efficient lighting systems.
- Analyze power factor of systems and propose suitable compensation techniques.
- Interpret energy conservation in HVAC systems.
- Analyze life cycle costing analysis and return on investment on energy efficient technologies.

III Year I Semester	Professional Core	L	T	P	C
		0	0	3	1.5
THERMAL ENGINEERING LAB					

Course Objective: To provide hands on experience in operating various types of internal combustion engines and understands their functioning and performance.

List of experiments:

1. I.C. Engines valve / port timing diagrams.
2. Testing of Fuels – Viscosity, flash point/fire point, carbon residue, calorific value.
3. I.C. Engines performance test and Exhaust emission measurements (4 -stroke diesel engine)
4. I.C. Engines performance test and Exhaust emission measurements (2-stroke petrol engine)
5. Evaluation of engine friction by conducting Morse test on 4-stroke multi cylinder petrol engine.
6. Determination of FP by retardation and motoring test on IC engine.
7. I.C. Engines heat balance at different loads and show the heat distribution curve.
8. Economical speed test of an IC engine.
9. Performance test on variable compression ratio engines.
10. Performance test on reciprocating air compressor unit.
11. Dis-assembly / assembly of different parts of two wheelers. 3 wheelers & 4 wheelers. Tractor & Heavy-duty engines covering 2-stroke and 4 stroke, SI and CI engines.
12. Study of boilers, mountings and accessories

Course outcomes:

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

1. Identify the valves and ports opening and closing of IC engines and Assembly and Dis-assembly of IC Engines. (BL-3)
2. Find the performance characteristics of an internal combustion engines (BL-1)
3. Solve the heat load by drawing the Heat Balance sheet (BL-3)
4. Demonstrate the performance of engine by economical speed tests and Study of Boilers (BL-2)
5. Analyze the performance parameters like IP, BP and FP for multi cylinder engines (BL-2)

III Year I Semester	Professional Core	L	T	P	C
		0	0	3	1.5
THEORY OF MACHINES LAB					

Course objective:

The students will acquire the knowledge

To analyze gyroscope, frequency of free and forced vibration and study static and dynamic balancing.

List of experiments:

1. To determine whirling speed of shaft theoretically and experimentally.
2. To determine the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation.
3. To analyze the motion of a motorized gyroscope when the couple is applied along its spin axis
4. To determine the frequency of undamped free vibration of an equivalent spring mass system.
5. To determine the frequency of damped force vibration of a spring mass system
6. To study the static and dynamic balancing using rigid blocks.
7. To find the moment of inertia of a flywheel
8. To plot follower displacement vs cam rotation for various Cam Follower systems.
9. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism
10. To find coefficient of friction between belt and pulley.
11. To study simple and compound screw jack and determine the mechanical advantage, velocity ratio and efficiency
12. To study various types of gears- Spur, Helical, Worm and Bevel Gears

Course outcomes:

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

1. Examine the motion of a motorized gyroscope when the couple is applied along its spin axis. (BL-4)
2. Find the frequency of undamped and damped free vibration of an equivalent spring mass system. (BL-1)
3. Find the position of sleeve against controlling force and speed of a Hartnell governor and to plot the characteristic curve of radius of rotation (BL-1)
4. Interpret the static and dynamic balancing using rigid blocks (BL-2)
5. Interpret the moment of inertia of a flywheel and determine whirling speed of shaft theoretically and experimentally (BL-2)

III Year-I Semester	Skill Oriented Course	L	T	P	C
		0	0	4	2
MACHINE TOOLS AND METROLOGY LAB					

Course Objectives:

1. To interpret the working principles of various machines viz lathe, Drilling, milling, shaping.
2. To illustrate the usage of CNC in Lathe and Milling machines.
3. To learn about basic measuring instruments vernier callipers, screw gauge, vernier height gauge.
4. To learn the measurement of the angle and taper by Bevel protractor, Sine bar, etc.
5. To learn about Mechanical parameter measuring systems and different alignment techniques.

Part A -List of Experiments

1. Introduction of general-purpose machines -Lathe, drilling machine, Milling machine, Shaper,
1. Planning machine, slotting machine, Cylindrical Grinder, surface grinder and tool and cutter grinder.
3. To perform Step turning and taper turning on lathe machine
4. To perform Thread cutting and knurling on lathe machine.
5. To perform spur gear cutting using milling machine.
6. To perform flat surface operation on a block using shaper.
7. To perform Drilling & Tapping operations.
8. To perform precise surface grinding operations.
9. To perform precision cylindrical grinding operations.
10. To perform splines on a block using slotting machine.
11. To perform step turning operation using CNC lathe.

Part B - List of Experiments

1. Measurement of lengths, heights, diameters by vernier callipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. To Study the Angle and taper measurements by Bevel protractor, Sine bars, etc.
4. Measurements by Gear Tooth Vernier Callipers.
5. To study about the Tool makers microscope and its application
6. Surface Roughness Measurement

Course Outcomes:

Students get exposure to

1. Perform step, taper turning, knurling and threading operations on lathe.
2. Practical exposure on Flat Surface machining, Shaping, Slotting, Milling and grinding operations.
4. Develop programs on CNC lathe and Milling machines.
5. Apply the procedures to measure length, width, depth, bore diameters, external tapers, tool angles, and surface roughness by using different instruments.
6. Demonstrate knowledge of different machine tools used in machine shops.

III Year-I Semester	Skill Oriented Course	L	T	P	C
		0	0	4	2
MECHATRONICS LAB					

Course Objectives:

The students will acquire the knowledge:

1. To measure load and temperature using analogue and digital sensors.
2. To measure displacement using analogue and digital sensors.
3. To develop PLC programs for control of traffic lights, water level, lifts and conveyor belts.
4. To simulate and analyze PID controllers for a physical system using MATLAB.
5. To develop pneumatic and hydraulic circuits using Automaton studio.

List of Experiments

1. DYNA 1750 Transducers Kit:-
 - a. Characteristics of LVDT
 - b. Principle & Characteristics of Strain Gauge
 - c. Characteristics of Summing Amplifier
 - d. Characteristics of Reflective Opto Transducer
2. PLC PROGRAMMING
 - a. Ladder programming on Logic gates, Timers & counters
 - b. Ladder Programming for digital & Analogy sensors
 - c. Ladder programming for Traffic Light control, Water level control and Lift control Modules
3. AUTOMATION STUDIO software
 - a. Introduction to Automation studio & its control
 - b. Draw & Simulate the Hydraulic circuit for series & parallel cylinders connection
 - c. Draw & Simulate Meter-in, Meter-out and hydraulic press and clamping.
4. MATLAB Programming
 - a. Sample programmes on Matlab
 - b. Simulation and analysis of PID controller using SIMULINK

Course outcomes:

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

1. Measure load using analogue and digital sensors (BL-5)
2. Measure displacement using analogue and digital sensors (BL-5)
3. Develop PLC programs for control of traffic lights, water level and lift system (BL-3)
4. Analyze PID controllers for a physical system using MATLAB (BL-4)
5. Develop pneumatic and hydraulic circuits (BL-3)

III Year-I Semester	Engineering Science Course	L	T	P	C
		0	0	2	1
COMPUTATIONAL FLUID DYNAMICS LAB					

Course Objectives:

The students will acquire the knowledge

1. To solve problems of fluid mechanics and heat transfer by writing programs in C-language and MATLAB.
2. To solve ANSYS-FLUENT build geometry, mesh that geometry, Perform CFD method on the mesh, perform the calculation, and post-process the results.
3. To interpret the validation of the numerical result by comparison with known analytical results.
4. To analyze the numerical result by invoking the physical principles of fluid mechanics and heat transfer.
5. To solve Elliptical, Parabolic, Partial and Hyperbolic partial differential equations.

Using ANSYS-FLUENT solve the following problems of heat transfer analysis

1. Steady state conduction
2. Lumped heat transfer
3. Convective heat transfer – Internal flow (study both velocity and thermal boundary layers)
4. Convective heat transfer – External flow (study both velocity and thermal boundary layers)
5. Radiation heat transfer–Emissivity
6. Fluid Flow inside a bend pipe
7. Flow inside a cyclone / scrubber
8. External flow over a airfoil
9. Pressure drop analysis in a valve
10. Heat transfer analysis in heat exchanger
11. Heat transfer analysis in solar flat plate collector
12. Heat transfer analysis in solar air heater

Course Outcomes:

At the end of the course the students shall be able to:

1. Solve problems of fluid mechanics and heat transfer by writing programs in C-language and MATLAB.
2. Solve ANSYS-FLUENT build geometry, mesh that geometry, Perform CFD method on the mesh, perform the calculation, and post-process the results.
3. Intrepret the validation of the numerical result by comparison with known analytical results.
4. Analyze the numerical result by invoking the physical principles of fluid mechanics and heat transfer.
5. Solve Elliptical, Parabolic, Partial and Hyperbolic partial differential equations.