SHRI VENKATESHWARA UNIVERSITY

Syllabus

Diploma

Mechanical Engineering (Production)

III semester

(Three Years Programme)

(w.e.f. 2019-20)

SCHOOL OF ENGINEERING & TECHNOLOGY

Mechanical Engineering (Production)

SEMESTER- III

Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	**PPE - 301**	Heat Power Engineering	2	1	0	20	10	30		70		100	3
	PPE-302	Metrology & Measurements	3	0	0	20	10	30		70		100	3
3	**PPE-303**	Fluid Mechanics & Hydraulic Machinery	2	1	0	20	10	30		70		100	3
4	**PPE - 304**	Industrial Production Technology -I	3	0	0	20	10	30		70		100	3
5	**PPE-305**	Basic Mechanical Engineering	**3**	**1**	**0**	20	10	30		70		100	**4**
6	**PPE -311**	Production Drawing Lab	0	0	2				10		15	25	1
7	**PPE-312**	Industrial Production Technology Lab-I	0	0	2				10		15	25	1
8	**PPE-313**	Precision Metrology Lab	0	0	2				10		15	25	1
9	**PPE-314**	Computer Aided Machine Drawing Practical	0	0	2				10		15	25	1
10	**PPE-315**	Heat Power Engineering Lab	0	0	2				10		15	25	1
11	**PPE-316**	Summer Internship - I	0	0	0				50			50	2
												675	**23**

Summer Internship-I (4 weeks) after IInd Sem

Course Code	:	PPE-301
Course Title	:	BASIC MECHANICAL ENGINEERING
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course Learning Objectives:

- To understand General Principles of Mechanical Engineering
- To understand laws of thermodynamics, thermal and thermodynamic Processes

- To understand working principles of Thermal Machines and Power Transmitting Devices
- To understand basic materials and manufacturing processes

Course Content:

UNIT-I: Introduction to Thermodynamics - Role of Thermodynamics in Engineering and Science, Types of Systems, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Elementary introduction to Zeroth, First and Second laws of thermodynamics, Heat and Work Interactions for various non-flow and flow processes; Concept of Heat Engine, Heat Pump & Refrigerator, Efficiency/ COP; Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, T-S and P-V Diagrams, Concept of Entropy (Definition only).

Unit-II: Heat transfer & Thermal Power Plant: Modes of Heat Transfer; Conduction: Composite Walls and Cylinders, Combined Conduction and Convection: Overall Heat Transfer Co-efficient, Simple Numerical Problems: Thermal Power Plant Layout; Rankine Cycle; Fire Tube and Water Tube boilers, Babcock & Wilcox, Cochran Boilers;

Unit-III: Steam Turbines: Impulse and Reaction Turbines; Condensers: Jet & Surface Condensers, Cooling Towers; **Internal Combustion Engines and Refrigeration:** Otto, Diesel and Dual cycles; P-V and T-S Diagrams; IC Engines: 2 - Stroke and 4 - Stroke I.C. Engines, S.I. and C.I. Engines.

Unit-IV: Materials and Manufacturing Processes: Engineering Materials, Classification and their Properties; Metal Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Metal Forming: Extrusion, Forging, Rolling, Drawing, Gas Welding, Arc Welding, Soldering, and Brazing.

Unit-V: Machine Tools and Machining Processes: Machine Tools: Lathe Machine and types, Lathe Operations, Milling Machine and types, Milling Operations, Shaper and Planer Machines: Differences, Quick-Return Motion Mechanism, Drilling Machine: Operations, Grinding Machine: Operations

Reference Books:

1. Basic Mechanical Engineering – M.P. Poonia & S.C. Sharma, Khanna Publishing House
2. Elements of Mechanical Engineering – M. L. Mathur, F.S. Mehta and R. P. Tiwari, Jain Brothers, New Delhi
3. Engineering Heat Transfer – Gupta & Prakash, Nem Chand & Brothers, New Delhi
4. Workshop Technology (Vol. 1 and 2) – B. S. Raghuvanshi, Dhanpath Rai and Sons, New Delhi.
5. Basic Mechanical Engineering – J Benjamin
6. Elements of Mechanical Engineering – Roy and Choudhary

7. Engineering Thermodynamics – Spalding and Cole

Course outcomes:

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

CO1	Understand basics of thermodynamics and components of a thermal power plant
CO2	Understand basics of heat transfer, refrigeration and internal combustion engines
CO3	Understand mechanism of thermal power plant and boiler operation
CO4	Identify engineering materials, their properties, manufacturing methods encountered in engineering practice
CO5	Understand functions and operations of machine tools including milling, shaping, grinding and lathe machines

Course Code	:	PPE-314
Course Title	:	COMPUTER AIDED MACHINE DRAWING PRACTICAL
Number of Credits	:	2 (L: 0, T: 0, P: 4)
Prerequisites	:	NIL
Course Category	:	PC

Course Learning Objectives:

- To use computer aided drafting,
- To prepare geometrical model of various machineelements
- To draw the different views of machine elements
- To interpret the drawing in engineering field and illustrate three dimensional objects

Course Content:

1. Introduction to CAD software
2. Drawing aids and editing commands
3. Basic dimensioning, hatching, blocks and views
4. Isometric drawing, printing and plotting
5. CAD drawing practice detailed drawings of following machine parts are given to students to assemble and draw the sectional or plain elevations / plans / and side views with dimensioning and bill of materials using cad software – 12 exercises: sleeve & cotter joint, spigot & cotter joint, knuckle joint, stuffing box, screw jack, foot step bearing, universal coupling, plummer block, simple eccentric, machine vice, connecting rod, protected type flanged coupling.

Reference Books:

1. Bhatt, N.D., Machine Drawing, Charotar Publishing House, 2003.
2. Sidheswar, N., Kannaiah, P.and Sastry, V.V.S., Machine Drawing, Tata McGraw Hill Book Company, New Delhi, 2000.
3. Kannaih, P., Production Drawing, New Age International, 2009

Course outcomes:

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

CO1	Understand the representation of materials used in machine drawing
CO2	Draw the development of surfaces for sheet metal working applications.

CO3	Draw the machine elements including keys, couplings, cotters, riveted, bolted and welded joints.
CO4	Construct an assembly drawing using part drawings of machine components
CO5	Represent tolerances and the levels of surface finish of machine elements.

Course Code	:	PPE-303
Course Title	:	FLUID MECHANICS & HYDRAULIC MACHINERY
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course Learning Objectives:

- To understand fluid flow & related machinery for power generation, water supply and irrigation.
- To Select and use appropriate flow measuring device.
- To Select and use appropriate pressure measuring device.
- To understand and analyze the performance of pumps and turbines.

Course Content:

UNIT-I: Properties of fluid: Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility.

Fluid Pressure & Pressure Measurement: Fluid pressure, Pressure head, Pressure intensity, Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure, Simple and differential manometers, Bourdan pressure gauge, Concept of Total pressure on immersed bodies, center of pressure, Simple problems on Manometers.

Unit-II: Fluid Flow: Types of fluid flows, Path line and Stream line, Continuity equation, Bernoulli's theorem, Principle of operation of Venturimeter, Orifice meter and Pitot tube, Derivations for discharge, coefficient of discharge and numerical problems.

Flow Through Pipes: Laminar and turbulent flows; Darcy's equation and Chezy's equation for frictional losses, Minor losses in pipes, Hydraulic gradient and total gradient line, Numerical problems to estimate major and minor losses

Unit-III: Impact of jets: Impact of jet on fixed vertical, moving vertical flat plates, Impact of jet on curved vanes with special reference to turbines & pumps, Simple Numericals on work done and efficiency.

Unit-IV: Hydraulic Turbines: Layout of hydroelectric power plant, Features of Hydroelectric power plant, Classification of hydraulic turbines, Selection of turbine on the basis of head and discharge available, Construction and working principle of Pelton wheel, Francis and Kaplan turbines, Draft tubes – types and construction, Concept of cavitation in turbines, Calculation of Work done, Power, efficiency of turbines, Unit quantities and simple numericals.

Unit-V: Centrifugal Pumps: Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods, Cavitation, Manometric head, Work done, Manometric efficiency, Overall efficiency. Numericals on calculations of overall efficiency and power required to drive pumps.

Reciprocating Pumps: Construction, working principle and applications of single and double acting reciprocating pumps, Concept of Slip, Negative slip, Cavitation andseparation.

Reference Books:

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Book Publishing Co., Delhi
2. Hydraulic, fluid mechanics & fluid machines – Ramamrutham S, Dhanpath Rai and Sons, New Delhi.
3. Hydraulics and fluid mechanics including Hydraulic machines – Modi P.N.and Seth S.M., Standard Book House. New Delhi
4. One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGrawHill.
5. Hydraulic, fluid mechanics & fluid machines – S. Ramamrutham, Dhanpat Rai and Sons

Course outcomes:

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

CO1	Measure various properties such as pressure, velocity, flow rate using various instruments.
CO2	Calculate different parameters such as co-efficient of friction, power, efficiency etc of various Systems.
CO3	Describe the construction and working of turbines and pumps.
CO4	Test the performance of turbines and pumps.
CO5	Plot characteristics curves of turbines and pumps.

Course Code	:	PEPC219
Course Title	:	HEAT POWER ENGINEERING LAB
Number of Credits	:	1.5 (L: 0, T: 0, P: 3)
Prerequisites	:	PEPC207 HEAT POWER ENGINEERING
Course Category	:	PC

Course Learning Objectives:

- Tounderstand working of various IC Engines and familiarise with various parts of different engines physically
- To understand and relate the working of an engine as studied in theory.
- Understand troubleshooting to rectify some of the problems normally occurring in engines and automobiles.
- Understand and familiarise with the working of air compressor, refrigeration system and steam boilers.

Course Content:

List of Experiments:

PART-A

1. Determine flash and fire point of the given oil using open cup apparatus.
2. Determine flash and fire point of the given oil using closed cup apparatus.
3. Determine the absolute viscosity of the given lubricating oil using Redwood viscometer.
4. Determine the absolute viscosity of the given lubricating oil using Saybolt viscometer.
5. Port timing diagram of two stroke petrol Engine
6. Valve time diagram for four stroke petrol Engine.
7. Valve time diagram for four stroke diesel engines.

PART-B

8. Load test (Performance test) on Four Stroke Petrol Engine.
9. Load test (Performance test) on Four Stroke diesel Engine.
10. Morse test on Multi-cylinder petrol engine.

11. Heat balance test on Four Stroke Petrolengine.
12. Heat balance test on Four Stroke Dieselengine.
13. Volumetric efficiency of Air Compressor.
14. Thermal Conductivity measurement using guarded plate apparatus
15. Determination of COP of Refrigeration System

PART-C

16. Study of high-pressure boiler.
17. Study of boiler mountings and Accessories.

Reference Books:

1. Fundamental of thermodynamics, by Richard E Snnatag, Claus Borgnakke, Gordon J Vanwylen, Wiley Student edition, 6th Ed.,
2. Basic and applied thermodynamics by P.K. Nag ,Tata McGraw hill New delhi 2009
3. Heat engines(Vol-I & Vol-II) by Patel and Karmachandani
4. I. C. Engine Fundamentals by Hey wood
5. Thermal Engineering by R. S. Khurmi

Course outcomes:

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

CO1	Appreciate the practical applications of Bomb calorimeter /Boy's gas calorimeter
CO2	Appreciate the Mechanism of valve functioning in 2 and 4-stroke diesel engine
CO3	Understand the method of evaluating the performance characteristics of single cylinder diesel engine at different loads and draw the heat balance sheet
CO4	Understand the method of finding the indicated power of individual cylinders of an engine by using morse test
CO5	Study of high pressure boiler with model

Course Code	:	PPE-305
Course Title	:	HEAT POWER ENGINEERING
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course Learning Objectives:

- Describe internal combustion engine.
- Select appropriate type of compressor to suit the requirements.
- Calculate performance parameters of Air compressor.
- Understand Refrigeration & Air-conditioning processes and their application.

Course Content:

UNIT-I: Basics of Thermodynamics and Thermodynamic Processes of Perfect Gases: Introduction – definitions and units of mass, weight, volume, density, specific weight, specific gravity and specific volume – pressure – units of pressure – temperature - absolute temperature – S.T.P and N.T.P conditions – heat - specific heat capacity at constant volume and at constant pressure – work – power – energy – types - law of conservation of energy – thermodynamic system – types – thermodynamic equilibrium - properties of systems – intensive and extensive properties –State of System- process – cycle – point and path functions - zeroth , first and second laws of thermodynamics – problems Perfect gases – laws of perfect gases – Boyle's, Charles' , Joule's, Regnault's and Avogadro's laws –General

Gas Equation- characteristic gas equation – relation between specific heats and gas constant – universal gas constant - problems –Thermodynamic Processes-Change in Internal Energy- enthalpy – change in enthalpy – entropy – change in entropy – general equations for change in entropy. Constant volume, constant pressure, isothermal(hyperbolic) , isentropic (reversible adiabatic), polytropic, – p-V and T-s diagrams, work done , change in internal energy , heat transfer , change in enthalpy , change in entropy for various processes – problems - Free expansion and throttling processes.

UNIT-II: Thermodynamic Air Cycles and Steady Flow Energy Equation & Applications: Air cycles – air standard efficiency – reversible and irreversible processes – assumptions in deriving air standard efficiency – Carnot cycle – Otto cycle – Joule cycle – Diesel cycle – comparison of Otto cycle and Diesel cycle - Comparison of ideal and actual p-V diagrams of Otto and Diesel cycles – problems - dual combustion cycle (description only). Steady flow system – control volume – steady flow energy equation – assumptions –Engineering applications – steam boiler – condenser – nozzles – steam and gas turbines – reciprocating and rotary compressors –Centrifugal pump – non flow energy equation – problems.

UNIT-III: Air Compressors: Uses of compressed air – classifications of Air compressor – reciprocating compressor - single stage reciprocating compressor – compression processes – power required to drive the compressor (Neglecting clearance Volume)– problems – clearance volume and its effects – volumetric efficiency – power required to drive the compressor with clearance volume – problems – multi stage compression –merits and demerits –Two stage compressor with imperfect cooling- with perfect inter cooling - work input – condition for minimum work input in multi stage compressor with perfect inter cooling – ratio of cylinder diameters for minimum work input - problems – rotary compressors – Roots blower - vane blowers – centrifugal and axial flow air compressors. Gas turbines –uses - classifications – merits and demerits of gas turbines - constant pressure combustion gas turbine – gas turbine with – intercooler – reheater - regenerator -effects – closed cycle gas turbines - merits and demerits of open and closed cycle gas turbines – jet propulsion -turbojet engines – merits and demerits – turbo propeller engines – merits and demerits - ramjet– merits and demerits –Rocket engines – applications of rockets.

UNIT-IV: Fuels & Combustion of Fuels and Internal Combustion Engines: Classifications of fuels - merits and demerits – requirements of a good fuel – combustion equations – stoichiometric air required for complete combustion of fuels – excess air – products of combustion – problems – analysis of exhaust gases- Orsat apparatus - calorific value of fuels – higher and lower calorific values – Dulong's formula – problems – determination of calorific value – Bomb and Junker's calorimeter – problems -Internal combustion engines. Classifications of I.C Engines – components of I.C Engines and functions material and method of manufacturing - four stroke cycle petrol and diesel engines – two stroke cycle petrol and diesel engines - comparison of four stroke and two stroke engines – Comparison of petrol and diesel engines - valve timing diagram for four stroke petrol and dieselengines – port timing diagram for two stroke petrol and diesel engines.

UNIT-V: Refrigeration and Air- Conditioning: Introduction - COP of Heat Pump and refrigerator, Tonnes of Refrigeration. Vapour compression system - Vapour compression refrigeration cycle, components of Vapour Compression Cycle. Applications- Water Cooler Domestic refrigerator, Ice plant & cold storage. Psychrometry - Properties of air, psychrometric chart & processes (No Numerical) Air conditioning systems - Definition of Air conditioning and classification of Air Conditioning Systems.

Reference Books:

1. Thermal Engg, R. K. Rajput,8th Edition, Laxmi publications Pvt. Ltd, New Delhi.
2. Applied Thermodynamics, P.K. Nag, 2nd Edition, TATAMcGraw – Hill Publishing Company, New Delhi.
3. Thermal Engineering, R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co,New Delhi
4. Thermal Engineering, B. K. Sarkar, 3rd Edition, Dhanpat Rai & Sons New Delhi
5. Applied Thermodynamics, Domkundwar and C. P Kothandaraman, 2nd Edition, Dhanpat Rai & Sons, New Delhi.

Course outcomes:

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

CO1	Explain the basics of systems and laws of thermodynamics and thermodynamic processes. Explain different Air Cycles.
CO2	Apply steady flow energy equation for nozzles and condensers.
CO3	Familiarize the parts, functions and types of Air compressors and determine their efficiency. Describe the working of the gas turbines.
CO4	Explain different type of fuels and their combustion phenomenon.
CO5	Explain the types and functions of IC engines.

Course Code	:	PPE-312
Course Title	:	INDUSTRIAL PRODUCTION TECHNOLOGY-I
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course Learning Objectives:

- To understand the types of pattern, casting, moulding, furnaces and castingprocesses.
- To know the construction and working principles various weldingprocesses.
- Tounderstand various forming technologies and metal powder manufacturing methods.

Course Content:

UNIT-I: Foundry Technology

Patterns: Definition – types of pattern – solid piece – split piece – loose piece – match plate – sweep – skeleton – segmental – shell – pattern materials – pattern allowances.

Moulding: Moulding sand – constituents – types – properties of moulding sand – moulding sand preparation – moulding tools – moulding boxes – types of moulds – green sand mould – dry sand mould – loam sand mould – methods of moulding – Moulding machines – Jolting – Squeezing – sand slinger Construction and working principle. Cores: Essential qualities of core – materials – core sand preparation – core binders – core boxes – CO2 process core making – types of core. Metallurgy: Introduction – Iron-carbon diagram. Melting furnaces: Blast furnace – Cupola furnace – Crucible furnace – types – Pit furnace – Coke fired – Oil fired – Electric furnace – types – Direct arc – Indirect arc – Induction furnace –working principles.

UNIT-II: Casting: Shell mould casting – Investment casting – Pressure die casting – Hot chamber die casting – Cold chamber die casting – Gravity die casting – Centrifugal casting – Continuous casting – Defects in casting – causes and remedies.

UNIT-III: Welding Technology

Arc Welding: Definition – arc welding equipment – electrode types – filler and flux materials – arc welding methods – Metal arc – Metal Inert gas (MIG) – Tungsten inert gas (TIG) - Submerged arc - Electro slag welding – Resistance welding – Spot welding – Butt welding – Seam welding – Plasma arc welding – Thermit welding – Electron beam welding – Laser beam welding – Friction welding – Ultrasonic welding – Induction welding – working principle – applications – Advantages and disadvantages.

Gas welding: Oxy-acetylene welding – advantages – limitations – gas welding equipment –three types of flames – welding techniques – filler rods. – Flame cutting – soldering – brazing – difference between soldering and brazing. Types of welded joints –Selection of welding rod and type of flame for gas welding of ferrous metals- merits and demerits of welded joints – Inspection and testing of welded joints – destructive and non-destructive types of tests – magnetic particle test – radiographic and ultrasonic test - defects in welding – causes and remedies.

UNIT-IV: Forming Technology

Forging: Hot working, cold working – advantages of hot working and cold working – hot working operations – rolling, forging, smith forging, drop forging, upset forging, press forging – roll forging. Press Working: Types of presses – mechanical and hydraulic presses – press tools and accessories – press working operations – bending operations – angle bending – channel bending – curling – drawing – shearing operations – blanking, piercing, trimming – notching – lancing.

UNIT-V: Powder Metallurgy: Methods of manufacturing metal powders – atomization, reduction and electrolysis deposition – compacting – sintering – sizing – infiltration – mechanical properties of parts made by powder metallurgy – design rules for the power metallurgyprocess.

Reference Books:

1. Elements of Workshop Technology Volume I & II, Hajra Chowdry & Bhatt Acharaya, Media Promoters, 11th Edition, 2007
2. Introduction of Basic Manufacturing Processes and Workshop Technology, Rajendersingh, New age International (P) Ltd. New Delhi- 110002,2006
3. Manufacturing Process Begeman, Tata McGraw Hill, New Delhi.
4. Workshop Technology- Volume I, II, & III, WAJ Chapman Viva Books Pvt. Ltd., New Delhi

Course outcomes:

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

CO1	Demonstrate understanding of casting process
CO2	Illustrate principles of forming processes
CO3	Demonstrate applications of various types of welding processes.
CO4	Explains the concepts of rolling, forming and forging.
CO5	Illustrates the concept of powder metallurgy

Course Code	:	PPE-302
Course Title	:	METROLOGY & MEASUREMENTS
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course Learning Objectives:

- To study advances in technology, measurement techniques, types of instrumentation devices, innovations, refinements.
- To study the principles of instrumentation, transducers & measurement of non-electrical parameters like temperature, pressure, flow, speed, force and stress.

Course Content:

UNIT-I: Introduction to measurements: Definition of measurement; Significance of measurement; Methods of measurements: Direct & Indirect; Generalized measuring system; Standards of measurements: Primary & Secondary; Factors influencing selection of measuring instruments; Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range,

Threshold, Hysteresis, calibration; Errors in Measurements: Classification of errors, Systematic and Random error.

Measuring instruments: Introduction; Thread measurements: Thread gauge micrometer; Angle measurements: Bevel protractor, Sine Bar; Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge; Comparators: Characteristics of comparators, Types of comparators; Surface finish: Definition, Terminology of surface finish, Talysurf surface roughness tester; Co-ordinating measuring machine.

Unit-II: Transducers and Strain gauges: Introduction; Transducers: Characteristics, classification of transducers, two coil self-inductance transducer, Piezoelectric transducer; Strain Measurements: Straingauge, Classification, mounting of straingauges, Strain gaugerosettes-twoand threeelements.

Measurement of force, torque, and pressure: Introduction; Force measurement: Spring Balance, Proving ring, Load cell; Torque measurement: Prony brake, Eddy current, Hydraulic dynamometer; Pressure measurement: Mcloed gauge.

Unit-III: Applied mechanical measurements: Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers; Displacement measurement: Linear variable Differential transformers (LVDT); Flow measurement: Rotometers, Turbine meter; Temperature measurement: Resistance thermometers, Optical Pyrometer.

Miscellaneous measurements: Humidity measurement: hair hygrometer; Density measurement: hydrometer; Liquid level measurement: sight glass, Float gauge; Biomedical measurement: Sphygmo monometer.

Unit-IV: Limits, Fits & Tolerances: Concept of Limits, Fits, and Tolerances; Selective Assembly; Interchangeability; Hole And Shaft Basis System; Taylor's Principle; Design of Plug; Ring Gauges; IS

919-1993 (Limits, Fits & Tolerances, Gauges} IS 3477-1973; concept of multi gauging and inspection.

Angular Measurement: Concept; Instruments For Angular Measurements; Working and Use of Universal Bevel Protractor, Sine Bar, Spirit Level; Principle of Working of Clinometers; Angle Gauges (With Numerical on Setting of Angle Gauges).

Screw thread Measurements: ISO grade and fits of thread; Errors in threads; Pitch errors; Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch; Twowire method; Thread gauge micrometer; Working principle of floating carriage dial micrometer.

Unit-V: Gear Measurement and Testing: Analytical and functional inspection; Rolling test; Measurement of tooth thickness (constant chord method); Gear tooth vernier; Errors in gears such as backlash, runout, composite.

Machine tool testing: Parallelism; Straightness; Squareness; Coaxiallity; roundness; run out; alignment testing of machine tools as per IS standard procedure.

Reference Books:

1. Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Metrology & Measurement – Anand K Bewoor,Vinay kulakarni, Tata McGraw Hill, New Delhi, 2009
3. Principles of Industrial instrumentation and control systems – Channakesava. R. Alavala, DELMAR cenage learning, 2009.
4. Principles of Engineering metrology – Rega Rajendra, Jaico publishers, 2008
5. Dimensional Metrology – Connie Dotson, DELMAR, cenage learning, 2007
6. Instrumentation measurement and analysis – B.C. Nakara, K.K. chaudary, second edition, Tata cgraw Hill, 2005.
7. A text book of Engineering metrology – I.C. Gupta, Dhanpat Rai and Sons, New Delhi,2005
8. Metrology for Engineers – J.F.W. Galyer and C. R. Shotbolt,ELBS
9. Engineering Metrology – K. J. Hume, Kalyani publishers

Course outcomes

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

CO1	Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology.
CO2	Distinguish between various types of errors.
CO3	Understand the principle of operation of an instrument and select suitable measuring device for a particular application.
CO4	Appreciate the concept of calibration of an instrument.
CO5	Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form.

Course Code	:	PPE-313
Course Title	:	PRECISION METROLOGY LAB
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	PEPC201 Metrology & Measurements
Course Category	:	PC

Course Learning Objectives

- Tounderstand techniques for precise measurement of the dimensions of various objects and shapes.

Course Content:

I. LINEAR MEASUREMENTS:

1. Determine the thickness of ground MS flat to an accuracy of 0.02mm using Vernier caliper.

2. Determine the diameter and length of cylindrical objects to an accuracy of 0.02mm using vernier caliper.

3. Determine the inside diameter of a bush component to an accuracy of 0.02 using Vernier caliper.

4. Determine the diameter of a cylindrical component to an accuracy of 0.01mm using micrometer and check the result with digital micrometer

5. Determine the height of gauge block or parallel bars to an accuracy of 0.02mm using Vernier height gauge.

6. Determine the depth of a blind bore component to an accuracy of 0.02mm using vernier depth gauge.

7. Determine the thickness of ground MS plates using slip gauges.

II. ANGULAR MEASUREMENTS:

8. Determine the angle of V-block, Taper Shank of Drill and Dovetails in mechanical components using universal bevel protractor.

9. Determine the angle of machined surfaces of components using sine bar with slipgauges.

III. GEOMETRIC MEASUREMENT

10. Measure the geometrical dimensions of V-Thread

11. Measure the geometrical dimensions of spur gear.

IV. MACHINE TOOL TESTING

Geometrical Test: Position of machine tool components and displacement of machine tool components relative to one another is checked.

The instruments required for Geometrical tests are Dial Gauge, test mandrel, Straight edge, Squareness, sprit level.

- Test for level of installation of machine tool in Horizontal and VerticalPlanes.
- Test for Flatness of machine bed and for straightness and parallelism of bed ways on bearing surface.
- Test for perpendicular of guide ways to other guide ways or bearing surface.
- Test for true running of the main spindle and its axial movements.
- Test for parallelism of spindle axis to guide ways or bearingsurfaces.
- Test for line of movements of various members like spindle and table crossslides.
- Practical test in which some test pieces are done and their accuracy and finishis checked.

Reference Books:

1. Measurement System (Application and Design) – Ernest O Doebelin.
2. Mechanical and Industrial measurements- R. K. Jain
3. Engineering precision metrology – R. C. Gupta
4. A text book of engineering of metrology- I. C. Gupta.
5. Hand book of Industrial Metrology – ASME

Course outcomes:

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

CO1	Measure various component of linear measurement using Vernier calipers and Micrometer
CO2	Measure various component of angle measurement using sine bar and bevel Protractor
CO3	Measure the geometrical dimensions of V-thread and spur gear