STATE BOARD OF TECHNICAL EDUCATION BIHAR

Scheme of Teaching and Examinations for

IVth SEMESTER DIPLOMA IN MECHANICAL ENGINEERING

(Effective from Session 2020-21 Batch)

THEORY

Sr. No.	SUBJECT	SUBJECT CODE	TEACHIN G	EXAMINATI ON-SCHEME						
			Periods per Week	Hours of Exam.	Teacher's Assessment (TA) Marks A	Class Test (CT) Marks B	End Semester Exam (ESE) Marks C	Total Marks (A+B+C)	Pass Marks ESE	Pass Marks in the Subject	Credits
1.	Measurements & Metrology	2025401	03	03	10	20	70	100	28	40	03
2.	Strength of Materials	2025402	03	03	10	20	70	100	28	40	03
3.	Thermal Engineering- II	2025403	03	03	10	20	70	100	28	40	03
4.	Theory of Machines & Mechanisms	2025404	03	03	10	20	70	100	28	40	03
5.	Tool Engineering	2025405	03	03	10	20	70	100	28	40	03
		Total: -	**15**				**350**	**500**			**15**

PRACTICAL

Sr. No.	SUBJECT	SUB.JECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME					
			Periods per Week	Hours of Exam.	Practical (ESE)		Total Marks (A+B)	Pass Marks in the Subject	Credits
					Internal(A)	External(B)			
6.	Measurements & Metrology Lab	2025406	02 50% Physical 50% Virtual	03	15	35	50	20	01
7.	Material Testing Lab	2025407	04 50% Physical 50% Virtual	03	15	35	50	20	02
8.	Thermal Engineering Lab-II	2025408	04 50% Physical 50% Virtual	03	15	35	50	20	02
Total: – 10							**150**		**05**

TERM WORK

Sr. No.	SUBJECT	SUBJECT CODE	TEACHING SCHEME	EXAMINATION-SCHEME				
			Periods per Week	Marks of Internal Examiner (X)	Marks of Extern al Examine	Total Marks (X+Y)	Pass Marks in the Subject	Credits
9.	Minor Project	2025409	04	15	35	50	20	02
10.	Course Under Moocs / Swayam / Others	2025410	04	15	35	50	20	02
Total: -			08			100		**24**
Total Periods per week Each of duration One Hour 33				Total Marks = 750				

MEASUREMENTS & METROLOGY

Subject Code 2025401	Theory						Credits
	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03		—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

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

CONTENTS: THEORY

Unit	Name of Topics	Hrs.
Unit-I	**1.1 Introduction:** 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. 1.2 **Measuring instruments**: Introduction; Thread measurements: Thread gauge micrometre; Angle measurements: Bevel protractor, Sine Bar; Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge; Comparators: Characteristics of comparators, Types of comparators. **1.2 Surface finish**: Definition, Terminology of surface finish, Talysurf surface roughness tester; Co- ordinating measuring machine.	**10**
Unit-II	**2.1 Transducers and Strain gauges:** Introduction of Transducers, Characteristics, classification of transducers, two coil self-inductance transducer, Piezoelectric transducer, Strain gauges & Measurements: Strain gauge, Classification, mounting of strain gauges, Strain gauge rosettes-two and three elements. **2.2 Measurement of force, torque, and pressure:** Introduction to Force measurement: Spring Balance, Proving ring, Load cell; Torque measurement: Prony brake, Eddy current, Hydraulic dynamometer; Pressure measurement**:** Mcloed gauge.	**10**
Unit-III	3.1 **Applied mechanical measurements:** Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers; Displacement measurement: Linear variable Differential transformers (LVDT); Flow measurement: Rotameters, Turbine meter; Temperature measurement: Resistance thermometers, Optical Pyrometer. 3.2 **Miscellaneous measurements**: Humidity measurement: hair hygrometer; Density measurement: hydrometer; Liquid level measurement: sight glass, Float gauge; Biomedical measurement: Sphygmo monometer.	**10**
Unit-IV	4.1 **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. 4.2 **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). 4.3 **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	**10**

	diameter, pitch; Two wire method; Thread gauge micrometer; Working principle of floating carriage dial micrometer.	
Unit- V	5.1 **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. 5.2 **Machine tool testing:** Parallelism; Straightness; Squareness; Coaxially; roundness; run out; alignment testing of machine tools as per IS standard procedure.	**10**

References:

1. Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Metrology & Measurement – Annand 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 Rupendra, 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. Engineering Metrology – R.K. Jain, Khanna Publishers, New Delhi, 2005.
8. A text book of Engineering Metrology – I.C. Gupta, Dhanpat Rai and Sons, New Delhi, 2005
9. Metrology for Engineers – J.F.W. Galyer and C. R. Shotbolt, ELBS

10 Engineering Metrology – K. J. Hume, Kalyani publishers

11 Measurement & Metrology - Rohit Bajaj, FPH

12 Measurement & Metrology - Ram Manohar Pandey, FPH

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.**

STRENGTH OF MATERIALS

Subject Code	Theory						Credits
2025402	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

- To understand the concept of Simple Stresses and Strains.
- To understand the concept of Strain Energy.
- To understand the concept of Shear Force and Bending Moment Diagrams.
- To understand the concept of Theory of Simple Bending and Deflection of Beams.
- To understand the concept of Torsion in Shafts and Springs.
- To understand the concept of Thin Cylindrical Shells.

CONTENTS: THEORY

Unit	Name of Topics	Hrs
Unit- I	**1.1 Simple Stresses and Strains:** Types of forces; Stress, Strain and their nature; Mechanical properties of common engineering materials; Significance of various points on stress – strain diagram for M.S. and C.I specimens; Significance of factor of safety; Relation between elastic constants; Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in bodies of uniform section and composite sections; Related numerical problems on the above topics. **1.2 Strain Energy: Strain** energy or resilience, proof resilience and modulus of resilience Derivation of strain energy for the following cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/ shock load; Related numerical problems.	**12**
Unit- II	**2.1 Shear Force & Bending Moment Diagrams**: Types of beams with examples: **a)** Cantilever beam, **b)** Simply supported beam, **c)** Over hanging beam, **d**) Continuous beam, **e)** Fixed beam; Types of Loads – Point load, UDL and UVL; Definition and explanation of shear force and bending moment; **2.2 Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams by the analytical method only for the following cases: a**) Cantilever with point loads, **b)** Cantilever with uniformly distributed load, **c)** Simply supported beam with point loads**, d)** Simply supported beam with UDL, **e)** Over hanging beam with point loads, at the centre and at free ends, **f)** Over hanging beam with UDL throughout, **g)** Combination of point and UDL for the above; Related numerical problems.	**12**
Unit-III	**3.1 Theory of Simple Bending and Deflection of Beams**: Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; As assumptions in theory of simple bending; Bending Equation $M/I = \sigma/y = E/R$ with derivation; calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross-section; Definition and explanation of deflection as applied to beams; Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only); Related numerical problems.	**12**

Unit- IV	**4.1 Torsion in Shafts and Springs:** Definition and function of shaft; Calculation of polar M.I. for solid and hollow shafts; Assumptions in simple torsion; Derivation of the equation **T / J = G*θ / L =τ / r**; Problems on design of shaft based on strength and rigidity; Numerical Problems related to comparison of strength and weight of solid and hollow shafts; Classification of springs; Nomenclature of closed coil helical spring; Deflection formula for closed coil helical spring (without derivation); stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.	**12**
Unit- V	**5.1 Thin Cylindrical Shells:** Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell; Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells; Related numerical Problems for safe thickness and safe working pressure (Related simple problems only)	**12**

Reference Books:

1. **Strength of Materials – D.S. Bedi, Khanna Book Publishing Co. (P) Ltd., Delhi, 2017**
2. **Strength of Materials – B.C.Punmia, A K Jain Laxmi Publica- tions, New Delhi, 2013**
3. **Strength of Materials – S. Ramamrutham, Dhanpat Rai & Publication New Delhi**
4. **Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi**
5. **A Text Book strength of Material – R.K. Bansal, Laxmi Publication New Delhi.**
6. **Strength of Materials - Ravi Agarwal, FPH**
7. **Mechanics of Materials - Roshan Sinha, FPH**

Course outcomes

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

- **CO1** **Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces.**
- **CO2** **Calculate thermal stresses, in bodies of uniform section and composite sections.**
- **CO3** **Define resilience, proof – resilience and modulus of resilience and obtain expressions for instantaneous stress developed in bodies subjected to different loads.**
- **CO4** **Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams of for UDL and Point loads.**
- **CO5** **Calculate the safe load, safe span and dimensions of cross section.**
- **CO6** **Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring.**

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THERMAL ENGINEERING - II

Subject Code	Theory						Credits
2025403	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

- To understand the working and applications of Gas turbines & Jet Propulsion.
- To understand the methods of computing various properties of steam.
- To understand the working of various Steam Boilers, functions of various accessories and mountings of boilers.
- To understand the Working of Steam Nozzles and Steam turbines.
- To understand the necessity of compounding and governing of a turbine.

CONTENTS: THEORY

Unit	Name of Topics	Hrs
Unit-I	**1.1 Gas Turbines:** Air-standard Brayton cycle; Description with p-v and T-S diagrams; Gas tur- bines Classification: open cycle gas turbines and closed cycle gas turbines; comparison of gas turbine with reciprocating I.C. engines and steam turbines. Applications and limitations of gas turbines; General lay-out of Open cycle constant pressure gas turbine; PV and T-S diagrams and working; General lay-out of Closed cycle gas turbine; P-V and T-S diagrams and working. **1.2 Jet Propulsion:** Principle of jet propulsion; Fuels used for jet propulsion; Applications of jet propulsion; Working of a turbojet engine; Principle of Ram effect; Working of a Ram jet engine; Principle of Rocket propulsion; Working principle of a rocket engine; Applications of rocket propulsion; Comparison of jet and rocket propulsions. (Related simple problems only)	**12**
Unit-II	**2.1 Properties of Steam:** Formation of steam under constant pressure; Industrial uses of steam; Basic definitions: saturated liquid line, saturated vapour line, liquid region, vapour region, wet region, superheat region, critical point, saturated liquid, saturated vapour, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, saturated steam, superheated steam, degree of superheat. **2.2 Determination of enthalpy, internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart for the following processes:** Isochoric process, Isobaric process, Hyperbolic process, Isothermal process, Isentropic process, throttling process, Polytropic process; Simple direct problems on the above using tables and charts; **2.3 Steam calorimeters:** Separating, throttling, Combined Separating and throttling calorimeters (Related simple problems only)	**14**

Unit-III	**3.1 Steam Generators:** Function and use of steam boilers; Classification of steam boilers with examples; Brief explanation with line sketches of Cochran, Babcock and Wilcox Boilers; Comparison of water tube and fire tube boilers; Description with line sketches and working of modern high pressure boilers Lamont and Benson boilers; **3.2 Boiler mountings:** Pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve, (dead weight type, spring loaded type, high pressure and low water safety alarm); Boiler accessories: feed pump, economiser, super heater and air pre-heater; Study of steam traps & separators; **3.3 Explanation of the terms:** Actual evaporation, equivalent evaporation, factor of evaporation, boiler horse power and boiler efficiency; Formula for the above terms without proof; Simple direct problems on the above; Draught systems (Natural, forced & induced). (Related simple problems only)	**12**
Unit-IV	**4.1 Steam Nozzles:** Flow of steam through nozzle; Velocity of steam at the exit of nozzle in terms of heat drop using analytical method and Mollier chart; Discharge of steam through nozzles; Critical pressure ratio; Methods of calculation of cross-sectional areas at throat and exit for maximum discharge; Effect of friction in nozzles and Super saturated flow in nozzles; Working steam jet injector; Simple numerical problems.	**10**
Unit-V	**5.1 Steam Turbines:** Classification of steam turbines with examples; Difference between impulse & reaction turbines; Principle of working of a simple Delavel turbine with line diagrams-Velocity diagrams; Expression for work done, axial thrust, tangential thrust, blade and diagram efficiency, stage efficiency, nozzle efficiency; Methods of reducing rotor speed; compounding for velocity, for pressure or both pressure and velocity; Working principle with line diagram of a Parson's Reaction turbine–velocity diagrams; Simple problems on single stage impulse turbines (without blade friction) and reaction turbine including data on blade height. Bleeding, re-heating and re-heating factors (Problems omitted); **5.2 Governing of steam turbines:** Throttle, By Nozzle control governing. (Related simple problems only)	**12**

Reference Books:

1. **A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai & Publication, New Delhi**
2. **Thermal Engineering – R.K. Rajput, Laxmi Publication New Delhi**
3. **Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002**
4. **Treatise on Heat Engineering in MKS and SI Units – V.P. Vasandani & D.S. Kumar, Metropolitan Book Co. Pvt. Ltd, New Delhi.**
5. **Thermal Engineering II -Tarun Maskara , FPH**

Course outcomes

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

CO1 Explain the working cycle of gas turbines, and the working of Jet and Rocket Engines apart from identifying the fuels used for Jet and Rocket propulsion.

CO2 Compute the work done, enthalpy, internal energy and entropy of steam at given conditions using steam tables and Mollier chart.

CO3 Distinguish between water tube and fire-tube boilers and explain the function all the mountings and accessories.

CO4 Calculate Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart.

CO5 State the necessity of governing and compounding of a turbine.

CO6 Explain the principle of working of a steam turbine and distinguish between the impulse turbines and reaction turbines.

THEORY OF MACHINE & MECHANISMS

Subject Code 2025404	Theory						Credits
	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

- To understand different types of cams and their motions and also to draw cam profiles for various motions.
- To understand the mechanism of various types of drives available for transmission of power.
- To understand the design of Brakes, Dynamometers, Bearings and Clutches and their function and working.
- To understand the need for balancing of masses in the same plane
- To know different types of governors.

CONTENTS: THEORY

Unit	Name of Topic	Hrs
Unit-I	Cams and Followers: 1.1 Concept; Definition and application of Cams and Followers; Classification of Cams and Followers; Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation; 1.2 Drawing of profile of radial cam with knife- edge and roller follower with and without Offset with reciprocating motion (graphical method).	**4**
Unit-II	Power Transmission: 2.1 Types of Drives – Belt, Chain, Rope, Gear drives & their comparison; Belt Drives - flat belt, V– belt & its applications; Material for flat and V-belt; Angle of lap, Belt length. Slip and Creep; Determination of Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension; Condition for maximum power transmission (Simple numericals); 2.2 Chain Drives – Advantages & Disadvantages; Selection of Chain & Sprocket wheels; Methods of lubrication; Rope Drives – Types, applications, advantages & limitations of Steel ropes. 2.3 Gear Drives – Spur gear terminology; Types of gears and gear trains, their selection for different applications; Train value & Velocity ratio for compound, reverted and simple epicyclic gear train; Methods of lubrication; Law of gearing;	**14**
Unit-III	3.1 Flywheel and Governors: Flywheel - Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine (no Numericals); Co-efficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance; Governors: Types and explanation with neat sketches (Centrifugal, Watt and Porter); Concept, function and applications& Terminology of Governors; Comparison between Flywheel and Governor.	**14**

Unit-IV	Brakes, Dynamometers, Clutches & Bearings: 4.1 Function of brakes and dynamometers; Types of brakes and Dynamometers; Comparison between brakes and dynamometers; Construction and working of shoe brake, ii) Band Brake, iii) Internal expanding shoe brake iv) Disc Brake; v) Concept of Self Locking & Self energizing brakes; Numerical problems to find braking force and braking torque for shoe & band brakes; 4.2 Construction and working of Rope Brake Dynamometer, Hydraulic Dynamometer, Eddy current Dynamometers; 4.3 Clutches- Uniform pressure and Uniform Wear theories; Function of Clutch and its application; Construction and working of Single plate clutch, ii) Multiplate clutch, iii) Centrifugal Clutch iv) Cone clutch and v) Diaphragm clutch. (Simple numerical on Single and Multiplate clutch); Bearings Simple Pivot, Collar Bearing iii) Conical pivot. Torque & power lost in friction (no derivation). Simple numerical.	**08**
Unit-V	Balancing & Vibrations: 5.1 Concept of balancing; Balancing of single rotating mass; Graphical method for balancing of several masses revolving in same plane; 5.2 Concept and terminology used in vibrations Causes of vibrations in machines; their harmful effects and remedies.	**08**

References:

1. Theory of machines – S.S .Rattan ,Tata McGraw-Hill publications.
2. Theory of machines – R.K.Bansal ,Laxmi publications
3. Theory of machines – R.S. Khurmi&J.K.Gupta ,S.Chand publications.
4. Dynamics of Machines – J B K Das, Sapna Publications.
5. Theory of machines – Jagdishlal, Bombay Metro – Politan book Ltd.
6. Theory of Machines & Mechanisms - Shishir Kumar, FPH
7. Theory of Machines & Mechanisms - Sanjay Goel, FPH

Course outcomes:

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

CO1 Know different machine elements and mechanisms.
CO2 Understand Kinematics and Dynamics of different machines and mechanisms.
CO3 Select Suitable Drives and Mechanisms for a particular application.
CO4 Appreciate concept of balancing and Vibration.
CO5 Develop ability to come up with innovative ideas.
CO6 Understand different types of cams and their motions and also draw cam profiles for various motions.

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TOOL ENGINEERING

Subject Code	Theory						Credits
2025405	No. of Periods Per Week			Full Marks	:	100	03
	L	T	P/S	ESE	:	70	
	03	—	—	TA	:	10	
	—	—	—	CT	:	20	

Course objectives:

- To understand metal cutting and forming process and factors affecting machinability.
- To develop knowledge of tools, dies and tool materials.
- To understand processes for increased productivity and quality.

CONTENTS: THEORY

Unit	Name of Topics	Hrs.
Unit-I	**1.1 Metal Cutting:** Mechanics of Metal cutting; requirements of tools; cutting forces; types of chips; chip thickness ratio; shear angle; simple numerical only; types of metal cutting process; orthogonal; oblique and form cutting. **1.2 Cutting fluids:** types; characteristics and applications. **1.3 Tool wear:** Types of wear; Tool life; Tool life equations	**12**
Unit-II	**2.1 Machinability:** definition; factors affecting machinability; machinability index. **2.2 Tool materials:** Types; characteristics; applications; Heat treatment of tool steels; Specification of Carbide tips; Types of ceramic coatings. **2.3 Cutting Tool Geometry:** Single point cutting tool; drills; reamers; milling; cutters.	**12**
Unit-III	**3.1 Types of dies and construction:** Simple Die; Compound Die; Progressive Die; Combination Die. **3.2 Punch & Die mountings:** pilots; strippers; misfeed detectors; Pressure Pads; Knock outs; stock guide; FeedStop; guide bush; guide pins.	**12**
Unit-IV	4.1 **Die Design Fundamentals:** Die Operations; blanking; piercing; shearing; cropping; notching; lancing; coining; embossing; stamping; curling; drawing; bending; forming; Die set; Die shoe; Die area; Calculation of clearances on die and punch for blanking and piercing dies; Strip layout; Calculation of material utilization factor.	**12**
Unit-V	**5.1 Forming Dies:** Bending methods; Bending Dies; bend allowance; spring back; spanking; bending pressure; pressure pads; development of blank length. **5.2 Drawing:** operations; Metal flow during drawing; Calculation of Drawing blank size; variables affecting metal flow during drawing; single action and double action dies; combination dies. **5.3 Fundamentals of other Tools:** Constructional features of - Pressure Die casting dies; metal extrusion dies; injection molding dies; forging dies; plastic extrusion dies.	**12**

Reference Books:

1. **Tool Design - Donaldson Anglin, Tata McGraw Hill.**
2. **Production Technology- H.M.T.Jain, Tata McGraw Hill.**
3. **A Text Book of Production engineering – P.C. Sharma, S.Chand & Co.**

4. **Production Technology, R.K.Jain, Khanna Publishers. Course outcomes:**

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

5. **Tool Engineering - Prasant Banka, FPH**

Course outcomes

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

CO1	Understand concepts, principles and procedures of tool engineering
CO2	Classify and explain various tools and tool operations
CO3	Select proper tool and a die for a given manufacturing operation to achieve highest productivity
CO4	Estimate tool wear and tool life

MEASUREMENTS & METROLOGY LAB

Subject Code	Theory						Credits
2025406	No. of Periods Per Week			Full Marks	:	50	01
	L	T	P/S	Internal	:	15	
		—	02	External	:	35	
	—	—	—		:		

Course Objectives:

To understand techniques for precise measurement of the dimensions of various objects and shapes. Course Content:

S.No. Topics for practice

I Measure the diameter of a wire using micrometre and compare the result with digital micrometer

II Measure the angle of the machined surface using sine bar with slip gauges.

III Measure the angle of a V-block / Taper Shank of Drill / Dovetail using universal bevel protractor.

IV Measure the dimensions of ground MS flat/cylindrical bush using Vernier Calliper compare with Digital/Dial Vernier Calliper.

V Measure the geometrical dimensions of V-Thread using thread Vernier gauge. VI Measure the thickness of ground MS plates using slip gauges

Reference Books:

1. Engineering Metrology – R. K. Jain
2. Engineering precision metrology – R. C. Gupta
3. A 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 callipers and Micrometre.

CO2 Measure various component of angle measurement using sine bar and bevel Protractor

CO3 Measure the geometrical dimensions of V-thread and spur gear

MATERIAL TESTING LAB

Subject Code	Theory						Credits
2025407	No. of Periods Per Week			Full Marks	:	50	02
	L	T	P/S	Internal	:	15	
		—	04	External	:	35	
					:		

Course Objectives:

- To identify the type of material based on its grain structure
- To learn the procedure for identifying the cracks in the material
- To understand various material testing methods to determine mechanical properties such as yield stress, Ultimatestress, percentage elongation, Young's Modulus etc.

Course Content:

S.No. Topics for practice

I Prepare a specimen and examine the microstructure of the Ferrous and Non- ferrous metals using theMetallurgical Microscope.

II Detect the cracks in the specimen using (i) Visual inspection and ring test (ii) Die penetration test (iii) Magnetic particle test.

III Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminium.

IV Finding the resistance of materials to impact loads by Izod test and Charpy test.

V Torsion test on mild steel – relation between torque and angle of twist determination of shear modulus and shear stress.

VI Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.

VII Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)

VIII Single or double Shear test on M.S. bar to finding the resistance of material to shear load.

Reference Books:

1. Measurement system (Application and Design) – Ernest O Doebelin.
2. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
3. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi

Course outcomes

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

CO1 Identify the given specimen by viewing the micro structure using metallurgical microscope

CO2 Identify the cracks in the specimen using different techniques

CO3 Determine the various types of stress and plot the stress strain diagram for mild steel.

CO4 Determine the torsion, bending, impact and shear values of given materials

CO5 Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring

THERMAL ENGINEERING LAB-II

Subject Code	Theory						Credits
2025408	**No. of Periods Per Week**			Full **Marks**	:	50	**02**
	L	**T**	**P/S**	**Internal**	:	**15**	
		—	**04**	**External**	:	**35**	
	—	—	—		:		

Course Objectives:

- To understand the working of boilers, compressors and IC engines.
- To observe various parts of engines and understand their functions.
- To perform various tests on IC engines and calculate performance parameters.
- To understand economical and optimum running conditions of the engines.

Course Content:

S.No.	Topics for practice
I	Study of high-pressure boiler with model
II	Study of boiler mountings and accessories
III	Conduct performance test on VCR test rig to determine COP of the refrigerator
IV	Conduct performance test on multi stage reciprocating compressor
V	Conduct Morse test to determine the indicated power of individual cylinders
VI	Conduct Performance test on 2-S CI/SI engine.
VII	Conduct Performance test on 4-S CI/SI engine.
VIII	Conduct Heat balance test on CI/SI engine.
IX	Conduct Economical speed test on 4-S CI/SI engine.
X	Thermal conductivity test on 1) Thick slab 2) Composite wall 3) Thick cylinder
XI	Leak detection of refrigeration equipment
XII	Conduct performance test on A/C test rig to determine COP of the refrigerator

Reference Books:

1. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
2. A Course in Thermal Engineering – S. Domkundwar & C.P. Kothandaraman, Dhanpat Rai & Publication New Delhi
3. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, New Delhi

Course outcomes

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

CO1	Evaluate the performance characteristics of single cylinder diesel/petrol engine at different loads and draw the heat balance sheet.
CO2	Find the indicated power of individual cylinders of an engine by using morse test.
CO3	Evaluate the performance characteristics Multi stage air compressor
CO4	Evaluate the co efficient of performance of refrigerator

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TERM WORK

MINOR PROJECT.

Subject Code 2025409	Theory						Credits
	No. of Periods Per Week			Full Marks	:	50	02
	L	T	P/S	Internal	:	15	
		—	04	External	:	35	
	—	—	—		:		

Course objectives:

The projects if done right can help enthusiastic Mechanical engineering students to develop the skills/profile needed for an exciting career in core technologies. Since practical skills are very important to work on core industries, experts tend to analyze candidate's performance based on their project experience during the interviews.

These projects provide an excellent opportunity to learn and showcase your practical skills to your future interviewers easily. If spent qualitatively you can build a very innovative electrical project and get a great learning experience. By doing so, you will not only develop an innovative project but also develop valuable skills needed for a successful career in core technologies related to electrical engineering. The best way to master a subject is by doing projects. Through a project you not only get a deeper understanding of the subject but also gain hands-on practical experience. If you are looking to do internships in college, the best way to catch the companies' attention is through projects.

Projects are generally done as a combined team effort. Two or more students work under a guide or a staff to get a certain result. By doing a project, you will

- Understand your subject better
- Get practical experience
- Chance to showcase your skills
- Learn about team work, communication skills and responsibilities

When companies look for interns, they prefer students who have good understanding of the subject with at least some hands-on experience. The best to achieve both is by doing projects.

There is no fixed time to do a project. You can do it right from your first year in college. If you are looking to do a technical project, then the best time to start would be mid second year. It's not mandatory that you do many projects but make sure that you at least do one project. A lot of students tend to do few small projects from their second year and do a big project in their final year. By showcasing your projects, you can even look for internships while in college.

You can do any kind of projects based on your interests or subjects. The best way to go about this is to figure out what you are interested in. So, the first step is to find your interest and then do projects in your area of interest. Find your area of interest and then do a project in that field.

TERM WORK

COURSE UNDER MOOCS / SWAYAM / OTHERS.

Subject Code	Theory						Credits
2025410	No. of Periods Per Week			Full Marks	:	50	02
	L	T	P/S	Internal	:	15	
		—	04	External	:	35	
	—	—	—		:		