CBCS SCHEME

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18ME32

Third Semester B.E. Degree Examination, July/August 2021
Mechanics of Materials

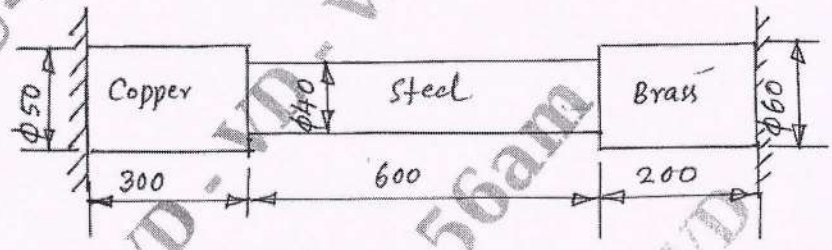
Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Define the terms : (i) Modulus of rigidity (ii) Factor of safety (iii) True stress (iv) Volumetric strain **(04 Marks)**

b. Deduce expression to determine the elongation of tapered rectangular bar of uniform thickness. **(06 Marks)**

c. A composite bar made of copper, steel and brass is rigidly attached to the end supports as shown in Fig. Q1 (c). Determine the stresses in the three portions of the bar when the temperature of the composite system is raised by 70°C, considering that the supports are rigid. Take $E_c = 100\,GPa$, $E_s = 205\,GPa$, $E_b = 95\,GPa$, $\alpha_c = 18\times10^{-6}/^\circ C$, $\alpha_s = 11\times10^{-6}/^\circ C$, $\alpha_b = 19\times10^{-6}/^\circ C$. **(10 Marks)**

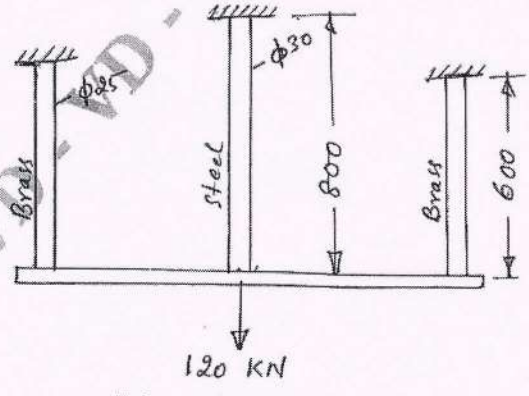


All dimensions are in mm

Fig. Q1 (c)

2 a. Define Bulk modulus. Derive a relationship between Young's modulus, modulus of rigidity and Poisson's ratio. **(10 Marks)**

b. Three equally spaced rods in the same vertical plane support a rigid bar AB. Two outer rods are of brass, each 600 mm long and of 25 mm in diameter. The central rod is of steel that is 800 mm long and 30 mm in diameter. Determine the forces in the rods due to an applied load of 120 kN through the mid point of the bar. The bar remains horizontal after the application of load. Take $\frac{E_s}{E_b} = 2$. The rigid bar system is shown in Fig. Q2 (b). **(10 Marks)**



Dimensions are in mm

Fig. Q2 (b)

3 a. Define Principal plane. Deduce expressions for stresses on an inclined plane in a body subjected to bi-axial stress condition. **(10 Marks)**

b. A thick cylinder has inner and outer diameters as 120 mm and 180 mm respectively. It is subjected to an external pressure of 9 MPa. Find the value of internal pressure which can be applied if the maximum stress is not to exceed 30 MPa. Draw the curves showing the variation of hoop and radial stresses through the material of the cylinder. **(10 Marks)**

4 a. What assumptions are taken in the analysis of thin cylinders? Deduce expressions for the circumferential and longitudinal stresses developed in thin cylinder. **(10 Marks)**

b. A plane element is subjected to stresses as shown in Fig. Q4 (b). Draw the Mohr's circle and determine principal stresses, maximum shear stress and their planes. **(10 Marks)**

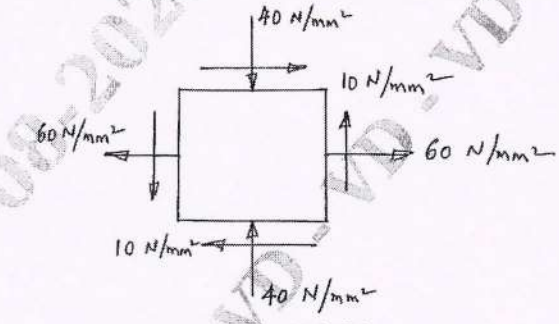


Fig. Q4 (b)

5 a. Draw the shear force and bending moment diagrams for a Cantilever subjected to forces as shown in Fig. Q5(a). **(10 Marks)**

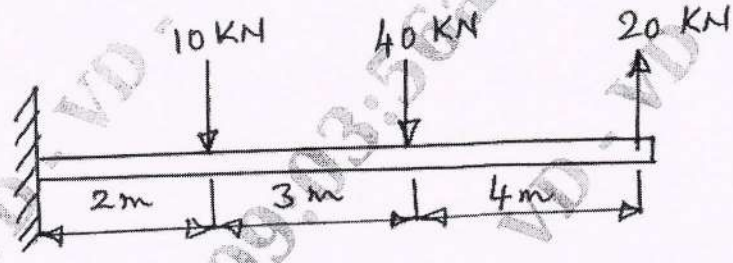


Fig. Q5 (a)

b. Prove the relation $\frac{\sigma_y}{y} = \frac{M}{I} = \frac{E}{R}$ for simple bending. **(10 Marks)**

6 a. A 10 m long simply supported beam is loaded as shown in Fig. Q6 (a). Draw the shear force and bending moment diagrams. **(10 Marks)**

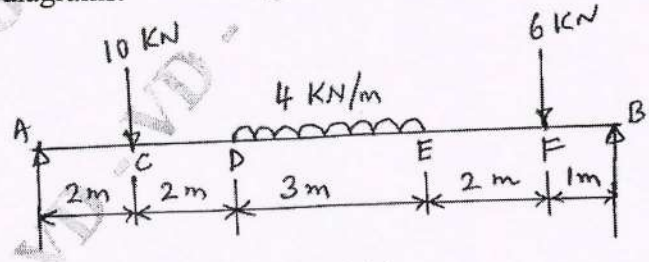


Fig. Q6 (a)

b. A 200 mm × 80 mm I-beam is to be used as a simply supported beam of 6.75 m span. The web thickness is 6 mm and the flanges are of 10 mm thickness. Determine what concentrated load can be carried at a distance of 2.25 m from one support if the maximum permissible stress is 80 MPa. **(10 Marks)**

7 a. A bolt is acted upon by an axial pull of 16 kN along with a transverse shear force of 10 kN. Determine the diameter of the bolt required according to (i) Maximum principal stress theory (ii) Maximum shear stress theory. **(10 Marks)**

b. Deduce the torsion equation with usual notations, stating the assumptions made. **(10 Marks)**

8 a. A shaft transmits 280 kW of power at 160 rpm. Determine

(i) The diameter of solid shaft to transmit the required power.

(ii) The inner and outer diameters of a hollow circular shaft if the ratio of the inner to the outer diameter is $\frac{2}{3}$.

(iii) The percentage saving in the material on using a hollow shaft instead of a solid shaft.

Take the allowable stress as 80 MPa and the density of the material 78 kN/m^3. **(10 Marks)**

b. A thin walled 800 mm long member has the cross section as shown in Fig. Q8 (b). Determine

(i) The maximum torque if the angle carried by the section is limited to 4°.

(ii) The maximum shear stress induced for the maximum torque.

Take G = 82 GPa. **(10 Marks)**

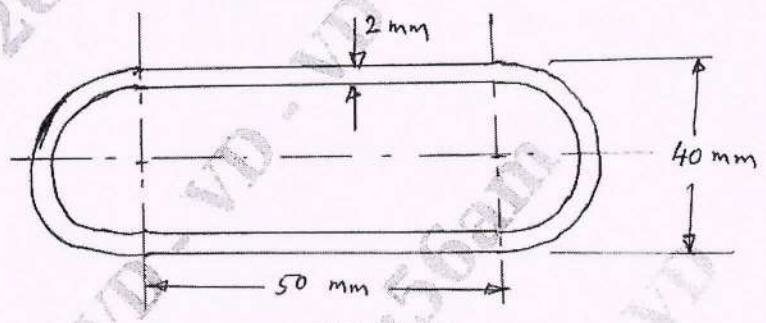


Fig. Q8 (b)

9 a. Derive an expression for Euler's critical load for a column with both ends hinged. **(10 Marks)**

b. A 4-m long hollow alloy tube with inside and outside diameters as 36 mm and 48 mm elongates by 3 mm under a tensile force of 50 kN. Determine the buckling load for the tube when it is used as a column with both ends pinned (hinged) and a factor of safety of 5. **(10 Marks)**

10 a. Derive an expression for strain energy for a member subjected to axial load. **(05 Marks)**

b. Explain Castigliano's theorem – I. **(05 Marks)**

c. Two elastic bars of equal length and of the same material ; one is of circular cross section of 80 mm diameter and the other of square cross section of 80 mm side. Both absorb the same amount of strain energy under axial forces. Compare the stresses in the two bars. **(10 Marks)**

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CBCS SCHEME

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18ME35B/18MEB305

Third Semester B.E. Degree Examination, July/August 2021
Metal Casting and Welding

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1	a.	Explain in detail any four types of pattern allowances.	(10 Marks)
	b.	With neat sketches, explain investment moulding process.	(10 Marks)
2	a.	With neat sketches, explain shell moulding process.	(10 Marks)
	b.	Explain Open Riser and Blind Riser with neat sketches.	(10 Marks)
3	a.	With neat sketches, explain working principle of Cupola furnace.	(12 Marks)
	b.	With net sketches, explain working of Resistance Furnace.	(08 Marks)
4	a.	With neat sketches, explain the steps involved in slush casting process.	(10 Marks)
	b.	With net sketch, explain continuous casting process.	(10 Marks)
5	a.	Explain induction degassing and stream droplet degassing methods with neat sketches.	(12 Marks)
	b.	With neat sketches, explain any four casting defects.	(08 Marks)
6	a.	Describe the need of directional solidification in casting.	(06 Marks)
	b.	State the advantages and limitations of casting process.	(08 Marks)
	c.	With neat sketch, explain stir casting process.	(06 Marks)
7	a.	With neat sketch, explain metal inert gas welding process. Also state its advantages and limitation.	(10 Marks)
	b.	With neat sketch, explain electron beam welding process, also state its advantages.	(10 Marks)
8	a.	State the advantages and limitations of welding processes.	(06 Marks)
	b.	With neat sketch, explain hydrogen welding process.	(08 Marks)
	c.	With neat sketch, explain explosive welding process.	(06 Marks)
9	a.	Explain the different zones in welding with neat sketch.	(06 Marks)
	b.	Differentiate between brazing and soldering.	(08 Marks)
	c.	With neat sketch, explain ultrasonic inspection method.	(06 Marks)
10	a.	With neat sketches, explain any five welding defects.	(10 Marks)
	b.	With neat sketches, explain the types of flames that can be obtained during oxy-acetylene welding process.	(10 Marks)

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CBCS SCHEME

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18ME35A/MEA305

Third Semester B.E. Degree Examination, July/August 2021
Metal Cutting and Forming

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Sketch and explain Tool signature of Single point cutting tool. **(07 Marks)**
b. Determine the Shear Plane angle of Single Point cutting tool. **(10 Marks)**
c. What are the types of chips? **(03 Marks)**

2 a. Sketch and explain the parts of an Engine Lathe. **(10 Marks)**
b. What are the Lathe Operations? **(05 Marks)**
c. Differentiate between Engine Lathe and Capstan and Turret Lathe. **(05 Marks)**

3 a. Sketch and brief about the various Milling Operations. **(10 Marks)**
b. What are the methods of Indexing? **(05 Marks)**
c. Note the differences between drilling , boring and reaming operations. **(05 Marks)**

4 a. What are the differences between Shaper, Planar and Slotter? **(08 Marks)**
b. Sketch and explain Surface Grinding machine. **(12 Marks)**

5 a. What are the effect of Process Parameters on tool life? Explain. **(10 Marks)**
b. What are the functions of cutting fluids? **(05 Marks)**
c. What are the effect of Machining Parameters on Surface finish. **(05 Marks)**

6 a. What is Machinability and Machinability Index? Explain. **(08 Marks)**
b. The following equation for tool life is given for a turning operation ($VT^{(0.13)}.f^{(0.77)}.d^{(0.37)} = C$). A 60min tool life was obtained while cutting at V = 30m/min , f = 0.3mm/rev and depth of mt d = 25mm. Calculate the change in tool life, if the cutting speed , feed , depth of cut are increased by 25%, Individaully and also taken together. What will be their effect on tool life? **(12 Marks)**

7 a. Sketch and explain different forging equipments. **(12 Marks)**
b. Write a note on different forging defects. **(08 Marks)**

8 a. Sketch and explain the types of Rolling Mills. **(12 Marks)**
b. What are the variables in drawing process? **(08 Marks)**

9 a. Sketch and explain Sheet Metal Cutting Operation. **(12 Marks)**
b. Brief out the different variables in drawing process. **(08 Marks)**

10 a. Explain : i) Drawing Ratio ii) Thickness Ratio iii) Drawing Force iv) Blank holding force v) Ironing. **(10 Marks)**
b. Explain with neat sketches, Progressive and Combination dies. **(10 Marks)**

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CBCS SCHEME

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17ME33

Third Semester B.E. Degree Examination, July/August 2021
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions.***
2. ***Use of thermodynamic data book is permitted.***

1 a. Differentiate between open system and control volume. Give examples. **(06 Marks)**

b. With examples, define the following :
(i) Intensive property (ii) Extensive property
(iii) Path function (iv) Point function **(08 Marks)**

c. A constant volume gas thermometer containing a gas gives the reading of gas pressure of 1 bar and 1.5 bar at ice point and steam point respectively. Assuming $T = a + bP$, where P is in N/m^2, express the gas thermometer Celsius temperature T in terms of gas pressure. What is the temperature recorded by the thermometer when it registers a pressure of 1.2 bar. **(06 Marks)**

2 a. List out the similarities and dissimilarities between work and heat. **(06 Marks)**

b. Derive the work done expression for, (i) Isothermal process (ii) Isentropic process. **(06 Marks)**

c. A fluid is heated reversibly at a constant pressure of 1.013 bar until it has a specific volume of 0.1 m^3/kg. It is then compressed reversibly according to a law $PV = C$ to a pressure of 4.2 bar, then allowed to expand reversibly according to a law $PV^{1.3} = C$ to the initial conditions. The work done in the constant pressure process is 515 Nm and the mass of fluid present is 0.2 kg. Calculate the net work done on or by the fluid in the process. Sketch the cycle on P-V diagram. **(08 Marks)**

3 a. Describe Joule's experiment to verify First law of thermodynamics. **(06 Marks)**

b. Why PMMKI and PMMKII are impossible? **(06 Marks)**

c. A centrifugal pump delivers 50 kg of water per second. The inlet and outlet pressures are 1 bar and 4.2 bar. The suction is 2.2 m below the centre of the pump and delivery is 8.5 m above the centre of the pump. The suction and delivery pipe diameters are 20 cm and 10 cm respectively. Determine the capacity of the electric motor to run the pump if pump efficiency is 85%. **(08 Marks)**

4 a. Show that reversible heat engine has higher efficiency than irreversible heat engine. **(10 Marks)**

b. A refrigerator produces 2 tonnes of ice at 0°C per day from water maintained at 0°C. It rejects heat to atmosphere at 27°C. The power to the refrigerator is supplied by an angine which absorbs heat from a source, which is maintained at 227°C by burning fuel of calorific value 20×10^3 KJ/kg. Find the consumption of fuel per hour and the power developed by the engine. Assume both the devices to run on Carnot cycle. Take latent heat of ice as 335 KJ/kg. **(10 Marks)**

5 a. Clearly explain the factors that make a process irreversible. **(10 Marks)**

b. What is internal and external irreversibility? **(04 Marks)**

c. Show that entropy change is an irreversible process. **(06 Marks)**

6 a. State and prove Clausius inequality. **(08 Marks)**

b. The heat engine receives 300 kJ/min of heat from a source at 327°C and rejects heat to a sink at 27°C. Three hypothetical amounts of heat rejections are given below:

(i) 200 kJ/min, (ii) 150 kJ/min (iii) 100 kJ/min

Using entropy concept, state which of these cases is a reversible, irreversible or an impossible one. **(06 Marks)**

c. A perfect gas of mass 1.7 kg and volume 1.5 m^3/kg are compressed reversibly and polytropically from pressure 1 bar to 7.5 bar in a cylinder. The index of compression is 1.25, R = 0.540 kJ/kg K, C_V = 1.687 kJ/kgK. Calculate the work done, heat transfer and change in entropy. **(06 Marks)**

7 a. Define the following:

(i) Available and Unavailable energy.

(ii) Availability.

(iii) II law efficiency. **(06 Marks)**

b. Draw pressure-temperature diagram for a pure substance. Explain its salient features. **(07 Marks)**

c. 15 kg of water is heated in an insulated tank by a churning process from 300 K to 340 K. If the surrounding temperature is 300 K, find the loss in availability for the process. **(07 Marks)**

8 a. With a neat sketch, explain the working of Throttling calorimeter. What are its advantages and disadvantages? **(10 Marks)**

b. A certain quantity of steam in a closed vessel of fixed volume of 0.14 m^3 exerts pressure of 10 bar and 250°C. If the vessel is cooled so that the pressure falls to 3.6 bar, determine (i) final quality of steam (ii) final temperature (iii) change in internal energy (iv) heat transferred during the process. Take C_p = 2.1 kJ/kgK. **(10 Marks)**

9 a. State the following :

(i) Dalton's law of additive pressures.

(ii) Amagat's law of volume additives. **(04 Marks)**

b. Define the psychrometric properties given below:

(i) Wet bulb temperature

(ii) Dew point temperature.

(iii) Specific humidity

(iv) Relative humidity

(v) Degree of saturation

(vi) Dry bulb depression. **(09 Marks)**

c. A mixture of ideal gases consists of N_2 of 3 kg and CO_2 of 5 kg at a pressure of 300 KPa and temperature of 20°C. Find (i) Mole fraction of each constituent (ii) Gas constant of mixture (iii) Molecular weight of mixture (iv) Partial pressures and volumes. **(07 Marks)**

10 a. Write a note on : (i) Law of corresponding states (ii) Compressibility chart. **(06 Marks)**

b. With usual notations, write the Vander-Waal's equation of state. What is the significance of constants 'a' and 'b'. **(06 Marks)**

c. Determine the pressure in a steel vessel having a volume of 15 lit and containing 3.4 kg of N_2 at 400°C using,

(i) Ideal gas equation (ii) Vanderwaal's equation.

Also calculate the compressibility factor by using the answer obtained from the Vanderwaal's equation of state. **(08 Marks)**

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CBCS SCHEME

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18ME34

Third Semester B.E. Degree Examination, July/August 2021
Material Science

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Define Atomic Packing Factor. Calculate APF for Face Cubic Centre (FCC) unit cell. **(08 Marks)**

b. Explain briefly points, line and surface defects, with neat sketches. **(12 Marks)**

2 a. With the help of stress – strain diagram, briefly explain the ductile and brittle behavior of Engineering Materials. **(10 Marks)**

b. Explain slip and twinning, with neat sketches. **(10 Marks)**

3 a. List different types of fatigue loading with examples. **(04 Marks)**

b. Explain with a neat sketch, the different stages of creep. **(08 Marks)**

c. What is meant by Stress Relaxation? Derive an expression for the stress relaxation. **(08 Marks)**

4 a. Construct and label the Iron – Carbon equilibrium diagram and explain briefly. **(10 Marks)**

b. What is Nucleation? Explain homogeneous nucleation in solidification. **(10 Marks)**

5 a. Explain the steps to construct TTT diagram. Draw a labeled sketch of TTT diagram for an eutectoid steel. **(10 Marks)**

b. Explain the following : i) Annealing ii) Normalizing. **(10 Marks)**

6 a. Explain the following : i) Pack carburizing ii) Flame hardening. **(10 Marks)**

b. Briefly explain Microstructure of Grey Cast Iron and SG Iron. Mention the composition , properties and applications of each. **(10 Marks)**

7 a. Explain the process of preparation of MMC using Melting and Casting method (Stir Casting method). **(10 Marks)**

b. Explain the following with neat sketches :
i) Hand layup process ii) Spray process. **(10 Marks)**

8 a. Explain with a neat sketch, the Sheet – Moulding Compound (SMC) process of producing composites. **(08 Marks)**

b. What are the Applications of Composites? **(04 Marks)**

c. Calculate the tensile modulus of elasticity of unidirectional Carbon – fiber reinforced Composite Material which contains 62% by volume of carbon fibers in Iso – strain and Iso – stress condition.
$E_{carbon\ fibers} = 3.86 \times 10^4\ kg/mm^2$ and $E_{epoxy} = 4.28 \times 10^2\ kg/mm^2$. **(08 Marks)**

9 a. Make use of different processing methods for the manufacturing of thermoplastics and explain the following : i) Hydrostatic extrusion ii) Slip casting. **(10 Marks)**

b. Explain the following with neat sketches : i) Calendering ii) Blow moulding. **(10 Marks)**

10 a. Write a note on Piezoelectric materials. **(06 Marks)**

b. List and explain the Biological applications of smart materials. **(06 Marks)**

c. Explain briefly few common NDT methods used for the testing of materials. **(08 Marks)**

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CBCS SCHEME

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17ME34

Third Semester B.E. Degree Examination, July/August 2021
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Define the following:
(i) Elasticity (ii) Ductility (iii) Poison's ratio
(iv) Shear stress (v) Hooks law **(10 Marks)**

b. Derive an expression for the extension of a tapering bar whose diameter D_1 at one end tapers linearly to a diameter D_2 in a length L, under an-axial pull 'P' and Young's modulus E. **(06 Marks)**

c. A bar having cross-sectional area 300 mm^2 is subjected to axial forces as shown in Fig.Q1(c). Find the total elongation of the bar. Take E = 84 GPa.

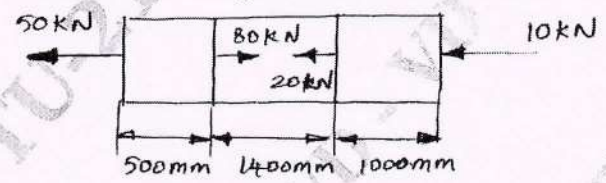

Fig.Q1(c) **(04 Marks)**

2 a. Derive a relation between Young's modulus and Modulus of rigidity. **(10 Marks)**

b. A copper bar of length 160 mm is placed on a rigid support in vertical position. Clearance between the upper support and top surface of the member is 0.1 mm as shown in the Fig.Q2(b). Determine:
(i) Increase in temperature required for the bar to touch the upper support.
(ii) Temperature rise required to induced compressive stress of 100 MPa.
(iii) Stress induced in the bar when its temperature is increased by 90°C and the upper support yields by 0.12 mm.
(iv) Stress induced in the bar when the temperature is increased by 30°C, assume that there is no clearance between upper support and top surface of the bar. Take E_c = 120 GPa and $\alpha_c = 18 \times 10^{-6}$/°C.

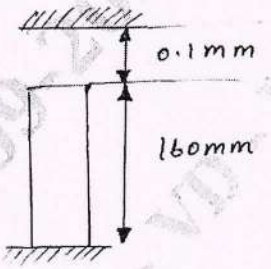

Fig.Q2(b) **(10 Marks)**

3 a. Derive an expression for normal stress and shear stress acting on a inclined plane. **(10 Marks)**

b. A point in a strained member is subjected to tensile stresses 100 MPa and 70 MPa along two mutually perpendicular directions. The point is also subjected to a shear stress 50 MPa such that shear force on vertical face give rise to anticlockwise couple. Determine:
(i) Stresses acting on a plane whose normal is at an angle of 120° with the reference to the 100 MPa stress plane.
(ii) Magnitude of principal stresses and maximum shear stresses
(iii) Orientations of the principal plane and maximum and minimum shear stress planes. Solve the problem using Mohr's circle method. **(10 Marks)**

4 a. Derive an expression for Hoop stress and longitudinal stress for thin cylinder. **(08 Marks)**

b. A thin cylindrical vessel of 1000 mm diameter and 3000 mm length has a metal wall of thickness 10 mm. It is subjected to an internal fluid pressure of 3 N/mm^2. Find the circumferential and longitudinal stresses in the wall. Determine the change in the length, diameter and volume of the cylinder. Assume $E = 2.1 \times 10^5$ N/mm^2 and Poisson's ratio = 0.3. **(12 Marks)**

5 For the beam shown in the Fig.Q5, draw shear force and bending moment diagrams. Locate the point of contraflexure, if any.

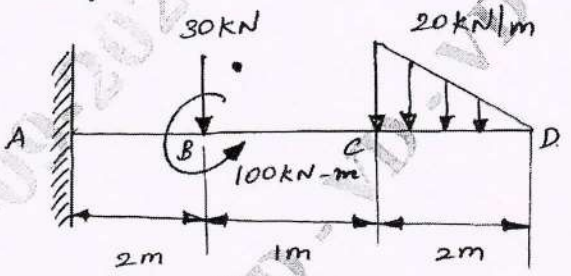

Fig.Q5 **(20 Marks)**

6 a. Derive the deflection equation, $EI\frac{d^2y}{dx^2} = M$. **(06 Marks)**

b. A T section of flange 120 × 12 mm and overall depth is 200 mm with 12 mm web thickness is loaded, such that, at a section it has a moment of 20 kN-m and shear force of 120 kN. Sketch the bending and shear force distribution diagram. **(14 Marks)**

7 a. Derive an expression for torque and shear stress of a shaft. **(08 Marks)**

b. A 2m long hollow cylinder shaft has 80 mm outer diameter and 10 mm wall thickness. When the torsional load on the shaft is 6 kN-m, determine:

(i) Maximum shear stress induced

(ii) Angle of twist

(iii) Also draw the distribution of shear stress in the wall of the shaft. Take G = 80 GPa. **(12 Marks)**

8 a. Derive a Euler's crippling load for a column when both of its ends are hinged. **(10 Marks)**

b. A 2m long column has a square cross-section of side 40 mm. Taking FOS = 4. Determine the safe load for the end conditions.

(i) Both ends are hinged

(ii) One end fixed and other end is free

(iii) Both ends are fixed.

Take E = 210 GPa. **(10 Marks)**

9 a. Derive an expression for strain energy due to shear stresses. **(10 Marks)**

b. Explain:

(i) Maximum principal stress theory

(ii) Maximum shear stress theory **(10 Marks)**

10 a. Derive an expression for the strain energy in bending and strain energy in torsion. **(16 Marks)**

b. A solid circular shaft is 4 m long has a diameter of 80 mm. Find the torsional strain energy stored in it when it is subjected to a torque of 200 N-m. Take G = 80 GPa. **(04 Marks)**

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CBCS SCHEME

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18ME36B/18MEB306

Third Semester B.E. Degree Examination, July/August 2021
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Explain with a neat sketch International Prototype Meter. **(07 Marks)**

b. Discuss the following standards of measurement:
(i) Line standard (ii) Wavelength standard (iii) End standard **(06 Marks)**

c. Explain the classification of standards. **(07 Marks)**

2 a. Explain with a sketch working of Auto Collimator. **(07 Marks)**

b. Build dimension of 49.3115 mm and 68.208 mm using M112 set slip gauges. **(06 Marks)**

c. Explain the process of wringing of slip gauges. **(07 Marks)**

3 a. Explain with a sketch Hole base system and Shaft base system. **(07 Marks)**

b. What is a fit? Explain different types of fits. **(07 Marks)**

c. Differentiate between Inter Changeability and Selective assembly. **(06 Marks)**

4 a. Determine the tolerances on a hole and shaft for a running fit 50H796. Given:
(i) 50 mm lies between 30-50 mm
(ii) $i = 0.45 \sqrt[3]{D} + 0.001D$
(iii) Fundamental deviation for 'H' hole = 0
(iv) Fundamental deviation for 'g' shaft $= -2.5\ D^{0.34}$
(v) IT7 = 16i, IT6 = 10i **(07 Marks)**

b. Explain the needs and characteristics of comparators. **(06 Marks)**

c. Explain with a sketch construction and working of LVDT. **(07 Marks)**

5 a. Explain with a sketch working of Tool Maker's microscope. **(07 Marks)**

b. Sketch and explain the two-wire method of measuring the effective diameter of a screw thread. **(07 Marks)**

c. Derive the expression for Best Size Wire. **(06 Marks)**

6 a. Explain with a neat diagram construction and working of coordinate measuring machine. **(08 Marks)**

b. Explain: (i) Runout (ii) Concentricity (iii) Involute profile (iv) Composite error **(12 Marks)**

7 a. Explain with an example Generalized measurement system. **(08 Marks)**

b. Explain: (i) Accuracy (ii) Threshold (iii) Hysteresis (iv) Sensitivity **(12 Marks)**

8 a. Explain with a neat sketch Ballast circuit. **(10 Marks)**

b. Explain with a neat sketch working of Cathode Ray Oscilloscope (CRO). **(10 Marks)**

9 a. Explain with a neat sketch working of proving ring. **(10 Marks)**

b. Explain with a sketch McLeod Gauge. **(10 Marks)**

10 a. Explain with a sketch Wheatstone Bridge arrangement for strain measurement. **(10 Marks)**

b. What is a thermocouple? Explain the law of thermocouples. **(10 Marks)**

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CBCS SCHEME

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18ME42

Fourth Semester B.E. Degree Examination, July/August 2021
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note:* 1. *Answer any FIVE full questions.
2. Use of thermodynamics data hand book is permitted.

1 a. Derive an expression for efficiency of diesel cycle. **(08 Marks)**

b. The compression ratio in an air-standard Otto cycle is 10. At the beginning of the compression stroke, the pressure is 100 kPa and temperature is 15°C, the heat transfer to the air per cycle is 1800 kJ/kg of air. Determine:
(i) The pressure and temperature at all the salient points.
(ii) Thermal efficiency
(iii) Mean effective pressure **(12 Marks)**

2 a. Explain the process of combustion in C.I. engine with the help of P-θ diagram. **(08 Marks)**

b. In a test of a 4-cylinder, 4-stroke engine 75 mm bore and 100 mm stroke, the following results were obtained at full throttle at a particular constant speed and with fixed fuel supply of 6.0 kg/hr.

B.P. with all cylinders working	15.6 KW
B.P with cylinder no.1 cutoff	11.1 KW
B.P with cylinder no.2 cutoff	11.03 KW
B.P with cylinder no.3 cutoff	10.88 KW
B.P with cylinder no.4 cut off	10.66 KW

If the calorific value of the fuel is 83,600 kJ/kg and clearance volume is 0.0001 m^3, calculate:
(i) Mechanical efficiency
(ii) Indicated Thermal efficiency
(iii) Air standard efficiency **(12 Marks)**

3 a. For a simple gas turbine cycle, the optimum pressure ratio for maximum work output of cycle is $R_p = \left\{\eta_C \eta_t \frac{T_3}{T_1}\right\}^{\frac{\gamma}{2(\gamma-1)}}$. Prove. **(08 Marks)**

b. A gas turbine unit has a pressure ratio of 6:1 and maximum temperature in the cycle is 610°C. The efficiencies of compressor and turbine are 0.8 and 0.82 respectively. Calculate the overall efficiency of the gas turbine cycle. **(12 Marks)**

4 a. With the help of schematic and T-S diagrams, explain the methods of improving the efficiency of gas turbine cycle. **(10 Marks)**

b. In an air-standard Brayton cycle the air enters the compressor at 0.1 MPa and 15°C. The pressure loading the compressor is 1.0 MPa and maximum temperature in the cycle is 1100°C.
(i) Determine compressor work, turbine work and efficiency.
(ii) If an ideal regenerator is incorporated into the cycle determine compressor work, turbine work and efficiency. **(10 Marks)**

5 a. Explain with T-S diagrams, why Rankine cycle is used as an ideal cycle for power generation when compared to Carnot cycle. **(10 Marks)**

b. In a Rankine cycle, steam leaves the boiler and enters the turbine at 4 MPa and 400°C. The condenser pressure is 10 kPa. Determine cycle efficiency. **(10 Marks)**

6 a. With the help of neat diagram, explain the working of reheat cycle and derive an expression for the efficiency of the cycle. **(10 Marks)**

b. In a reheat cycle, steam leaves the boiler and enters the turbine at 4 MPa and 400°C. After expansion in the turbine to 400 kPa, the steam is reheated to 400°C and then expanded in the low pressure turbine to 10 kPa. Determine cycle efficiency. **(10 Marks)**

7 a. With P-H diagram and T-S diagram, explain the effect of super heating and sub cooling, on simple saturated refrigeration cycle. **(08 Marks)**

b. A R-12 plant is to develop 5 tons of refrigeration. The condenser and evaporator temperature are 40°C and –10°C respectively. Determine:

(i) COP of refrigerator
(ii) COP of heat pump
(iii) Power required by compressor **(12 Marks)**

8 a. With the help of sketch and psychrometric chart, explain the working of summer air conditioning system for Mangalore city. **(10 Marks)**

b. Air at 20°C, 40% RH is mixed adiabatically with air at 40°C, 40% RH in the ratio of 1 kg of former with 2 kg latter. Find the final condition of air. **(10 Marks)**

9 a. Derive an expression for volumetric efficiency of a single stage air compressor interms of pressure ratio, clearance volume and 'n' polytropic index. **(08 Marks)**

b. A single stage, double acting compressor has a free air delivery of 14 m^3/min measured at 1.013 bar and 15°C. The pressure and temperature in the cylinder during suction is 0.95 bar and 32°C. The delivery pressure is T bar and index of compression and expansion is 1.3. The clearance volume is 5% of swept volume, find: (i) Indicated power (ii) Volumetric efficiency. **(12 Marks)**

10 a. Explain different shapes of nozzles. **(06 Marks)**

b. Starting from steady flow energy equation, derive an expression for velocity of steam coming out of nozzle. **(06 Marks)**

c. Steam at a pressure of 20 bar and 25°C expands to an exit pressure of 4 bar in a convergent-divergent nozzle. Assuming frictionless flow upto throat and considering frictionless factor of 0.85 from throat to exit. Determine:

(i) Mass flow rate of steam for a throat area of 30 cm^2.
(ii) Exit area of the nozzle. **(08 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | |

17ME42

Fourth Semester B.E. Degree Examination, July/August 2021
Kinematics of Machines

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Differentiate between
(i) Higher and Lower pair
(ii) Mechanism and Machine
(iii) Kinematics and Dynamics **(06 Marks)**

b. With neat sketch explain the types of joints in a kinematic chain. **(06 Marks)**

c. What are the inversions? With sketch describe various inversions of 4 bar chain. **(08 Marks)**

2 a. With a neat proportionate sketch, explain crank and slotted lever quick return motion mechanism. **(10 Marks)**

b. Derive an expression for necessary condition for current steering and explain Ackerman steering gear with neat sketch. **(10 Marks)**

3 In a 4 bar mechanism, the dimensions of the links are under: AB = 50mm, BC = 66mm, CD = 56mm, AD = 100mm. At the instant when $\angle DAB = 60°$, the link AB has an angular velocity of 10.5 rad/s in the counter-clockwise direction. Determine
(i) Angular velocities of links BC and CD
(ii) Velocity of the point E on the link BC when BE = 40mm.
(iii) Velocity of rubbing at pins A, B, C and D when the radii of the pins are 30, 40, 25 and 35mm respectively. **(20 Marks)**

4 a. Explain the method of finding acceleration of slider crank mechanism using Klen's construction **(08 Marks)**

b. State and prove Kennedy's theorem. **(06 Marks)**

c. Write a note on Corioli's component of acceleration. **(06 Marks)**

5 In an IC engine mechanism, crank radius is 50mm and connecting rod length is 200mm. The crank is rotating at 100 rad/s clockwise. At a particular instant the crank is at 40° from TDC position. For this position of the mechanism, find out the velocity of piston using complex algebra method. **(20 Marks)**

6 a. Derive the expression for Freudenstein's equation for 4 bar mechanism. **(12 Marks)**

b. Explain function generation for slider crank mechanism. **(08 Marks)**

7 a. Obtain an expression for the minimum number of teeth on pinion to avoid interference. **(10 Marks)**

b. A pinion with 120mm pitch diameter meshes with a gear of 400mm pcd. The teeth are of module 2mm and pressure angle of 25°. If the addendum of each wheel is 6mm find the angle by which the pinion turns to maintain contact. Also find the maximum sliding velocity, assume pinion is the driver and it rotates at 200 rpm. **(10 Marks)**

8 An epicyclic gear train has a fixed annular wheel A concentric with sun wheel C. The gear A has a 72 teeth and C has 32 teeth. A planet wheel B gears with A and C and is carried on an arm F which rotates about the centre of A at 18 rpm. Determine the speed of gears B and C. **(20 Marks)**

9 The following data relate to a cam profile which operates a knife edge follower rising with SHM and lowering with UARM.
Minimum radius of cam 30mm
Line of stroke of follower is offset 15mm from the axis of the cam.
Lift of the follower 45mm
Angle of ascent 70°
Angle of descent 120°
Angle of dwell in highest position of follower is 45°
Speed of cam 200 rpm in CW direction.
Draw the profile of the cam and determine maximum velocity and acceleration during lift of the follower. **(20 Marks)**

10 A symmetrical cam with convex flanks operates a flat-faced follower. The lift is 8mm, base circle radius is 25mm and the nose radius is 12mm. If the total angle of cam action is 120°, find the radius of the convex flank. Determine the maximum velocity and the maximum acceleration when the cam shaft rotates at 500 rpm. **(20 Marks)**

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CBCS SCHEME

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17ME43

Fourth Semester B.E. Degree Examination, July/August 2021
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions.
2. Use of Thermodynamics data hand book is permitted.

1 a. With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of a diesel cycle. **(10 Marks)**

b. An engine of 250mm bore and 375mm stroke works on otto cycle. The clearance volume is $0.00263m^3$. The initial pressure and temperature are 1 bar and 50°C. If maximum pressure is 25 bar find: i) Air standard efficiency of the cycle ii) Mean effective pressure. **(10 Marks)**

2 a. Derive an expression for the optimum pressure ratio for the maximum network output in an Brayton cycle. **(08 Marks)**

b. What are methods of improving the efficiency of Brayton cycle? **(02 Marks)**

c. The following data refers to an open cycle gas turbine. Pressure ratio = 5, Maximum temperature = 1075K, Minimum temperature = 290K, C_p for gas = 1.15kJ/kg.K, γ for air = 1.4 and γ for gas = 1.33, calorific value of the fuel = 45000kJ/kg, Efficiency of the compressor = 0.85, Efficiency of the turbine = 0.9, Efficiency of combustion = 0.95, Mass flow rate = 5kg/sec, Find: i) Thermal efficiency of the plant ii) Power output of the plant iii) Air to fuel ratio. **(10 Marks)**

3 a. Discuss the effect of i) Boiler pressure ii) Condenser pressure iii) Superheat on the performance of Rankine cycle. with the help of T-S diagram. **(09 Marks)**

b. With a schematic diagram and its P-V and T-S diagrams explain the Rankine cycle and also derive its thermal efficiency. **(11 Marks)**

4 a. With a schematic diagram and its T-S diagram, explain the working of reheat vapour cycle of deduce an expression for cycle efficiency. **(10 Marks)**

b. A steam turbine working of a Rankine cycle is supplied with dry saturated steam at 25 bar and the exhaust takes place at 0.2 bar. For a steam flow rate of 10 kg/s, determine,
i) Quality of steam at the end of expansion
ii) Turbine shaft work
iii) Power required to operate the pump
iv) Work ratio. **(10 Marks)**

5 a. Explain the following terms with reference to a combustion process:
i) Stoichiometric air ii) Enthalpy of formation iii) Enthalpy of combustion
iv) Adiabatic flame temperature v) Enthalpy of reaction. **(10 Marks)**

b. The products of combustion of an unknown hydrocarbon C_xH_y have the following composition as measured by an Orsat apparatus. CO_2 = 8%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%. Determine: i) The composition of fuel ii) The air-fuel ratio iii) The percentage of excess air used. **(10 Marks)**

6 a. Define indicated power. Explain briefly how the frictional power of a multicylinder engine is determined using Morse test. State the assumptions made. **(10 Marks)**

b. A two stroke diesel engine was motored when meter reading was 1.5kW. Test on the engine was carried out for one hour and data observed were, brake torque = 120N-m, rpm = 600, fuel used = 2.5kg, cooling water = 818kg, CV of fuel = 40.3MJ/kg, Rise in temperature of cooling water = 10°C, room temperature = 27°C, A:F used = 32:1, exhaust gas temperature = 347°C, C_p for exhaust gases = 1.05kJ/kg.K. Determine, brake power, indicated power, mechanical efficiency and thermal efficiency. Draw heat balance sheet on minute and percentage basis. **(10 Marks)**

7 a. With a neat sketch, explain the working of vapour absorption refrigeration system. **(10 Marks)**

b. A food storage chamber requires a refrigeration system of 10 Ton capacity with an evaporator temperature of -10°C and condenser temperature of 30°C. The refrigerant F-12 is sub cooled by 5°C before entering the throttle valve and the vapour is superheated by 6°C before entering the compressor. The specific heats of vapour and liquid are 0.7327 and 1.235 respectively. Determine: i) The refrigerating capacity per kg ii) Mass of refrigerant circulated per minute iii) COP. **(10 Marks)**

8 a. Define the following: i) Dry bulb temperature ii) Wet bulb temperature iii) Specific humidity iv) Saturated air v) Degree of saturation. **(10 Marks)**

b. Represent the following processes on a psychrometric chart i) Sensible heating ii) Dehumidification. **(04 Marks)**

c. Atmospheric air at 101.325kPa has 30°C DBT and 15°C DPT, without using the psychrometric chart using the property values from the tables, calculate:
i) Partial pressure of air ii) Specific humidity iii) Relative humidity. **(06 Marks)**

9 a. Derive an expression for volumetric efficiency of a single stage air compressor interms of pressure ratio, clearance ratio and the index of expansion and compression. **(10 Marks)**

b. A single stage double acting reciprocating compressor delivers $0.25m^3/s$. of air measured at 1.013 bar and 27°C. The delivery pressure is 7bar. At the beginning of compression, air is at 0.98 bar and 40°C. The clearance volume is 4% of swept volume. The stroke to bore ratio is 1:3. Compressor runs at 300rpm. Calculate, the volumetric efficiency cylinder dimensions and indicated power if the index of compression and expansion is 1.3. **(10 Marks)**

10 a. Show that the optimum intermediate pressure of a two stage reciprocating air compressor for minimum work is the geometric mean of the suction and discharge pressures. **(10 Marks)**

b. Mention the types of nozzles. Explain any one. **(04 Marks)**

c. A two stage reciprocating air compressor works between pressure limits of 1 bar and 8 bar and draw in air at 15°C at the rate of 467 litres per minute. The compression in both stages is isentropic and inter cooling is perfect. Estimate minimum power supplied. **(06 Marks)**

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12

CBCS SCHEME

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17ME44

Fourth Semester B.E. Degree Examination, July/August 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. State and prove Pascal's law. **(10 Marks)**

b. The right limb of a simple U tube manometer containing Hg is open to the atmosphere. While the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of pipe is 12cms below the level of Hg in the right limb. Find the pressure of liquid or fluid in the pipe if the difference of Hg level in two limbs is 20cm. **(10 Marks)**

2 a. A caisson for closing the entrance to a dry done is of trapezoidal form 16 m wide at the top and 10m wide at the bottom and 6m deep. Find the total pressure and centre of pressure are the caisson, if the water on the outside is just with the tap and dock is empty. **(10 Marks)**

b. The velocity distribution of flow over a plate is parabolic with vertex 30cms from the plane, where the velocity is 180cm/s. If the viscosity of the fluid of 0.9N-s/m^2 find the velocity gradient and shear stresses at distances of 0.15cms and 30cms from the plane. **(10 Marks)**

3 a. Derive continuity equation in Cartesian coordinates for fluid flow in 3-dimensions. **(10 Marks)**

b. Differentiate between:
i) Study flow and Unsteady flow
ii) Viscous flow and Turbulent flow. **(05 Marks)**

c. Define and explain stream function and velocity potential function. **(05 Marks)**

4 a. State assumption in Bernoulli's equation and derive the relation. **(08 Marks)**

b. Differentiate between venturimeter and orificemeter. **(04 Marks)**

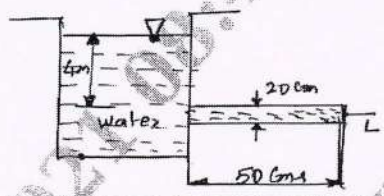
c. A 30cm × 15cm venturimeter is inserted in a vertical pipe line carrying oil of specific gravity 0.85, the flow of oil is upwards. Throat section is 50cm above inlet section of venturimeter. The oil mercury differential manometer gives a reading of 30cm of mercury. Find the rate of oil flow in lts/sec and the pressure difference between inlet and throat section. Assume C_d 0.96. Neglect all losses. **(08 Marks)**

5 a. Derive an expression for loss of head due to sudden enlargement. **(10 Marks)**

b. For laminar flow between the stationary parallel plates. Obtain an expression for velocity distribution. **(10 Marks)**

6 a. Determine the rate of flow of water through a pipe of diameter 20cm and length 50m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. Consider all minor losses and take f = 0.009 in the formula $h_f = \frac{4fLV^2}{2gd}$, refer the Fig.Q.6(a). **(10 Marks)**

Fig.Q.6(a)



b. Lubricating oil of specific gravity 0.85 and dynamic viscosity 0.1N-s/m^2 is pumped through a 3cm diameter pipe. If the pressure drop per metre length of the pipe is 15kPa. Determine:
i) The mass flow rate of oil kg/min
ii) Shear stress at the pipe wall
iii) Reynolds number of the flow and
iv) The power required per 40m length of the pipe to maintain the flow. **(10 Marks)**

7 a. What is the meaning of Boundary layer separation? What is the effect of pressure gradient on boundary layer separation? **(10 Marks)**

b. Using Rayleigh's method, show that the power 'P' developed by a Hydraulic turbine is given by $P = \rho N^3 D^5 \phi\left[\frac{gH}{N^2D^2}\right]$, where ρ = density of the liquid, N = rotational speed of the turbine in rpm, D = Diameter of the runner, H = Working Head, g = gravitational acceleration. **(10 Marks)**

8 a. The rate of discharge Q of a centrifugal pump is dependent upon density of the fluid 'ρ', pump speed N in rpm, diameter of the impeller 'D', pressure 'P', viscosity of the fluid 'μ'. Using Bucking Ham's π theorem method, show that

$$Q = ND^3\phi\left[\frac{P}{\rho N^3D^5}, \frac{\mu}{\rho ND^2}\right]$$ **(10 Marks)**

b. A kite 0.8m × 0.8m weighing 3.924N assumes an angle of 12° to the horizontal. The string attached to the kite makes an angle of 45° to horizontal. The pull on the string is 24.525N, when the wind is flowing at a speed of 30km/hr. Find the corresponding coefficient of drag and lift. Take density of air = 1.25kg/m^3. **(10 Marks)**

9 a. Explain stagnation properties. Obtain an expression for velocity of sound for adiabatic process. **(10 Marks)**

b. A projectile travels in air of pressure 15N/mm^2 at 10°C at a speed of 1500km/hr. Find the Mach number and Mach angle. Assume γ = 1.4 and R = 287J/kg K. **(05 Marks)**

c. What are the normal and oblique shocks? **(05 Marks)**

10 a. Starting from fundamental, show the velocity of propagation of elastic wave in an isothermal medium is given by $C = \sqrt{RT}$. **(06 Marks)**

b. Define the following terms: i) Mach number ii) Mach cone iii) Zone of action iv) Subsonic flow v) Supersonic flow. **(10 Marks)**

c. Explain the meaning of CFD and its applications. **(04 Marks)**

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13

CBCS SCHEME

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17ME46B/17MEB406

Fourth Semester B.E. Degree Examination, July/August 2021
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1	a.	What is metrology? Explain the objectives of metrology.	(05 Marks)
	b.	Explain subdivision of standards.	(07 Marks)
	c.	With a neat sketch, explain International prototype meter.	(08 Marks)
2	a.	Explain the wringing phenomena of slip gauges.	(05 Marks)
	b.	With a neat sketch, explain the working of sine centre.	(07 Marks)
	c.	With a neat sketch, explain the working of autocollimator.	(08 Marks)
3	a.	State and explain Taylor's principle of gauge design.	(05 Marks)
	b.	With neat sketches, explain different types of fit.	(07 Marks)
	c.	Explain the principle of interchangeability and selective assembly.	(08 Marks)
4	a.	Define comparator. What is the need of a comparator?	(05 Marks)
	b.	Explain with a neat sketch the working principle of mechanical optical comparator.	(07 Marks)
	c.	Explain with a neat sketch the working principle of solex pneumatic gauge.	(08 Marks)
5	a.	With a neat sketch, explain screw thread terminology.	(05 Marks)
	b.	Derive an expression for measurement of effective diameter by two wire method.	(07 Marks)
	c.	With a neat sketch, explain the working of Tools maker's microscope.	(08 Marks)
6	a.	With a neat sketch, explain gear teeth terminology.	(05 Marks)
	b.	With a neat sketch, explain the working of coordinate measuring machine.	(07 Marks)
	c.	With a neat sketch, explain the working of laser interferometer.	(08 Marks)
7	a.	Explain generalized measurement system, with a block diagram.	(05 Marks)
	b.	Define: (i) Accuracy (ii) Calibration (iii) Error (iv) Threshold (v) Hysteresis (vi) Least count (vii) Range	(07 Marks)
	c.	Explain with a neat sketch, electronic transducers.	(08 Marks)
8	a.	With a block diagram, explain telemetring system.	(05 Marks)
	b.	With a neat block, explain stylus type oscillography.	(07 Marks)
	c.	With a circuit diagram, explain Ballast circuit.	(08 Marks)
9	a.	With a neat sketch, explain the working of prony brake dynamometer.	(10 Marks)
	b.	With a neat sketch, explain McLeod gauge.	(10 Marks)
10	a.	Define thermocouple. State the laws of thermocouple and explain.	(08 Marks)
	b.	Define strain gauge. With a neat sketch, explain Wheatstone bridge circuit.	(08 Marks)
	c.	Write short notes on: (i) Thermo couple material (ii) Seebeck effect	(04 Marks)

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CBCS SCHEME

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18ME32

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. A mild steel bar of 25mm diameter and 200mm gauge length has an extension of 0.15mm under a load of 75kN. Load at elastic limit is 160kN and maximum load is 250kN. Total extension is 55mm. Diameter at failure is 18.5mm. Find i) Elastic limit ii) Young's modulus iii) Percentage elongation iv) Percentage reduction in area. **(06 Marks)**

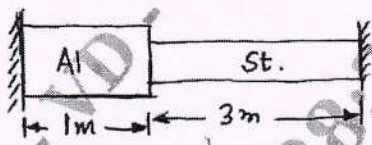
b. A tapered bar of length 'L' having rectangular cross – section of constant thickness 't' is subjected to a tensile force P. Find extension of the bar. **(08 Marks)**

c. Draw typical stress – strain curve for i) Mild steel ii) Aluminum and iii) Brittle material. **(06 Marks)**

OR

2 a. A composite bar is rigidly fitted at the support A and B as shown in Fig. Q2(a). Determine the reactions at the supports when temperature rises by 20^0C. $E_{Al} = 70$ GPa , $E_{St} = 200$ GPa $\alpha_{Al} = 11 \times 10^{-6}/^0$C and $\alpha_{St} = 12 \times 10^{-6}/^0$C. **(08 Marks)**

Fig. Q2(a)



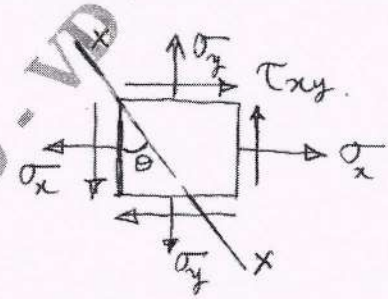
b. Define 'Bulk modulus'. Obtain an expression relating Young's modulus , Bulk modulus and Poisson's ratio. **(06 Marks)**

c. A 500mm long bar has rectangular cross – section 200mm × 40mm. This bar is subjected to
i) 40 kN tensile force on 20mm × 40mm faces
ii) 200 kN compressive force on 20mm × 500mm faces and
iii) 300 kN tensile force on 40mm × 500mm faces.
Find change in volume if E = 200 GPa and $\mu = 0.3$. **(06 Marks)**

Module-2

3 a. Obtain expressions for normal and shear stress acting on a plane XX shown in Fig. Q3(a). **(10 Marks)**

Fig. Q3(a)



b. Draw Mohr's circle and find
i) Maximum shear stress if $\sigma_x = 40$ MPa , $\sigma_y = 20$ MPa and $\tau_{xy} = 0$.
ii) Principal stresses if $\sigma_x = 0$, $\sigma_y = 0$ and $\tau_{xy} = 25$ MPa. **(10 Marks)**

OR

4 a. A thin cylinder of internal radius r_i , thickness t , length 'ℓ' is subjected to internal pressure p_i, find i) expressions for hoop stress and longitudinal stress
ii) expression for volumetric strain. **(10 Marks)**

b. A thick cylinder of outside diameter 300mm and thickness 50mm is subjected to an internal pressure of 40N/mm^2 and an external pressure of 2.5N/mm^2. Find maximum and minimum values of hoop stress and radial stress, Plot the stress variations across the cylinder section. **(10 Marks)**

Module-3

5 a. Obtain expressions relating load, shear force and bending moment. **(06 Marks)**

b. Draw the bending moment and shear force diagrams for the beam shown in Fig. Q5(b) indicating values at important sections. Also find the positions of i) Maximum bending moment ii) Maximum shear force and iii) Point of contraflexure. **(14 Marks)**

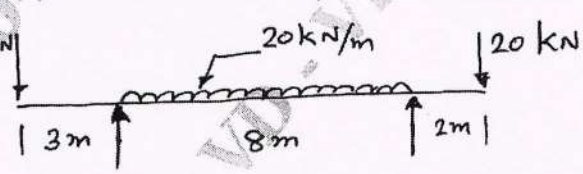


Fig. Q5(b)

OR

6 a. Stating the assumptions of Pure bending theory, derive

$$\frac{M}{I}=\frac{\sigma}{Y}=\frac{E}{R}.$$ **(10 Marks)**

b. A wooden beam 10m long , 360mm deep and 300 mm wide is simply supported and loaded with uniformly distributed load for the entire length. Maximum stress intensity of the material is 60MPa. Find the safe udℓ if factor of safety = 6. **(10 Marks)**

Module-4

7 A solid circular shaft is subjected to a bending moment of 9000 N-m and a twisting moment of 12000N-m. In a tensile test of the same material, it gave the following details :
Stress at yield point = 300Mpa ; Modulus of elasticity = 200GPa ; Poisson's ratio = 0.25.
Assuming factor of safety = 3, find the least diameter required according to i) Maximum Principal stress theory ii) Maximum Shear stress theory. **(20 Marks)**

OR

8 a. State the assumptions of 'Pure torsion' theory and prove

$$\frac{\tau_{max}}{r_0}=\frac{\tau}{r}=\frac{G\theta}{L}.$$ **(08 Marks)**

b. A hollow circular shaft with a 250mm external diameter and thickness of metal 25mm transmits power at 180 rpm. The angle of twist over a length of 3m was found to be 0.72^0. Calculate the power transmitted and the maximum shear stress induced. Modulus of rigidity = 84 GPa. **(12 Marks)**

Module-5

9 a. Obtain an expression for Euler's critical load for a long column with both ends pinned. **(10 Marks)**

b. State the assumptions made in Euler's theory and explain limitations of Euler's estimation of critical load. **(10 Marks)**

OR

10 a. What is Strain Energy? Explain in brief. **(05 Marks)**

b. Obtain an expression for strain energy due to shear stresses. **(05 Marks)**

c. Determine the ratio of strain energy stored in two bars of the same material shown in Fig. Q10 (c), if the gradually applied load is same. **(10 Marks)**

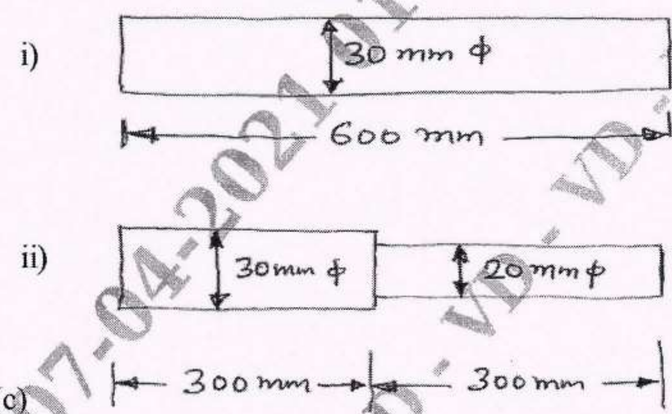


Fig. Q10(c)

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CBCS SCHEME

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18ME33

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note:* 1. *Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of thermodynamic data handbook is permitted.

Module-1

1 a. Explain microscopic and macroscopic approaches to thermodynamics. **(06 Marks)**

b. State and explain Zeroth law of thermodynamics. What is diathermal and adiabatic wall? **(06 Marks)**

c. The temperature t on a Celsius thermometer scale is defined in terms of property P by the relation $P = e^{\frac{(t-B)}{A}}$ where A and B are constants. At ice point and steam points the value of P is 1.86 and 6.81 respectively. Find the value of 't' for P = 2.5. **(08 Marks)**

OR

2 a. With examples distinguish between:
(i) Intensive and extensive property
(ii) Point and path function
(iii) Thermodynamic equilibrium **(10 Marks)**

b. In 1709m Newton proposed a linear temperature scale where ice point and normal human body temperature are maintained as two fixed points of 0°N ad 12°N respectively. The temperature of human body on the Celsius scale is 36°C. Obtain relation between Newton scale and Celsius scale. **(10 Marks)**

Module-2

3 a. Obtain the expression for displacement adiabatic work. **(06 Marks)**

b. Define heat and work with reference to thermodynamic point of view and also the sign convention of heat and work. **(06 Marks)**

c. A cylinder contains 1 kg of certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to law PV^2 = constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position. Heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to its original value of 20 bar. Calculate the net work done by the fluid for an initial volume of 0.05 m^3. **(08 Marks)**

OR

4 a. Apply steady flow energy equation to each of the following:
(i) Boiler (ii) Nozzle (iii) Centrifugal pump
(iv) Throttling device (v) Turbine **(10 Marks)**

b. The working fluid in a steady flow process flows at the rate of 220 kg/min. the fluid rejects 100 kJ/s of heat passing through the system. The fluid enters at a velocity of 320 m/s, pressure of 6 bar, internal energy 2000 kJ/kg, specific volume of 0.36 m^3/kg and leaves the system at a velocity of 140 m/s, pressure of 1.2 bar, internal energy 1400 kJ/kg, specific volume of 1.3 m^3/kg. Determine the power output in MW. The change in potential energy is neglected. **(10 Marks)**

Module-3

5 a. Prove that Kelvin-Planck statement and clausius statements of second law of thermodynamic are equivalent. **(10 Marks)**

b. A reversible heat engine operates between two reservoirs at temperature of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40°C and –20°C. The heat transfer to the heat engine is 2000 kJ and net work output of combined engine refrigerator plant is 360 kJ. Evaluate the heat transfer to the refrigerant and net heat transfer to the reservoir at 40°C. **(10 Marks)**

OR

6 a. Show that entropy is a property of the system. **(04 Marks)**

b. Derive the maximum work attainable from a finite body and a thermal energy reservoir. **(10 Marks)**

c. A lump of steel of mass 10 kg at 627°C is dropped in 100 kg of oil at 30°C. The specific heats of steel and oil are 0.5 kJ/kgK and 3.5 kJ/kgK respectively. Calculate the entropy change of steel, the oil and the universe. **(06 Marks)**

Module-4

7 a. Explain the concept of available and unavailable energy. **(04 Marks)**

b. Write Maxell relations and explain the terms involved. **(06 Marks)**

c. A vessel of volume 0.04 m^3 contains a mixture of saturated water and saturated steam of a temperature of 250°C. The mass of liquid present is 9 kg. Find the pressure, mass, specific volume, enthalpy and internal energy. **(10 Marks)**

OR

8 a. With a neat sketch, explain the working of combined separating and throttling calorimeter. **(10 Marks)**

b. Steam at 10 bar and dry state is cooled under constant pressure until it becomes 0.85 dry. Using steam tables, find the work done, change in enthalpy, heat transferred and change in entropy. **(10 Marks)**

Module-5

9 a. Determine the Vander Waal's constant in terms of critical properties. **(08 Marks)**

b. Explain the following:
(i) Generalized compressibility chart
(ii) Law of corresponding state
(iii) Compressibility factor **(04 Marks)**

c. Determine the pressure exerted by carbon dioxide in a container of 1.5 m^3 capacity when it contains 5 kg at 27°C using (i) Ideal gas equation (iii) Vander Waal's equation. Take Vander Waal's constant for CO_2 as a = 364.3 $kNm^4/kgmol^2$, b = 0.0427 $m^3/kgmol$. **(08 Marks)**

OR

10 a. Explain Dalton's law if partial pressure and Amagat's law of additive volumes with reference to ideal gas mixture. **(08 Marks)**

b. Derive an expression for internal energy and enthalpy of gaseous mixtures. **(04 Marks)**

c. A mixture of gases contains 1 kg of CO_2 and 1.5 kg and N_2. The pressure and temperature of the mixture are 3.5 bar and 27°C. Determine for the mixture :
(i) The mass and mole fraction of each constituent gas
(ii) Average molecular weight
(iii) The partial pressure **(08 Marks)**

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CBCS SCHEME

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18ME34

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Material Science

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Calculate APF for FCC crystal structure. **(06 Marks)**

b. Discuss briefly point and line imperfections in crystals. **(06 Marks)**

c. What is Fick's law of diffusion? Explain the factors affecting diffusion. **(08 Marks)**

OR

2 a. With a stress – strain diagram for mild steel. Explain yield strength, ductility , toughness and ultimate tensile strength. **(06 Marks)**

b. Show that $\epsilon' = \ln(1 + \epsilon)$. **(04 Marks)**

c. A plain – carbon steel rod is subjected to a tensile load of 7000 kg. Assume no change in volume during extension, determine engineering stress, engineering strain , true stress and true - strain. The initial diameter of the rod is 13mm and the specimen under load is 12mm. **(10 Marks)**

Module-2

3 a. Discuss Type I , Type II and Type III fractures. **(10 Marks)**

b. What is Fatigue? Explain fatigue testing with a sketch. **(06 Marks)**

c. Explain three stages of Creep process. **(04 Marks)**

OR

4 a. What is a Solid solution? Discuss Hume – Rothary rules for formation of Solid - solution. **(05 Marks)**

b. Draw a neat Iron – Carbon equilibrium diagram and label all phases and write invariant reactions like eutectoid , eutectic and peritectic reactions. **(10 Marks)**

c. Derive an expression for critical radius in homogeneous nucleation and discuss the significance of this critical radius. **(05 Marks)**

Module-3

5 a. Explain Annealing , Normalizing and Hardening heat treatment processes. **(06 Marks)**

b. With the help of TTT and CCT diagrams, explain mar tempering and give one industrial application. **(10 Marks)**

c. What is Hardenability? Discuss various factors affecting hardenability. **(04 Marks)**

OR

6 a. Discuss 'Nitriding' and 'Flame – hardening' processes. **(08 Marks)**

b. With Aℓ - Cu phase diagram, explain age – hardening process. **(08 Marks)**

c. Explain properties, composition and uses of Gray Cast Iron. **(04 Marks)**

Module-4

7 a. Give a broad classification of composites. **(04 Marks)**

b. Discuss various applications of composites. **(06 Marks)**

c. Explain 'Pultrusion process' for manufacturing composites. **(10 Marks)**

OR

8 a. Discuss 'Characterization of Composites'. **(06 Marks)**

b. Explain 'Filament winding process' for producing FRPs. **(08 Marks)**

c. Calculate the modulus of elasticity, tensile strength and the fraction of the load carried by the fibre for the following composite material stresses under iso strain condition. The composite consists of a continuous glass fibre – reinforced epoxy resin produced by using 60% by volume of E – glass fiber having a modulus of elasticity of 72400×10^6 N/m^2 and a tensile strength of 2400×10^6 N/m^2 and a hardened epoxy resin with a modulus of elasticity of 3100×10^6 N/m^2 and a tensile strength of 60×10^6 N/m^2. **(06 Marks)**

Module-5

9 a. Explain types and properties of Ceramics. **(08 Marks)**

b. Explain 'Injection and Moulding' process for producing polymers. **(06 Marks)**

c. List out various applications of ceramics and polymers. **(06 Marks)**

OR

10 a. What are Smart Materials? Discuss the functioning of shape memory alloy. **(08 Marks)**

b. Explain biological and other applications of SMA. **(06 Marks)**

c. What are the factors to be considered for the Selection of materials? Discuss. **(06 Marks)**

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CBCS SCHEME

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18ME35A

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Metal Cutting and Forming

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. With a neat sketch explain the types of chips formed during metal cutting. **(06 Marks)**

b. Explain the following machining factors.
i) Cutting speed ii) Depth of cuts iii) Metal Removal Rate (MRR) iv) Feed **(08 Marks)**

c. While machining a mild steel rod on the lathe, following results are obtained:
Width of cut = 2.5mm, uncut chips thickness = 0.27mm, chip thickness = 0.7mm,
Rake angle = 0 degree, cutting force = 900N. Thrust force = feed force = 450N. Determine:
i) Chip thickness ratio ii) Chip reduction co efficient
iii) Shear angle iv) Coefficient of friction. **(06 Marks)**

OR

2 a. With neat sketch, how is the size of lathe determined. **(06 Marks)**

b. List and briefly explain the any four operations carried out on lathe. **(10 Marks)**

c. Differentiate between turret and capstan lathe. **(04 Marks)**

Module-2

3 a. Explain the following operations in milling machine:
i) Plain milling ii) Face milling
iii) Angular milling iv) Key slot and groove milling **(08 Marks)**

b. With a neat sketch explain any one type of drilling machine. **(06 Marks)**

c. With a neat sketch explain the operation of Boring, Reaming and Counter Sinking. **(06 Marks)**

OR

4 a. With a neat sketch explain the hydraulic mechanism of a shaper. **(08 Marks)**

b. Mention the advantage and disadvantages of planer. **(06 Marks)**

c. With a neat sketch, explain the plain cylindrical grinding. **(06 Marks)**

Module-3

5 a. What are the factors affecting the tool life. **(08 Marks)**

b. List and explain the types of cutting fluids. **(06 Marks)**

c. List and explain the any two cutting tool materials. **(06 Marks)**

OR

6 a. Briefly explain the economical of metal machining process. **(08 Marks)**

b. Define tool wear. Explain the various form of tool failure. **(08 Marks)**

c. Briefly explain the machinability. **(04 Marks)**

Module-4

7 a. Explain the hot and cold working processes, mention its advantages and disadvantages. **(14 Marks)**

b. Differentiate between press forging and drop forging. **(06 Marks)**

OR

8	a.	Explain the various defects in forging.	**(06 Marks)**
	b.	List the types of rolling mills. Explain any two types of rolling mills.	**(08 Marks)**
	c.	With a neat sketch explain the wire drawing and tube drawing process.	**(06 Marks)**

Module-5

9	a.	With a neat sketch explain the blanking and punching (piercing).	**(06 Marks)**
	b.	With a neat sketch explain the steps in shearing process.	**(08 Marks)**
	c.	Differentiate between compound die and progressive die.	**(06 Marks)**

OR

10	a.	With a neat sketches explain the embossing and coining operation.	**(08 Marks)**
	b.	With a neat sketches, explain the following dies, a) Combination die. b) Progressive die.	**(12 Marks)**

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18ME35B

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Metal Casting and Welding

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Give the complete classification of manufacturing process and give examples for each process. **(06 Marks)**

b. With a neat sketch explain sweep pattern and follow board pattern. **(08 Marks)**

c. With a necessary sketch explain distortion allowance and draft allowance. **(06 Marks)**

OR

2 a. With a neat sketch explain Jolting machine for mould preparation. **(08 Marks)**

b. With a neat sketch explain CO_2 moulding technique. **(06 Marks)**

c. Write a note on following:
i) Hanging core ii) Bottom gate. **(06 Marks)**

Module-2

3 a. With a neat sketch explain gas fired pit furnace. **(06 Marks)**

b. Explain with a neat sketch working of coreless induction furnace. **(06 Marks)**

c. Explain the working of cupola furnace. **(08 Marks)**

OR

4 a. With a neat sketch explain pressure die casting process. **(06 Marks)**

b. Explain the process of centrifugal casting process. **(06 Marks)**

c. Explain the process of continuous casting process. **(08 Marks)**

Module-3

5 a. Explain the variables in the metal solidification process. **(06 Marks)**

b. List the sources of gases in liquid metals and explain vacuum degassing process. **(08 Marks)**

c. With a neat sketch explain induction degassing technique. **(06 Marks)**

OR

6 a. Briefly explain different methods of smoothening the surface of casting. **(06 Marks)**

b. Explaining the following casting defects and list the remedies.
i) Blow hole ii) Mould mismatch iii) cold shut. **(06 Marks)**

c. What a neat sketch explain stir casting process. **(08 Marks)**

Module-4

7 a. Give the complete classification of welding processes. **(06 Marks)**

b. With a neat sketch explain working of TIG welding process. **(06 Marks)**

c. Explain the principle of atomic hydrogen welding process and mention its advantages. **(08 Marks)**

OR

8 a. With a neat sketch explain principle and applications of projection welding process. **(08 Marks)**

b. With a neat sketch explain thermit welding process. **(06 Marks)**

c. Explain Laser welding process and list the advantages and disadvantages. **(06 Marks)**

Module-5

9	a.	Draw a neat sketch and explain terminology of a welding joint.	(06 Marks)
	b.	List the functions of electrode coating in welding electrode.	(06 Marks)
	c.	Explain the following weld defects with simple sketches i) Inclusion ii) Over Penetration iii) Porosity iv) Under cut	(08 Marks)

OR

10	a.	Explain the brazing process and mention its advantages and limitations.	(06 Marks)
	b.	With a neat sketch explain different types of flames in gas welding process.	(06 Marks)
	c.	With a neat sketch explain radiographic inspection of non destructive testing	(08 Marks)

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CBCS SCHEME

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18ME36B/18MEB306

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. What are the objectives of metrology? **(05 Marks)**

b. With a neat sketch explain the Imperial standard yard. **(10 Marks)**

c. A Calibrated metre and bar has an actual length of 1000.0006mm. It is to be used in the calibrate of two bars A and B each having a length of 500mm. When compare with metre bar $L_A + L_B$ was found to be shortened by 0.0003 mm. In compare A with B, it was found that A was 0.0005 mm longer than B. Find the actual length of A and B. **(05 Marks)**

OR

2 a. Explain the wringing phenomena of the slip gauges. **(05 Marks)**

b. Build the dimension 83.3435mm from M87set. **(05 Marks)**

c. With a sketch explain the Autocollimator and how do you measure the straightness with this? **(10 Marks)**

Module-2

3 a. With a general sketch explain the limits, tolerance Fits, Allowances and Deviations. **(10 Marks)**

b. Explain the Hole basis and shaft basis systems for a fits. **(10 Marks)**

OR

4 a. List the functional requirements of a comparator. **(05 Marks)**

b. With a neat sketch explain the electrical comparator. **(10 Marks)**

c. With a sketch label the parts of Zeiss Ultra optimeter. **(05 Marks)**

Module-3

5 a. With a sketch, show the terminology of screw threads. **(05 Marks)**

b. How do you measure the major and minor diameter of an internal threads? **(10 Marks)**

c. Write a note on tool markers microscope. **(05 Marks)**

OR

6 a. Explain the Gear Tooth Thickness measurement using constant chord method. **(10 Marks)**

b. With a neat sketch explain the Gear Roll tester for composite error. **(10 Marks)**

Module-4

7 a. What are the significance of the measurement? **(05 Marks)**

b. Explain the stages in Generalized measurement system. **(10 Marks)**

c. List and brief the classification of errors. **(05 Marks)**

OR

8	a.	Explain the primary and secondary transducers.	**(05 Marks)**
	b.	What are the inherent problems of mechanical intermittent elements?	**(05 Marks)**
	c.	With a neat sketch explain the working of Cathode Ray Oscilloscope.	**(10 Marks)**

Module-5

9	a.	With a sketch explain the Prony Brake dynamometer.	**(10 Marks)**
	b.	Explain the working of a McLeod gauge with a neat sketch.	**(10 Marks)**

OR

10	a.	Explain the mounting of strain gauges.	**(05 Marks)**
	b.	Explain the methods of strain measurements.	**(10 Marks)**
	c.	What are the Laws of Thermocouple?	**(05 Marks)**

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17ME36B/17MEB306

Third Semester B.E. Degree Examination, Jan./Feb.2021
Mechanical Measurement and Metrology

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define the term metrology. List the objectives. **(04 Marks)**

b. Explain with neat sketches:
(i) Principle of sine bar.
(ii) Wringing procedure of slip gauges. **(10 Marks)**

c. Explain with a neat sketch international prototype metre. **(06 Marks)**

OR

2 a. Explain with a neat sketch working principle of Autocollimator. **(07 Marks)**

b. Build up the slip gauge set up by using M112 set for the dimensions:
(i) 49.3115 mm (ii) 92.357 mm (iii) 48.3275 mm **(09 Marks)**

c. Compare line and End standards. **(04 Marks)**

Module-2

3 a. Explain with neat sketches types of fits. **(09 Marks)**

b. Explain Taylor's principle for gauges. **(05 Marks)**

c. Explain : (i) Selective assembly (ii) Significance of hole base and shaft base system **(06 Marks)**

OR

4 a. Explain briefly : (i) Unilateral tolerance (ii) Bilateral tolerance
(iii) Interchangebility **(06 Marks)**

b. Determine the tolerance on the hole and shaft for a precision running fit designated by 50 H_7g_6. Given
(i) 50 mm lies between 30 – 50.
(ii) Fundamental deviation for a shaft = $-2.5D^{0.34}$
(iii) $IT_7 = 16\ i$
(iv) $IT_6 = 10\ i$
State the actual maximum and minimum sizes of hole and shaft with clearances. **(14 Marks)**

Module-3

5 a. Explain with neat sketches the method of measuring minor diameter of external thread and internal thread. **(08 Marks)**

b. Explain with a neat sketch 3 – wire method to find effective diameter of screw thread. **(06 Marks)**

c. Explain with a neat sketch working principle of tool maker's microscope. **(06 Marks)**

OR

6 a. Explain with a neat sketch measuring of gear tooth thickness using gear tooth verneir. **(08 Marks)**

b. Explain with a neat sketch CMM. **(08 Marks)**

c. List any two advantages and disadvantages of LASER. **(04 Marks)**

Module-4

7 a. Briefly explain the generalized system of measurement with an example. **(08 Marks)**

b. Define : Sensitiviy, Hysterisis, Repeatability, Accuracy, Threshold, Precision and Loading effect. **(07 Marks)**

c. What are the advantages of Electrical transducers over mechanical transducers? **(05 Marks)**

OR

8 a. Define error, what are the different types of errors. Explain any two. **(08 Marks)**

b. Write a note on mechanical transducers. Explain Bourdon tube and diaphragam. **(08 Marks)**

c. Explain piezo electric transducers. **(04 Marks)**

Module-5

9 a. Explain with a neat sketch, prony brake dynamometer. **(08 Marks)**

b. Explain with a neat sketch, McLeod vacuum gauge. **(08 Marks)**

c. Write a note on strain measurement. **(04 Marks)**

OR

10 a. Explain Laws of thermocouple. **(09 Marks)**

b. Explain with a neat sketch analytical balance. **(06 Marks)**

c. Briefly explain mounting of strain gauges. **(05 Marks)**

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17ME45B/MEB405

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Machine Tools and Operations

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define Machine tool. Give classification of drilling machines. **(04 Marks)**
b. Briefly explain various parts of Radial drilling machine. **(08 Marks)**
c. With a neat sketch, explain principal parts of horizontal boring machine. **(08 Marks)**

OR

2 a. Define Milling. With a neat sketch, explain Horizontal milling machine. **(10 Marks)**
b. With a neat sketch, explain Vertical Broaching machine. **(06 Marks)**
c. Differentiate between Shaper and Planer. **(04 Marks)**

Module-2

3 a. What is Machining? With a neat sketch, explain relative motion of tool and work piece in milling. **(08 Marks)**
b. Explain briefly, with neat sketches of any Four drilling operations. **(06 Marks)**
c. List the operations performed on grinding machine. Explain any two operations with neat sketches. **(06 Marks)**

OR

4 a. List and explain different machining parameters and related quantities on a shaping machine. **(06 Marks)**
b. Explain Centreless grinding operation, with a neat sketch. **(07 Marks)**
c. Explain Slotting Operation on Slotting Machine. **(07 Marks)**

Module-3

5 a. Explain the geometry of a Single Point Cutting tool, with a neat sketch. **(08 Marks)**
b. Illustrate the desirable properties of cutting tool material. **(05 Marks)**
c. A shaping machine is used to machine a rectangular piece of 18cm long and 35cm width, with a cutting speed of 26 mpm. Feed is 0.8mm per cycle. Cutting stroke is adjusted 20cm. Time for cutting to return stroke is 3:2. Find the time required for machining the whole surface. **(07 Marks)**

OR

6 a. Define Cutting fluid and explain essential properties of cutting fluid. **(07 Marks)**
b. Explain different types of cutting fluids with their application. **(06 Marks)**
c. Find the time required for drilling a 18mm hole in a work piece having – thickness of 50mm. Assume cutting speed of 12 meters per minute and feed 0.2mm/revolution. Neglect the length of approach. **(07 Marks)**

Module-4

7 a. Explain the concept of oblique and Orthogonal cutting. **(08 Marks)**
b. Explain different types of chips, with neat sketches. **(05 Marks)**

c. In an experiment, a pipe is turned on end in Orthogonal cutting conditions with a tool of 20^0 rake angle. A chip – length of 85mm is obtained from an uncut chip length of 202mm while cutting with a depth of cut of 0.5mm. Determine the shear plane angle and chip thickness. **(07 Marks)**

OR

8 a. Draw Merchant circle diagram using usual notations and state the assumptions. **(06 Marks)**

b. Derive an expression for horizontal cutting force in terms of shear force, rake angle, friction angle and shear plane angle in an orthogonal cutting process. **(05 Marks)**

c. A seamless tubing 35mm outside diameter is turned orthogonally on a lathe. The following data is available. Rake angle = 35^0 , Cutting speed = 15m/min , Feed = 0.10mm/rev. Length of continuous chip in one revolution = 50.72mm, Cutting force = 200N , Feed force = 80N. Calculate the Coefficient friction, Shear plane angle , Velocity of chip along tool face and Chip thickness. **(09 Marks)**

Module-5

9 a. Define Tool Life. List out the wear mechanism. Explain any one. **(08 Marks)**

b. Define Machinability. List out the various parameters affecting the machinability. **(06 Marks)**

c. A cast iron bar stock was turned at 50m/min for which, the tool life was 3 hours. For the same material, at 40m/min, the tool life was 5 hours. Find the value of constant C and n in the Taylor's tool life equation. **(06 Marks)**

OR

10 a. Explain various criteria for determining machinability. **(06 Marks)**

b. Explain effect of variations in cutting speed on various cost factors. **(08 Marks)**

c. Determine the optimum cutting speed for an operation carried on a lathe using the following data : Tool change time 4 min , tool regrind time 3 min , machine running cost 20 paise per minute , depreciation tool grind one rupee. Assume values of C and n of Taylor's tool equation as 60 and 1/5 respectively. **(06 Marks)**

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17ME46B/17MEB406

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define Metrology. What are the objectives of metrology from industrial point of view? **(06Marks)**

b. Explain International Prototype Meter with sketch. **(08 Marks)**

c. Three 100mm end bars are measured on a level comparator by first wringing them together and comparing with 300mm bar. There was error of 0.03mm and three bars together have total error of 0.064mm less than the standard bar. Bar A is 0.02mm longer than bar B and 0.025mm longer than bar C. Determine the actual dimensions of all end bars. **(06 Marks)**

OR

2 a. Using M112 set of slip gauges, build the following dimensions :
(i) 49.3115 (ii) 68.208 (iii) 52.496 **(06 Marks)**

b. Sketch and explain Sine bar. **(06 Marks)**

c. Explain the principle of Auto-Collimeter with a neat sketch and list the advantages of wave length standards. **(08 Marks)**

Module-2

3 a. Explain the Hole basis and Shaft basis system. **(06 Marks)**

b. Determine the type of fit after deciding the fundamental deviations and tolerances in the following:
Fit $\phi\ 70H_9e_7$, Diameter step 50 to 80mm, FD for 'e' shaft $= -11D^{0.41}$, $IT_7 = 16i$, $IT_9 = 40i$, i(microns) $= 0.45\sqrt[3]{D} + 0.001D$ **(10 Marks)**

c. Explain Taylor's principle of Gauge design. **(04 Marks)**

OR

4 a. What is a comparator? What are the basic requirements of comparators? **(06 Marks)**

b. Describe with a neat sketch the working of LVDT. Mention its advantages and disadvantages. **(08 Marks)**

c. Sketch and explain Solex comparators. **(06 Marks)**

Module-3

5 a. With the set up, explain how Effective diameter of a screw thread is measured using 3 wire method. **(08 Marks)**

b. Define the following terminology of screw threads:
(i) Angle of the thread, (ii) Pitch, (iii) Major-diameter, (iv) Minor diameter. **(04 Marks)**

c. Explain with a neat sketch of Tool Maker's microscope. What are its applications? **(08 Marks)**

OR

6 a. Explain with a neat sketch, Gear tooth thickness measurement using Gear tooth vernier caliper. **(10 Marks)**

b. Explain construction and working of coordinate measuring machine. Write its applications. **(10 Marks)**

Module-4

7 a. Explain the generalized measurement system with block diagram with an example. **(10 Marks)**

b. Briefly explain the following terms:
(i) Hysteresis (ii) Accuracy (iii) Precision (iv) Threshold (v) Repeatability **(10 Marks)**

OR

8 a. What are the transducers? List the advantages and disadvantages of a Mechanical transducer. **(06 Marks)**

b. Explain Ballast circuit with sketch. **(06 Marks)**

c. Explain the working principle of CRO and give its applications. **(08 Marks)**

Module-5

9 a. Explain with a neat sketch the Analytical balance. **(10 Marks)**

b. Explain with a neat sketch Prony brake dynamometer. What are its limitations? **(10 Marks)**

OR

10 a. State and explain laws of thermocouple. **(04 Marks)**

b. What is Pyrometer? Explain with a neat sketch working principle of Optical Pyrometer. **(10 Marks)**

c. What are the steps to be taken in the preparation of the specimen and mounting of strain gauges? **(06 Marks)**

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CBCS SCHEME

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17ME33

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of thermodynamic data book, steam tables are permitted.

Module-1

1 a. What is thermodynamics? Differentiate between the classical and statistical approaches to thermodynamics. **(06 Marks)**

b. Classify the following into intensive and extensive properties.
i) Enthalpy specific entropy
ii) Viscosity
iii) Quality of steam
iv) Refractive index
v) Roll strength of class. **(06 Marks)**

c. A new scale N of temperature is devised in such a way that the freezing point of ice is 100°N and the boiling point of water is 400°N. What is the temperature reading on this new scale when the temperature is 150°C? At what temperature both the Celsius and the new scale reading would be the same? **(08 Marks)**

OR

2 a. Distinguish between:
i) Point function and path function
ii) Intensive and extensive property. **(08 Marks)**

b. What is flow work? Is it different from displacement work? **(04 Marks)**

c. To a closed system 150kJ of work is supplied. If the initial volume is $0.6m^3$ and pressure of the system changes as $P = 8-4V$, where P is in bar and V is in m^3, determine the final volume and pressure of the system. **(08 Marks)**

Module-2

3 a. State the first law of thermodynamics for a closed system undergoing change of state. Explain the property introduced by this law. **(04 Marks)**

b. What are the limitations of first law of thermodynamics? **(04 Marks)**

c. A stationary fluid system goes through a following cycle:
Process 1-2 isochoric heat addition of 235kJ/kg
Process 2-3 adiabatic expansion to its original pressure with loss of 70kJ/kg in internal energy.
Process 3-1 isobaric compression to its original volume with heat rejection of 200kJ/kg
Prepare a balance sheet of energy quantities. **(12 Marks)**

OR

4 a. Define the following:
   i) Thermal Energy Reservoir (TER)
   ii) Mechanical Energy Reservoir (MER). **(04 Marks)**

b. Show that efficiency of a reversible engine is independent of the nature or amount of the working substance going through the cycle. **(06 Marks)**

c. An inventor claims that his engine has the following specifications:

Heating value of the fuel	: 74500kJ/kg
Temperature limits	: 750°C and 25°C
Power developed	: 75kW
Fuel burnt	: 0.07kg/min

State whether claim is valid or not.

(06 Marks)

ire difference is irreversible. (06 Marks)

t gas whose temperature varies from 127°C
: specific heat varies linearly with absolute
8 + 0.0096T)kJ/kg K. (08 Marks)

ly of system. (06 Marks)

nd impossibility to a thermodynamic cycle.
(06 Marks)

reservoir at the temperature of the normal
voir at the temperature of the triple point of
e engine and the thermal efficiency.
(08 Marks)

(06 Marks)

ays degraded. Explain. (04 Marks)

(10 Marks)

rdinate for a pure substance, whose volume
(04 Marks)

are wet, dry or superheated: Justify your

K (08 Marks)

ethod of estimating quality of wet steam by
(08 Marks)

Module-3

5 a. Explain the conditions for reversibility.

b. Show that heat transfer through a finite temperatu

c. Determine the entropy change of 4kg of a perfec
to 227°C during a constant volume process. The
temperature and is given by the relation $C_v = (0.4$

OR

6 a. Define entropy and show that entropy is a proper

b. Write the criteria of reversibility, irreversibility a

c. A Carnot engine absorbs 200J of heat from a
boiling point of water and rejects heat to a reser
water. Find the heat rejected, the work done by th

Module-4

7 a. Define the following:
   i) Thermodynamic dead state
   ii) Energy
   iii) Second law efficiency

b. Energy is always conserved, but its quality is alw

c. Prove that, $\eta_{II} = \dfrac{\eta_I}{\eta_{carnot}}$

OR

8 a. Draw the phase equilibrium diagram on P-V coo
decreases on melting.

b. State whether the following samples of steam
answer.
   i) Temperature = 200°C, pressure = 1.2MPa
   ii) Pressure = 1MPa volume = 0.235m^3/kg
   iii) Pressure = 500kPa enthalpy = 2530kJ/kg
   iv) Temperature = 100°C entropy = 7.35kJ/kg

c. What is dryness fraction of steam? Explain the m
a combined separating and throttling calorimeter.

Module-5

9 a. State 'Dalton's law of partial pressure' **(04 Marks)**

b. Define the following terms:
   i) Saturated air
   ii) Wet bulb temperature
   iii) Specific humidity
   iv) Dew point temperature. **(04 Marks)**

c. A mixture of gas has the following volumetric analysis. $O_2 = 30\%$, $CO_2 = 40\%$, $N_2 = 30\%$. Determine:
   i) The analysis on a mass base.
   ii) The partial pressure of each component if the total pressure is 100kPa and temperature is 32°C.
   iii) The molecular weight of mixture. **(12 Marks)**

OR

10 a. What is the generalized compressibility chart? Explain. **(04 Marks)**

b. Write the Vander Waal's equation of state. In what ways, it is an improvement over the ideal gas equation of state. **(04 Marks)**

c. One kg-mol of oxygen undergoes a reversible non-flow isothermal compression and the volume decreases from $0.2m^3/kg$ to $0.08m^3/kg$ and the initial temperature is 60°C. If the gas obeys Vander Waal's equation find: i) the work done during the process ii) the find pressure. **(12 Marks)**

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CBCS SCHEME

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17ME34

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define :
(i) Hook's law (ii) Poisson's ratio (iii) Modulus of rigidity (iv) Modulus of elasticity (v) Bulk modulus. **(05 Marks)**

b. Draw stress-strain diagram of a mild steel and name the salient points. **(05 Marks)**

c. A brass bar having cross-sectional area 300 mm^2 is subjected to axial forces as shown in Fig.Q1(c). Find the total elongation of the bar. E = 84 GPa. **(10 Marks)**

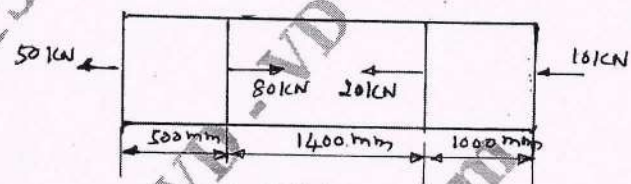

Fig.Q1(c)

OR

2 a. Define :
(i) Elasticity (ii) Plasticity (iii) Stiffness (iv) Resilience (v) Toughness **(05 Marks)**

b. Derive a relation between modulus of elasticity, modulus of rigidity and bulk modulus. **(05 Marks)**

c. At room temperature the gap between two bars as shown in Fig.Q2(c) is 0.25 mm. What are the stresses induced in the bars, if temperature rise is 35°C. Given A_A = 1000 mm^2, A_B= 800 mm^2, E_A= 2×10^5 MPa, E_B= 1×10^5 MPa, α_A= 12×10^{-6} per °C, α_B= 23×10^{-6} per °C.

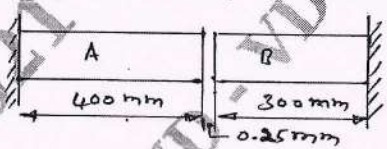

Fig.Q2(c) **(10 Marks)**

Module-2

3 a. Define principal plane and principal stress. **(02 Marks)**

b. Derive an expression for hoop stress and longitudinal stress for thin cylinder. **(06 Marks)**

c. At a point in a strained material the stress condition shown in Fig.Q3(c). Find
(i) Normal and shear stresses on the inclined plane AB.
(ii) Principal stress and principal planes
(iii) Maximum shear stress. **(12 Marks)**

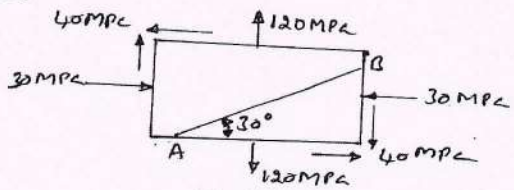

Fig.Q3(c)

OR

4 a. Derive Lame's equation for thick cylinder. **(08 Marks)**

b. A pipe of 500 mm internal diameter and 75mm thick is filled with a fluid at a pressure of 6 N/mm^2. Find the maximum and minimum hoop stress across the cross-section of the cylinder. Also sketch the radial pressure and hoop stress distribution across the section. **(12 Marks)**

Module-3

5 a. Derive the relations between intensity of load 'W', shear force 'F' and bending moment 'M' in the beam. **(06 Marks)**

b. Draw bending moment and shear force diagram for the beam shown in Fig.Q5(b). Clearly indicate the point of contraflexure. **(14 Marks)**

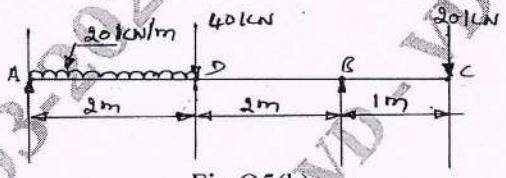

Fig.Q5(b)

OR

6 a. Derive the relationship between bending stress and radius of curvature. **(06 Marks)**

b. The T-section shown in Fig.Q6(b) is used as a simply supported beam over a span of 4 meters. It carries an uniformly distributed load of 8 kN/m over its entire span. Calculate the maximum tensile and compressive stresses occurring in the section. **(14 Marks)**

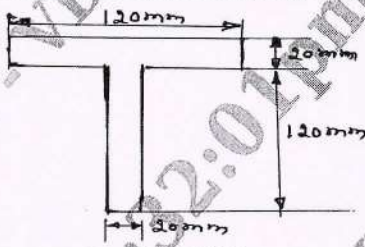

Fig.Q6(b)

Module-4

7 a. Derive the torsional equation. **(10 Marks)**

b. A solid shaft rotating at 1000 rpm transmits 50 kW. Maximum torque is more than 20% of mean torque. Material of the shaft had the allowable shear stress of 50 MPa and G = 80 GPa. Angle of twist in the shaft should not exceed 1° per meter length. Determine the diameter of the shaft. **(10 Marks)**

OR

8 a. Derive the expression for crippling load for a column when both ends are hinged. **(10 Marks)**

b. Determine the crippling load for a T-section of dimensions 100mm × 100mm × 20mm and length of column 12m with both ends fixed. Take E = 210 GPa. **(10 Marks)**

Module-5

9 a. Explain : (i) Castigliano's first theorem (ii) Castigliano's second theorem **(10 Marks)**

b. A cantilever beam of uniform cross-section carries a point load at the free end. Determine strain energy and deflection at the free end, if F = 200 kN, E = 200 GPa, L = 3 mt and I = 10^{-4} m^4. **(10 Marks)**

OR

10 a. Explain maximum normal stress theory and maximum shear stress theory. **(10 Marks)**

b. A machine member made of C40 steel having the yield stress of 328.6 MPa is loaded as follows. σ_x = 60 MPa, σ_y = –20 MPa and τ_{xy} = 30 MPa. Determine the factor of safety by (i) Maximum normal stress theory (ii) Maximum shear stress theory. **(10 Marks)**

CBCS SCHEME

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15ME33

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Thermodynamics Hand Book is permitted.
3. Assuming missing data suitably (if any).

Module-1

1 a. Define the following: i) State ii) Thermodynamic equilibrium iii) Process and path **(06 Marks)**

b. Define: i) Ice point ii) Steam point on temperature scales
What do you understand by Thermodynamic temperature scale? **(06 Marks)**

c. The temperature t on a scale is defined in terms of a property K by the relation $t = a \ln k + b$ (where a and b are constants). The values of K are found to be 1.83 and 6.78 at the ice point and the steam point, the temperature of which are assigned numbers 0 and 100 respectively. Determine the temperature corresponding to a reading of K equal to 2.42 on the thermometer. **(04 Marks)**

OR

2 a. List similarities between Heat and Work. **(04 Marks)**

b. Obtain expressions for thermodynamic work for i) $PV = C$ ii) $PV^n = C$. **(06 Marks)**

c. A piston cylinder device operates 1 kg of fluid at 20atm pressure. The initial volume is $0.04m^3$. The fluid is allowed to expand reversibly following a process $PV^{1.45} = C$ so that the volume doubles. Fluid is then cooled at constant pressure until the piston comes back to the original position. Keeping the piston position unaltered head is added reversibly to restore it to the initial pressure calculate the work done in the cycle. **(06 Marks)**

Module-2

3 a. State first law of Thermodynamics for a closed system undergoing a cycle. Explain Joule's experiment. **(06 Marks)**

b. Show that energy is a properly and a point function. **(04 Marks)**

c. In a gas turbine the gas enters at the rate of 5kg/s with a velocity of 50m/s and enthalpy of 900kJ/kg and leaves the turbine with a velocity of 150m/s and enthalpy of 400 kJ/kg. The loss of heat from the gases to the surroundings is 25kJ/kg. Assume R for gas = 0.285kJ/kg K and C_p = 1.004 kJ/kg K and the inlet conditions to be at 100kPa and 27°C. Determine the power output of the turbine and the diameter of the inlet pipe. **(06 Marks)**

OR

4 a. State the two classical statements of the second law of thermodynamics. Indicate all processes on i) P-V and ii) T-S diagrams for a reversible carnot heat engine. **(06 Marks)**

b. A car engine with a power output of 48.47kW has a thermal efficiency of 24%. Determine the fuel consumption rate of this car if the fuel has a heating value of 44000kJ/kg. Express fuel consumption in both kg/s and kg/h. **(05 Marks)**

c. A heat pump is used to maintain the temperature of a house at 20°C. On a day when the outdoor air temperature drops to -2°C, the house is estimated to lose heat at a rate of 80000kJ/h. If the heat pump under these conditions has a COP of 2.5, determine: i) The power consumed by the heat pump ii) The rate at which heat is absorbed from the cold outdoor air. **(05 Marks)**

Module-3

5 a. What are internally and externally reversible processes? List the factors causing irreversibilities. **(04 Marks)**

b. Explain "The reversed carnot cycle" on a P-V diagram. State "Carnot Principles" pertaining to thermal efficiency of reversible and irreversible (actual) heat engines. **(06 Marks)**

c. A heat source at 800K loses 2000kJ of heat of a sink at i) 500K and ii) 750K. Determine which heat transfer process is more irreversible. **(06 Marks)**

OR

6 a. State and prove Clausius in equality. **(05 Marks)**

b. Discuss "The increase of entropy principle" and entropy generation applying Clausius inequality to a cyclic process. **(05 Marks)**

c. One kg steam at 2.0 bar and quality 0.9 is heated in a rigid vessel to a temperature of 400°C. Calculate the final pressure and change in entropy of steam. **(06 Marks)**

Module-4

7 a. Define:
i) Available energy
ii) Unavailable energy
iii) Dead state
iv) Maximum useful work
v) Second law efficiency. **(10 Marks)**

b. In a certain process, a vapour while condensing at 420°C, transfers heat to water evaporating at 250°C. The resulting steam is used in a power cycle which rejects heat at 35°C. What is the fraction of the available energy in the heat transferred from the process vapour at 420°C that is lost due to the irreversible heat transfer at 250°C? Represent the process on a T-S diagram. **(06 Marks)**

OR

8 a. Define: i) Triple point ii) Subcooled liquid. **(04 Marks)**

b. Sketch and explain throttling calorimeter. Also plot throttling process on T-S and h-s plots. **(06 Marks)**

c. A vessel of volume 0.04m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°C. The mass of the liquid present is 9kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy. **(06 Marks)**

Module-5

9 a. State Dalton's law of partial pressures and define
i) Mole fraction ii) Gas constant for the mixture iii) Density of the mixture. **(08 Marks)**

b. A certain gas has $C_p = 1.968$ and $C_v = 1.507$ kJ/kg K. Find its molecular weight and the gas constant. A constant volume chamber of 0.3m^3 capacity contains 2kg of this gas at 5°C. Heat is transferred to the gas until the temperature is 100°C. Find the work done, the heat transferred, and the changes in internal energy, enthalpy and entropy. **(08 Marks)**

OR

10 a. Plot generalized compressibility chart and explain. **(06 Marks)**

b. Show that for an ideal gas $C_p - C_v = R$ **(04 Marks)**

c. Define i) Relative Humidity ii) Specific humidity iii) Wet bulb temperature. **(06 Marks)**

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CBCS SCHEME

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15ME/MA34

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Obtain an Expression for Elongation of a bar. **(04 Marks)**

b. A bar made up of two square sections, one of steel and the other of aluminium is shown in Fig Q1(b). The bar is acted upon by a compressive force P. Determine the value of P if the total decrease in length of the bar is 0.3mm. Take $E_s = 205GPa$ and $E_{al} = 75GPa$.

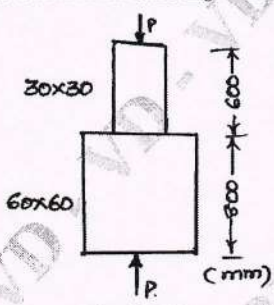

Fig Q1(b) **(06 Marks)**

c. A flat steel plate of trapezoidal section has a thickness of 20mm and taper uniformly from a width of 80mm to 30mm in a length of 500mm. What will be the elongation of the plate under an load of 200kN? E = 205GPa. **(06 Marks)**

OR

2 a. Two parallel walls, 8m apart, are to be stayed together by a steel rod of 30mm diameter with the help of washers and nuts at the ends. The steel rod is passed through the metal plates and is heated. When its temperature is raised to 90°C, the nuts are tightened. Determine the pull in the bar when it is cooled to 24°C if :

i) the ends do not yield

ii) the total yielding at the ends is 2mm

E = 205GPa and coefficient of thermal expansion of steel $\alpha_s = 11 \times 10^{-6}/°C$ **(08 Marks)**

b. The tangential (hoop) and longitudinal stresses in the plates of a cylindrical boiler of 2.2m diameter and 3.5m in length are 90MPa and 45MPa respectively. Determine the increase in the internal capacity. E = 205GPa, $\gamma = 0.3$. **(08 Marks)**

Module-2

3 a. Described the procedure for construction of Mohr's circle. **(06 Marks)**

b. The stresses on two perpendicular planes through a point in a body are 30MPa and 15MPa both tensile along with a shear stress of 25MPa. Find

i) the magnitude and direction of principal stresses.

ii) the planes of maximum shear stress

iii) the normal and shear stresses on the planes of maximum shearing stress. **(10 Marks)**

OR

4 a. A thick cylindrical shell of 200mm internal diameter is subjected to an internal fluid pressure of $7N/mm^2$. If the permissible tensile stress in the shell material is $8N/mm^2$ find the thickness of the shell. **(08 Marks)**

b. A thin cylinder, 2m long and 200mm in diameter with 10mm thickness is filled completely with a fluid, at the atmospheric pressure. If an additional 25000mm^3 fluid is pumped in, find the longitudinal and hoop stress developed. Also determine the changes in diameter and length if E = 2 × 10^{5}N/mm^2 and Poisson's ratio = 0.3. **(08 Marks)**

Module-3

5 a. Define shear force, shear force diagram, Bending moment and Bending moment diagrams for beams. **(04 Marks)**

b. A 10-m long simply supported beam carries two point loads of 10kN and 6kN at 2m and 9m respectively from the left end. It also has uniformly distributed load of 4kN/m run for the length between 4m and 7m from the left end. Draw shear force and bending moment diagrams. **(12 Marks)**

OR

6 a. Define the terms : i) Pure bending ii) Bending stress. **(04 Marks)**

b. Enumerate the assumptions made in the theory of simple bending and derive an relation for simple bending for beams. **(12 Marks)**

Module-4

7 a. A solid steel shaft transmits 100kW at 150rpm. Determine the suitable diameter of the shaft if the maximum torque transmitted exceeds the mean by 20% in each revolution. The shear stress is not to exceed 60MPa. Also find the maximum angle of twist in a length of 4m of the shaft. G = 80GPa. **(06 Marks)**

b. A shaft transmits 280kW of power at 160rpm. Determine :

i) the diameter of a solid shaft to transmit the required power

ii) the inner and outer diameters of a hollow circular shaft if the ratio of the inner to outer diameter is 2/3.

iii) The percentage saving in the material on using a hollow shaft instead of a solid shaft.

Take the allowable stress as 80MPa and the density of material 78kN/m^3. **(10 Marks)**

OR

8 a. Derive a Euler's crippling load for a column when one end is fixed and other free. **(08 Marks)**

b. A 4-m long hollow alloy tube with inside and outside diameter as 36mm and 48mm respectively elongates by 3mm under a tensile force of 50kN. Determine the buckling load for the tube when it is used as column with both ends pinned and with a factor of safety 5. **(08 Marks)**

Module-5

9 a. Derive an expression for strain energy due to shear stresses. **(08 Marks)**

b. A hollow circular shaft of 2m length has an external diameter 100mm and a thickness of 10mm. If it is subjected to a torque of 10kNm, determine the strain energy stored in the shaft. Take G = 80GPa. **(08 Marks)**

OR

10 a. Explain :

i) Maximum principal stress theory

ii) Maximum shear stress theory. **(08 Marks)**

b. The stresses induced at a critical point in a machine component made of steel are as follows: $\sigma_x = 100N/mm^2$, $\sigma_y = 40N/mm^2$, $\tau_{xy} = 80N/mm^2$.

Calculate the factor of safety by

i) Maximum shear stress theory

ii) Maximum normal stress theory. **(08 Marks)**

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CBCS SCHEME

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17ME44

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define following terms with SI units:
i) Capillarity
ii) Surface tension
iii) Kinematic viscosity
iv) Specific volume. **(06 Marks)**

b. Derive relation for pressure intensity and surface tension;
i) Liquid droplet ii) Soap bubble. **(06 Marks)**

c. A cube of 250mm sides, 300N weight slides down an inclined plane at 30° to horizontal. An oil film of thickness 0.5mm is between inclined plane and cube surface. Uniform velocity of slide is 3 m/sec. Determine the dynamic viscosity and kinematic viscosity if specific density of oil is 900 kg/m^3. **(08 Marks)**

OR

2 a. State and prove Hydrostatic law. **(06 Marks)**

b. Explain working of U-tube differential manometer, with neat sketch. **(06 Marks)**

c. A circular plate of 3m in diameter is submerged in oil of specific gravity 0.9, such that its greatest and least depths below the free surface are 3.5m and 2m respectively. Determine total pressure on one face and the depth of centre of pressure. **(08 Marks)**

Module-2

3 a. Derive continuity equation in 3-dimensional co-ordinates. **(06 Marks)**

b. Explain different types of fluid flows. **(06 Marks)**

c. A 2-dimensional flow is given by velocity potential $\phi = x(2y - 1)$. Determine the velocity at point P(2, 3). Find also the stream function. **(08 Marks)**

OR

4 a. Derive Bernoulli's equation for a fluid flow. List the assumptions made. **(08 Marks)**

b. Differentiate between venturimeter and orificemeter. **(04 Marks)**

c. A venturimeter with a throat diameter 10cm and area ratio 4 is provided in a vertical pipeline carrying oil of specific gravity 0.90. The difference in elevation of throat section and entry of venturimeter is 40cm. The differential u-tube mercury manometer shows a deflection of 30cm. Find: i) Discharge of oil ii) Pressure difference. Assume $C_d = 0.98$. **(08 Marks)**

Module-3

5 a. Derive relation for viscous flow through circular flow and obtain relation for head loss. **(10 Marks)**

b. A lubricating oil of viscosity 1.0 poise and specific gravity 0.9 is pumped through 30mm diameter pipe. The pressure drop per metre length is 20kN/m^2. Determine: i) Mass flow rate ii) Reynold's iii) Shear stress at pipe wall iv) Power required per 50m length of pipe to maintain the viscous flow. **(10 Marks)**

OR

6 a. Derive Darcy's equation for fluid flow through circular pipe. **(06 Marks)**

b. Define HGL and TEL, with sketch. **(04 Marks)**

c. Determine flow rate of water through a pipe of diameter 20cm and length 50m, when one end of pipe is connected to tank and the other end of pipe is open to the atmosphere. The pipe is horizontal and height of water in tank is 10mts above pipe axis. Consider all losses and assume f = 0.01. **(10 Marks)**

Module-4

7 a. Define lift and drag force. Derive relations with neat sketch. **(10 Marks)**

b. Experiments were conducted in a wind tunnel with a speed of 50km/hour on a flat plate of size 2m long and 1m wide. Density of air is 1.15kg/m^3. Coefficients of lift and drag are 0.75 and 0.15 respective. Determine Drag and lift force. **(10 Marks)**

OR

8 a. Define model similitude and explain. List the applications. **(08 Marks)**

b. The force 'F' acting on a screw propeller is given by, $F = \rho D^2 V^2 \phi\left(\frac{\rho D^3 V^2}{T}, \frac{ND}{V}, \frac{\rho VD}{\mu}\right)$

where T is Torque, 'D' diameter, V is velocity, N is RPM, ρ is density and viscosity of fluid 'μ'. Use Buckingham π method. **(12 Marks)**

Module-5

9 a. Derive relation for velocity of sound in terms of Bulk Modulus. **(08 Marks)**

b. Explain the terms: i) Mach Cone ii) Mach Number. **(04 Marks)**

c. An aero plane is flying at a height of 12km where the temperature is -53°C. Find the speed of the plane, if Mach Number is M = 2. Assume K = 1.4 and R = 287J/kg K. **(08 Marks)**

OR

10 a. Explain the importance of CFD. Mentions the applications of CFD. **(10 Marks)**

b. Explain types of sonicflows with neat sketch. **(06 Marks)**

c. Explain normal shock and oblique shock. **(04 Marks)**

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CBCS SCHEME

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17ME43

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Steam Tables / Mollier chart / Psychrometric chart is permitted.***

Module-1

1 a. Derive an expression for an air standard efficiency of diesel cycle with neat sketch of PV and TS diagram. State the assumptions made to formulate this expression. **(10 Marks)**

b. In an air standard dual cycle, the air is at a pressure of 100 kPa and a temperature of 27°C before the isentropic compression begins. In this process, the volume of air is reduced from 0.07 m^3 to 0.004 m^3. During the process of heat addition at constant pressure, the temperature of the air is increased from 1160°C to 1600°C. Determine:
(i) Compression ratio (ii) Cutoff ratio
(iii) Thermal efficiency (iv) Mean effective pressure **(10 Marks)**

OR

2 a. Explain in detail with TS diagram, how the following methods are employed to improve the performance of gas turbine. (i) Regeneration (ii) Reheating **(10 Marks)**

b. A gas turbine has a minimum and maximum temperature of 60°C and 900°C. The compressor and the turbine efficiencies are 0.80 and 0.85 respectively. Estimate the condition for maximum net work done. Also, calculate the net work done and the thermal efficiency. The pressure at the inlet of the compressor is 1 bar. **(10 Marks)**

Module-2

3 a. A steam power plant is working on simple ideal Rankine cycle with fixed inlet temperature and condenser pressure. Explain with TS diagram, the effect of following factors on the turbine work output, heat supplied, cycle efficiency and the steam quality at the turbine exit.
(i) Boiler pressure (ii) Super heating the steam **(10 Marks)**

b. A steam power plant operates on a Rankine cycle between the pressure limits of 17500 kPa and 10 kPa. The peak temperature is 500°C. If the adiabatic efficiency of the turbine is 80% and the adiabatic pump efficiency is 85%. Determine the thermal efficiency and the specific steam consumption. **(10 Marks)**

OR

4 a. With a neat schematic layout and TS diagram, explain how the performance of steam power plant change, when a simple Rankine cycle is modified with Reheater. **(10 Marks)**

b. Consider a steam power plant operating on an ideal Reheat Rankine cycle. Steam enters the high pressure turbine at 15 MPa and 600°C and is condensed in the condenser at a pressure of 10 kPa. If the moisture content of the steam at the exit of low pressure turbine is not to exceed 10.4%, determine: (i) Pressure at which the steam should be reheated (ii) Thermal efficiency of the cycle. Assume the steam is reheated to the inlet temperature of the high pressure turbine. **(10 Marks)**

Module-3

5 a. Define and briefly explain the following terms related to combustion thermodynamics:
(i) Excess air
(ii) Enthalpy of formation
(iii) Internal energy of combustion
(iv) Combustion efficiency
(v) Adiabatic flame temperature **(10 Marks)**

b. The products of combustion of an unknown hydrocarbon C_xH_y have the following composition measured by Orsat apparatus.
$CO_2 = 8\%$, $CO = 0.9\%$, $O_2 = 8.8\%$, $N_2 = 82.3\%$
Determine:
(i) The composition of fuel
(ii) Air fuel ratio
(iii) The percentage of excess air
(iv) Dew point temperature of the products if the total pressure is 1.01325 bar. **(10 Marks)**

OR

6 a. Explain the following methods of determining frictional power of an engine:
(i) Motoring test
(ii) Morse test **(10 Marks)**

b. The following observations are recorded in a test of one hour duration on a single cylinder, 4 stroke SI engine; Bore = 220 mm, stroke = 300 mm, fuel used = 4 kg, calorific value of fuel = 42000 kJ/kg, speed = 300 rpm, MEP = 5 bar, load on brake = 600 N, spring balance reading = 30 N, diameter of the brake drum = 1.4 m, quantity of cooling water = 500 kg/hr, temperature rise of cooling water = 20°C, air fuel ratio = 16, C_p of gases = 1.1 kJ/kgK, ambient temperature = 30°C, exhaust gas temperature = 410°C. Calculate the following:
(i) Brake thermal efficiency
(ii) SFC
Also draw heat balance sheet in kJ/min. **(10 Marks)**

Module-4

7 a. With a schematic diagram, explain the working of a vapour absorption refrigeration system. **(08 Marks)**

b. A 10 TR Ammonia ice plant operates between an evaporator temperature of –15°C and condenser temperature of 35°C. The ammonia enters the compressor as dry saturated vapour. Assuming isentropic compression. Determine:
(i) Mass flow rate of ammonia
(ii) COP of plant
(iii) Power input
(iv) Tonnes of ice at –10°C produced from water at 25°C in a day.
Take C_P of ammonia vapour = 4.81 kJ/kgK, $h_{fg(ice)}$ = 335 kJ/kg, $C_{P(ice)}$ = 2.1 kJ/kgK, $C_{P(water)}$ = 4.2 kJ/kgK. **(12 Marks)**

OR

8 a. With a neat sketch, explain the working of a summer air conditioning system for hot and dry weather. Represent the various processes of the system on a psychrometric chart. **(10 Marks)**

b. For a hall to be air conditioned, the following conditions are given:
Outdoor conditions = 40°C DBT, 20°C WBT
Required comfort conditions = 20°C DBT, 60% RH
Seating capacity of the hall = 1500
Amount of outdoor air supplied = 0.3 m^3/min/person.
If the required condition is achieved first by adiabatic humidification and then by cooling, estimate:
(i) Capacity of cooling coil in TR
(ii) Capacity of the humidifier in kg/hr
(iii) Condition of air after adiabatic humidification. **(10 Marks)**

Module-5

9 a. Derive the condition for minimum work in a 2 stage reciprocating air compressor. Using this condition obtain the expression for minimum work in a two stage compression. **(12 Marks)**

b. A single stage single acting compressor delivers 0.6 kg of air/minute at 6 bar pressure. The temperature and pressure at the end of suction stroke are 30°C and 1 bar. The bore and stroke of the compressor are 100 mm and 150 mm respectively. The clearance is 3% of swept volume. Assuming the index of compression and expansion to be 1.3, find:
(i) Volumetric efficiency of the compressor
(ii) Power required if the mechanical efficiency is 0.85
(iii) Speed of the compressor **(08 Marks)**

OR

10 a. Explain the following types of flows in a steam nozzle:
(i) Isentropic flow
(ii) Flow with friction
(iii) Super saturated flow **(10 Marks)**

b. A convergent divergent nozzle is required to discharge 360 kg/hr of steam. The nozzle is supplied with steam at 10 bar and 0.97 dryness and discharges against a back pressure of 0.5 bar. Neglecting the effect of friction, find the throat and the exit diameter. Assume the condition for maximum discharge. **(10 Marks)**

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CBCS SCHEME

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17ME42

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Kinematics of Machinery

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define the following terms : i) Inversion ii) Degree of freedom iii) Structure iv) Mechanism. **(04 Marks)**

b. Explain with neat sketch, Beam Engine and Whit worth quick return mechanism. **(10 Marks)**

c. Find the degrees of freedom (F) for the given diagram. **(06 Marks)**

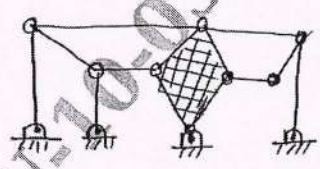

Fig. Q1(c)(i)

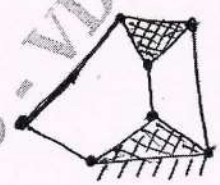

Fig. Q1(c)(ii)

OR

2 a. Derive the expression for the condition of correct steering. **(05 Marks)**

b. Explain with sketch Pantograph Mechanism and Geneva Wheel Mechanism. **(10 Marks)**

c. With a neat sketch, explain Peaucellier Straight line mechanism. **(05 Marks)**

Module-2

3 a. Define the following : i) Linear and Angular velocity ii) Linear and Angular Acceleration. **(04 Marks)**

b. A four bar mechanism ABCD is pin jointed at ends and the link AD is fixed of length 600mm. The links AB BC and CD are 300mm , 360mm and 360mm respectively. At certain instant the link AB makes an angle of 60^0 with link AD. If the link AB rotates at an angular velocity of 10 rad/sec and an angular acceleration of 30 rad/sec^2 both clockwise. Determine angular velocity and angular acceleration of links BC and CD by graphical methods. **(16 Marks)**

OR

4 a. What is Instantaneous centre of rotation of a body? Discuss different types of instantaneous centres. **(04 Marks)**

b. Explain Klein's construction for slider crank mechanism. **(08 Marks)**

c. In a slider crank mechanism the crank OA = 300mm and connecting rod AB = 1200mm. The crank OA is turbed 30^0 from I.D.C. Locate all instantaneous centre if the crank rotates at 15 rad/sec clockwise , find i) Velocity of slider B ii) Angular velocity of connecting rod AB. **(08 Marks)**

Module-3

5 Using Complex Algebra derive expression for Velocity , Angular velocity , Acceleration and Angular acceleration of Coupler link and output link of a four bar mechanism. **(20 Marks)**

OR

6 a. Derive Freudenstein's equation for slider crank mechanism. **(08 Marks)**

b. In a reciprocating engine length of crank is 250mm and length of connecting rod is 1000mm. The crank rotates at a uniform speed of 300 rpm CW. Crank is at 30^0 from I D.C. Determine

i) Velocity of piston and angular velocity of connecting rod.

ii) Acceleration of piston and angular acceleration of connecting rod by Complex Algebra method from first principle. **(12 Marks)**

Module-4

7 a. State and prove that the Law of Gear tooth action for constant velocity ratio. **(08 Marks)**

b. The following are particulars of pair of spur gears. Number of teeth on pinion = 19 , Number of teeth on gear = 47 , Pressure angle = 20^0 , Module = 6.5mm , Addendum = 6.5mm, determine i) Number of pairs of teeth of contact.

ii) Angle turned thrush by pinion and gear when one pair of teeth is in contact.

iii) Ratio of velocity of sliding to rolling velocity at the instant the engagements begins, the engagement terminates and at pitch point. **(12 Marks)**

OR

8 a. Sketch and explain i) Reverted gear train ii) Epicyclic gear train. **(06 Marks)**

b. An Epicyclic gear train as shown in fig. Q8(b) below, has a sunwheel S of 30 teeth and two planet wheels P of 50 teeth. The planet wheels mesh with the internal teeth of a fixed annulus A. The driving shaft carrying the sunwheel transmits 4 KW at 300 rpm. The driven shaft is connected to an arm which carries the planet wheels. Determine the speed of the driven shaft and the torque transmitted if the overall efficiency is 95%.

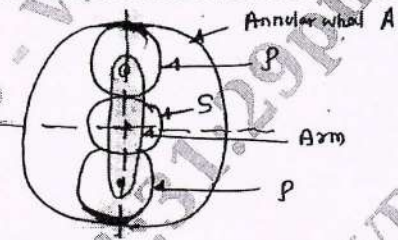

Fig.Q8(b)

(14 Marks)

Module-5

9 Draw to a full size, the profile of the cam which will give a lift of 38mm to a follower carrying a roller of 25mm diameter. The axis of follower is off-set by 18mm to the right of the axis of the cam. Ascent of follower takes place with SHM in 0.05sec followed by a period of rest 0.0125 sec. The follower by thin descent with VARM during 0.125 sec, the acceleration being 3/5 times retardation. The cam rotates in clockwise direction at a constant speed of 240 rpm and the base circle radius is 50mm. **(20 Marks)**

OR

10 a. Explain the following : i) Disc cam with Translating follower ii) Wedge cam with translating follower iii) Cylindrical cam with oscillating follower. **(06 Marks)**

b. In a four stroke petrol engine the crank angle is 4^0 after I.D.C when the suction valve opens and 50^0 after B.D.C when the suction valve closes. The lift is 10 mm the nose radius is 2.5mm and the least radius of cam is 20mm. The shaft rotates at 600 rpm. The cam is of circular type with a circular nose and flanks while the follower is flat faced. Determine the maximum velocity , maximum acceleration and retardation of the valve. What is the minimum force exerted by the springs to overcome the inertial of moving parts weighing 250gm. **(14 Marks)**

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CBCS SCHEME

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15ME42

Fourth Semester B.E. Degree Examination, Jan./Feb.2021
Kinematics of Machinery

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain :
(i) Kinematic chain (ii) Mechanism (iii) Degrees of freedom. **(06 Marks)**

b. Explain with neat sketches:
(i) Whit worth quick return motion mechanism. (ii) Toggle mechanism. **(10 Marks)**

OR

2 a. Explain :
(i) Grubler's criterion. **(02 Marks)**
(ii) Sketch and explain inversions of Grashoff's chain. **(09 Marks)**

b. Sketch and explain Pantograph mechanism. **(05 Marks)**

Module-2

3 Fig. Q3 shows configuration diagram of an engine mechanism. The dimensions are the following : Crank OA = 200 mm, Connecting rod AB = 600 mm; Distance of centre of mass from Crank end AD = 200 mm. At the instant, the crank has an angular velocity of 50 rad/s clockwise and an angular acceleration of 800 rad/s^2. Calculate the
(i) Velocity of 'D' and angular velocity of AB.
(ii) Acceleration of 'D' and angular acceleration of 'AB'. **(16 Marks)**

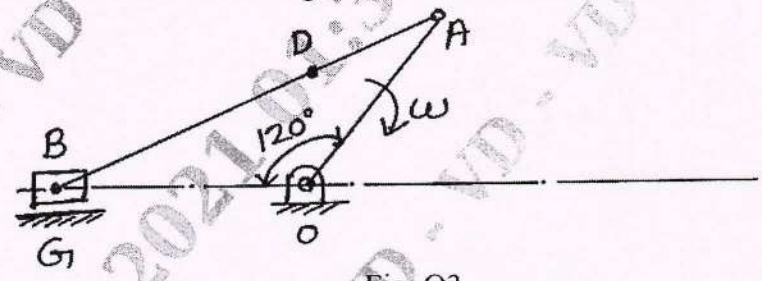

Fig. Q3

OR

4 a. Explain Klein's construction for slider crank mechanism to find velocity and acceleration of piston. **(06 Marks)**

b. In a slider crank mechanism the length of the crank and connecting rod are 200 mm and 800 mm respectively. Locate all the I-centres of the mechanism for the position of the crank when it has turned 30° from the inner dead centre. Also find the velocity of the slider and the angular velocity of the connecting rod if the crank rotates at 40 rad/s. **(10 Marks)**

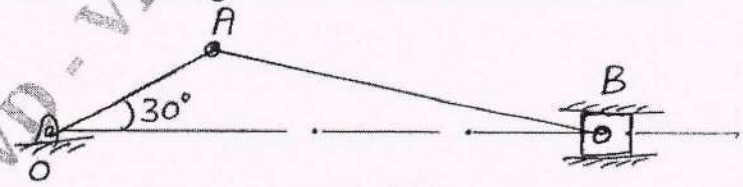

Fig. Q4 (b)

Module-3

5 In a four bar mechanism ABCD, link AB = 300 mm, BC = 360 mm, CD = 360 mm and the fixed link AD = 600 mm; The angle BAD = 60°, the link AB has an angular velocity of 10 rad/sec and an angular acceleration of 30 rad/sec^2, both clockwise. Determine the angular velocity and angular acceleration of link BC and CD by using complex algebra method. **(16 Marks)**

OR

6 a. Derive Freudensteins equation for four bar mechanism. **(10 Marks)**

b. Explain function generation for Four bar mechanism, by any method (two position synthesis). **(06 Marks)**

Module-4

7 a. Derive an expression for minimum number of teeth to avoid interference on a gear wheel. **(06 Marks)**

b. Two involute gear wheels having module 3 mm and pressure angle 20° mesh externally to give a velocity ratio of 3. The pinion rotates at 75 rpm and addendum is equal to one module. Determine (i) The number of teeth on each wheel to avoid interference (ii) The length of path and arc of contact (iii) The number of pairs of teeth in contact. **(10 Marks)**

OR

8 a. Define gear trains. Explain different types of gear trains. **(07 Marks)**

b. An epicyclic gear train is shown in Fig. Q8 (b). The number of teeth on A and B are 80 and 200 respectively. Determine the speed of the arm 'a',

(i) If A rotates at 100 rpm clockwise and B at 50 rpm counter clockwise.

(ii) If A rotates at 100 rpm clockwise and B is stationary. **(09 Marks)**

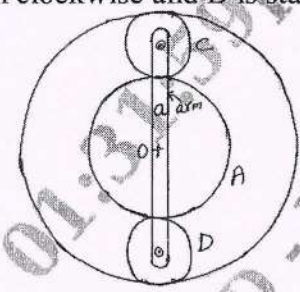

Fig. Q8 (b)

Module-5

9 The following data relate to a cam profile in which the follower moves with uniform acceleration and deceleration during ascent and descent:
Minimum radius of cam = 25 mm, Roller diameter = 7.5 mm, Lift = 28 mm, Offset of the follower axis = 12 mm towards right angle of ascent = 60°, Angle of descent = 90°, Angle of dwell between ascent and descent = 45°, Speed of the cam = 200 rpm. Draw the profile of the cam and determine the maximum velocity and uniform acceleration of the follower during outstroke. **(16 Marks)**

OR

10 a. Define the terms:

(i) Cam profile (ii) Pressure angle

(iii) Trace point (iv) Pitch circle. **(04 Marks)**

b. Derive expressions for displacement, velocity and acceleration of the follower when the flat faced follower touching circular flank (Arc cam). **(12 Marks)**

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CBCS SCHEME

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15ME43

Fourth Semester B.E. Degree Examination, Jan./Feb.2021
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. Use of Thermodynamics data hand book permitted.

Module-1

1 a. Derive an expression for mean effective pressure of an Otto cycle. **(08 Marks)**

b. The pressures on the compression curve of a diesel engine are at $\frac{1}{8}^{th}$ of stroke 1.4 bar and at $\frac{7}{8}^{th}$ stroke 14 bar. Estimate the compression ratio, calculate the air standard efficiency and mean effective pressure of the engine if the cut-off occurs at $\frac{1}{15}^{th}$ of the stroke. Assume initially air is at 1 bar and 27°C. **(08 Marks)**

OR

2 a. For a gas turbine working on ideal Brayton cycle, show that the maximum network produced can be expressed in terms of maximum and minimum temperatures in the cycle as, $[W_{net}]_{max} = C_P\left(\sqrt{T_{max}} - \sqrt{T_{min}}\right)^2$. **(08 Marks)**

b. In a reheat gas turbine cycle comprising one compressor and two turbines, air is compressed from 1 bar 27°C to 6 bar. The highest temperature in the cycle is 900°C. The expansion in the first stage turbine is such that the work from it just equals the work required by the compressor. Air is reheated between the two stages of expansion to 850°C. Assume that the isentropic efficiency of the compressor, the first stage and second stage turbines are 85% each and that working substance is air. Calculate the cycle efficiency. **(08 Marks)**

Module-2

3 a. Discuss the effect of, (i) Boiler pressure (ii) Condenser pressure (iii) Superheat on the performance of Rankine cycle. **(08 Marks)**

b. Steam at 20 bar, 360°C is expanded in a steam turbine to a pressure of 0.08 bar. If then enters a condenser, where it is condensed to saturated liquid water. Assuming the turbine and feed pump efficiencies as 60% and 90% respectively, determine per kg of steam, the network, the heat transferred to the working fluid and the Rankine efficiency of the cycle. **(08 Marks)**

OR

4 a. With neat sketch, explain working of binary vapour cycle. **(08 Marks)**

b. In a reheat cycle, steam at 150 bar, 500°C expands in HP turbine till it is saturated vapour. It is then reheated at constant pressure to 400°C and then expanded in LP turbine to 40°C. If the maximum moisture content at the turbine exhaust is limited to 15%, find (i) The Reheat pressure (ii) The pressure of steam at the inlet to HP turbine (iii) The cycle efficiency. **(08 Marks)**

Module-3

5 a. Define : (i) Stoichiometric air, (ii) Enthalpy of formation (iii) Enthalpy of reaction, (iv) Adiabatic flame temperature. **(08 Marks)**

b. The products of combustion of an unknown hydrocarbon C_xH_y have following composition as measured by an orset apparatus: CO_2 = 8%, O_2 = 8.8%, CO = 0.9%, N_2 = 82.3%, Determine (i) Composition of fuel (ii) Air fuel ratio (iii) Percentage of excess air used. **(08 Marks)**

OR

6 a. With a P-θ diagram, explain stages of combustion SI engine. **(08 Marks)**

b. Morse test is conducted on 4-S four cylinder petrol Engine at constant speed and the following power is measured: with all cylinders working = 15.6 kW. With number 1 cylinder cut-off = 11.1 kW, with number 2 cylinder cut off = 11.3 kW. With number 3 cylinder cut-off = 10.8 kW. With number 4 cylinder cut off = 11.0 kW. The bore and stroke of each cylinder is 75 mm and 100 mm respectively. The clearance volume of the cylinder is 100 cc. The fuel is consumed at the rate 6 kg/hr. If the calorific value of the fuel is 42000 kJ/kg. Determine (i) Indicated power (ii) Frictional power (iii) Mechanical efficiency (v) Relative efficiency with respect to brake thermal efficiency. **(08 Marks)**

Module-4

7 a. Sketch the flow diagram and the corresponding pressure volume diagram of an air refrigeration working on ideal Bell Colemen cycle and also derive an expression for COP of Bell Coleman cycle. **(08 Marks)**

b. An air refrigeration system is to be designed according to the following specifications:
Pressure of air at compressor inlet = 101 KPa.
Pressure of air at compressor outlet = 404 KPa.
Temperature of air at compressor inlet = $-6^{\circ}C$
Temperature of air at turbine inlet = 27°C.
Isentropic efficiency of compressor = 85%
Isentropic efficiency of turbine = 85%
Determine:
(i) COP of the cycle
(ii) Power required to produce 1 ton of refrigeration (iii) Mass flow rate of air required for 1 ton refrigeration. **(08 Marks)**

OR

8 a. Define the following terms : (i) Wet Bulb Temperature (WBT). (ii) Specific Humidity (SH) (iii) Relative Humidity (RH) (iv) Degree of Saturation (DS). **(08 Marks)**

b. An air conditioning system is designed under the following conditions : Outdoor conditions : 30°C DBT, 75% RH. Required conditions : 22°C DBT, 70% RH, Amount of air circulated 3.33 m^3/sec. Coil Dew Point Temperature (DPT) = 14°C. The required conditions is achieved first by cooling and humidification and then by heating. Estimate (i) The capacity of the cooling coil in tones of refrigeration. (ii) Capacity of heating coil in kW (iii) The amount of water vapour removed in kg/hr. **(08 Marks)**

Module-5

9 a. Obtain an expression for the volumetric efficiency of a single stage air compressor in terms of pressure ratio, clearance and 'n' the exponent of compressions expansion. **(06 Marks)**

b. Why Intercooling is necessary in multistage compression? **(02 Marks)**

c. A single stage double acting air compressor is required to deliver 14 m^3 of air per minute measured at 1.013 bar is 15°C. The delivery pressure is 7 bar and the speed is 300 rpm. Take the clearance volume is 5% of swept volume with a compression and re expansion index of n = 1.3. Calculates the swept volume of the cylinder, the delivery temperature and the indicated power. **(08 Marks)**

OR

10 a. With neat sketch, explain different shapes of nozzle. **(03 Marks)**

b. Derive an expression for exit velocity of nozzle in terms of pressure ratio and index of expansion. **(05 Marks)**

c. A multistage air compressor compresses air from 1 bar to 40 bar. The maximum temperature of air not to exceed 400 K in any stage. If the law of compression is $PV^{1.3} = C$ .Find number of stages for minimum power input, also find the actual intermediate pressure and temperatures. What will be minimum power input in kW required to compress and deliver 10 kg/min of air and the rate of heat rejection in each inter cooler. Assume ambient temperature = 27°C and perfect inter cooling between stages. **(08 Marks)**

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CBCS SCHEME

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15ME44

Fourth Semester B.E. Degree Examination, Jan./Feb. 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Differentiate between Newtonian and non-Newtonian fluids. Give examples for each. **(04 Marks)**

b. Define surface tension of a liquid. Derive an expression for surface tension of a i) liquid droplet ii) hollow bubble. **(05 Marks)**

c. A 15cm diameter vertical cylinder rotates concentrically inside another cylinder of 15.1cm diameter. Both cylinders are 25cm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. If a torque of 12N-m is required to rotate the inner cylinder at 100rpm, determine the viscosity of the fluid. **(07 Marks)**

OR

2 a. Derive an expression for the depth of centre of pressure from free surface of liquid of vertical plane surface submerged in the liquid. **(08 Marks)**

b. A solid cylinder of diameter 4m has a height of 4m. Find the metacentric height of the cylinder if the specific gravity of the material of the cylinder is 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. **(08 Marks)**

Module-2

3 a. Define the following :
i) Steady and unsteady flow
ii) Laminar and Turbulent flow. **(04 Marks)**

b. Derive the continuity equation in three dimensional Cartesian coordinate for a steady incompressible fluid flow. **(06 Marks)**

c. The velocity components in a two dimensional flow field for an incompressible fluid are expressed as $u = \frac{y^3}{3} + 2x - x^2y$, $v = xy^2 - 2y - \frac{x^3}{3}$. Obtain an expression for velocity potential function. **(06 Marks)**

OR

4 a. With usual notations, show that the discharge through a venturimeter is given by $Q = C_d \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \sqrt{2gh}$. **(06 Marks)**

b. A pipeline carrying oil of specific gravity 0.9 changes in diameter from 20cm at a position A to 50cm at position B which is 5m at higher level. If the pressure at A and B are 10N/cm^2 and 6N/cm^2 respectively and discharge is 200litres/s, determine the loss of head and the direction of flow. **(10 Marks)**

Module-3

5 a. Prove that the velocity distribution across the cross section of a circular pipe during viscous fluid flow is parabolic in nature. Also prove that the maximum velocity is in the centre of the pipe and is equal to twice the average velocity. **(10 Marks)**

b. Water at 15°C flows between two large parallel plates at a distance of 1.6mm apart. Determine : i) the maximum velocity ii) the pressure drop per unit length iii) the shear stress at the walls of the plates if the average velocity is 0.2m/s. The viscosity of water at 15°C is given as 0.01 poise. **(06 Marks)**

OR

6 a. Derive an expression for loss of head due to sudden enlargement of a pipe. **(08 Marks)**

b. An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200mm at the rate of 60 liters/s. Find the head loss due to friction for a 500m length of the pipe. Find the power required to maintain this flow. **(08 Marks)**

Module-4

7 a. Find the displacement thickness and the momentum thickness for the velocity distribution in the boundary layer given by $\frac{u}{U\infty} = \frac{y}{\delta}$, where u is the velocity at a distance y from the plate and $u = U_\infty$ and $y = \delta$, where δ = boundary layer thickness. Also calculate the ratio of displacement thickness to momentum thickness. **(08 Marks)**

b. Experiments were conducted in a wind tunnel with a wind speed of 50km/h on a flat plate 2m long and 1m wide. The density of air is 1.15kg/m^3. The plate is kept at such an angle that the coefficient of lift and drag are 0.75 and 0.15 respectively. Determine :
i) lift force ii) drag force iii) resultant force iv) power exerted by air stream on the plate. **(08 Marks)**

OR

8 a. Explain the following terms :
i) Geometric similarity ii) Kinematic similarity iii) Dynamic similarity. **(06 Marks)**

b. A partially submerged body is towed in water. The resistance R to its motion depends on the density ρ, the viscosity μ of water, length ℓ of the body, velocity v of the body and the acceleration due to gravity g. By using Buckingham's π-theorem, show that the resistance to the motion can be expressed in the form

$$R = \rho \ell^2 v^2 \phi \left[\frac{\mu}{\rho v L}, \frac{\ell g}{v^2} \right]$$ **(10 Marks)**

Module-5

9 a. From fundamentals, show that the velocity of a sound wave in a compressible fluid is given by $C = \sqrt{\frac{dp}{d\rho}}$. Further, show that this sonic velocity for an isentropic medium is given by $c = \sqrt{rRT}$, where r = ratio of specific heats, R = Gas constant ; T = Temperature. **(08 Marks)**

b. Define Mach number. Explain its significance in compressible flow. **(04 Marks)**

c. Compute the velocity of a bullet fired in still air and Mach number when the mach angle is 30°. Take R = 0.28714kJ/kg K and r = 1.4. Assume air temperature to be 15°C. **(04 Marks)**

OR

10 a. Define and write the expression for : i) Stagnation enthalpy ii) Stagnation temperature iii) Stagnation pressure. **(06 Marks)**

b. Mention the advantages, disadvantages and limitation of CFD. **(10 Marks)**

CBCS SCHEME

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18ME32

Third Semester B.E. Degree Examination, July/August 2021
Mechanics of Materials

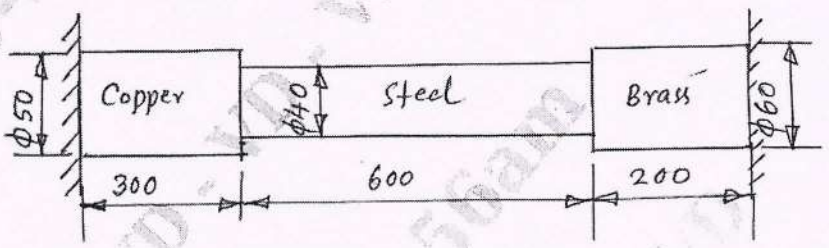
Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Define the terms : (i) Modulus of rigidity (ii) Factor of safety (iii) True stress (iv) Volumetric strain **(04 Marks)**

b. Deduce expression to determine the elongation of tapered rectangular bar of uniform thickness. **(06 Marks)**

c. A composite bar made of copper, steel and brass is rigidly attached to the end supports as shown in Fig. Q1 (c). Determine the stresses in the three portions of the bar when the temperature of the composite system is raised by 70°C, considering that the supports are rigid. Take $E_C = 100\,GPa$, $E_S = 205\,GPa$, $E_b = 95\,GPa$, $\alpha_C = 18\times10^{-6}/^\circ C$, $\alpha_S = 11\times10^{-6}/^\circ C$, $\alpha_b = 19\times10^{-6}/^\circ C$. **(10 Marks)**

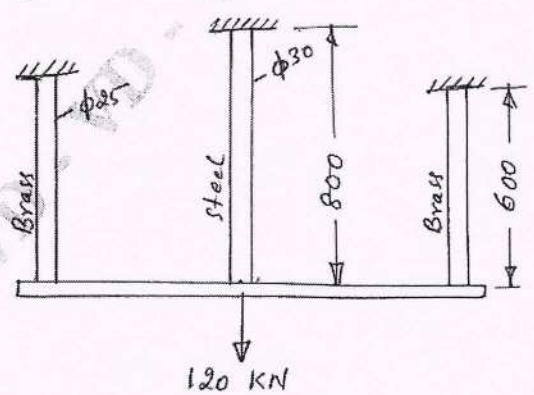


All dimensions are in mm

Fig. Q1 (c)

2 a. Define Bulk modulus. Derive a relationship between Young's modulus, modulus of rigidity and Poisson's ratio. **(10 Marks)**

b. Three equally spaced rods in the same vertical plane support a rigid bar AB. Two outer rods are of brass, each 600 mm long and of 25 mm in diameter. The central rod is of steel that is 800 mm long and 30 mm in diameter. Determine the forces in the rods due to an applied load of 120 kN through the mid point of the bar. The bar remains horizontal after the application of load. Take $\frac{E_S}{E_b} = 2$. The rigid bar system is shown in Fig. Q2 (b). **(10 Marks)**



Dimensions are in mm

Fig. Q2 (b)

3 a. Define Principal plane. Deduce expressions for stresses on an inclined plane in a body subjected to bi-axial stress condition. **(10 Marks)**

b. A thick cylinder has inner and outer diameters as 120 mm and 180 mm respectively. It is subjected to an external pressure of 9 MPa. Find the value of internal pressure which can be applied if the maximum stress is not to exceed 30 MPa. Draw the curves showing the variation of hoop and radial stresses through the material of the cylinder. **(10 Marks)**

4 a. What assumptions are taken in the analysis of thin cylinders? Deduce expressions for the circumferential and longitudinal stresses developed in thin cylinder. **(10 Marks)**

b. A plane element is subjected to stresses as shown in Fig. Q4 (b). Draw the Mohr's circle and determine principal stresses, maximum shear stress and their planes. **(10 Marks)**

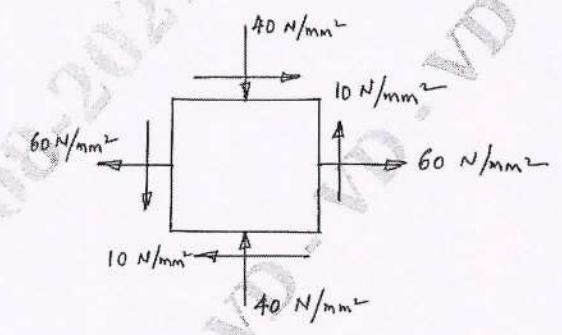


Fig. Q4 (b)

5 a. Draw the shear force and bending moment diagrams for a Cantilever subjected to forces as shown in Fig. Q5(a). **(10 Marks)**

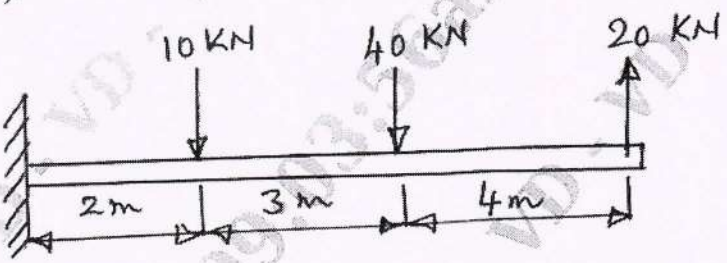


Fig. Q5 (a)

b. Prove the relation $\frac{\sigma_y}{y} = \frac{M}{I} = \frac{E}{R}$ for simple bending. **(10 Marks)**

6 a. A 10 m long simply supported beam is loaded as shown in Fig. Q6 (a). Draw the shear force and bending moment diagrams. **(10 Marks)**

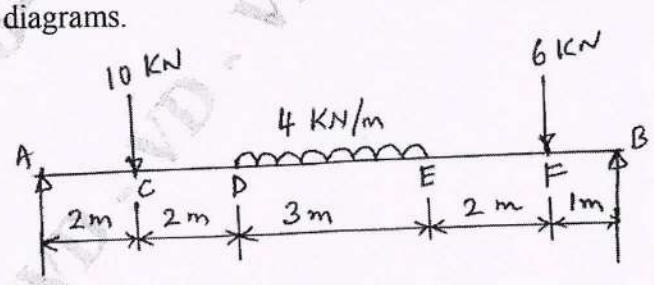


Fig. Q6 (a)

b. A 200 mm×80 mm I-beam is to be used as a simply supported beam of 6.75 m span. The web thickness is 6 mm and the flanges are of 10 mm thickness. Determine what concentrated load can be carried at a distance of 2.25 m from one support if the maximum permissible stress is 80 MPa. **(10 Marks)**

7 a. A bolt is acted upon by an axial pull of 16 kN along with a transverse shear force of 10 kN. Determine the diameter of the bolt required according to (i) Maximum principal stress theory (ii) Maximum shear stress theory. **(10 Marks)**

b. Deduce the torsion equation with usual notations, stating the assumptions made. **(10 Marks)**

8 a. A shaft transmits 280 kW of power at 160 rpm. Determine

(i) The diameter of solid shaft to transmit the required power.

(ii) The inner and outer diameters of a hollow circular shaft if the ratio of the inner to the outer diameter is $\frac{2}{3}$.

(iii) The percentage saving in the material on using a hollow shaft instead of a solid shaft.

Take the allowable stress as 80 MPa and the density of the material 78 kN/m^3. **(10 Marks)**

b. A thin walled 800 mm long member has the cross section as shown in Fig. Q8 (b). Determine

(i) The maximum torque if the angle carried by the section is limited to 4°.

(ii) The maximum shear stress induced for the maximum torque.

Take G = 82 GPa. **(10 Marks)**

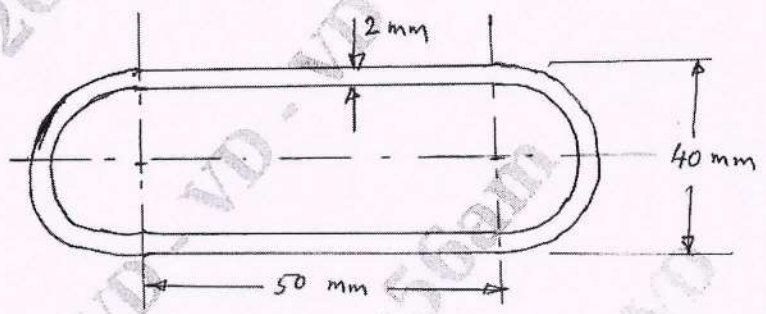


Fig. Q8 (b)

9 a. Derive an expression for Euler's critical load for a column with both ends hinged. **(10 Marks)**

b. A 4-m long hollow alloy tube with inside and outside diameters as 36 mm and 48 mm elongates by 3 mm under a tensile force of 50 kN. Determine the buckling load for the tube when it is used as a column with both ends pinned (hinged) and a factor of safety of 5. **(10 Marks)**

10 a. Derive an expression for strain energy for a member subjected to axial load. **(05 Marks)**

b. Explain Castigliano's theorem – I. **(05 Marks)**

c. Two elastic bars of equal length and of the same material ; one is of circular cross section of 80 mm diameter and the other of square cross section of 80 mm side. Both absorb the same amount of strain energy under axial forces. Compare the stresses in the two bars. **(10 Marks)**

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CBCS SCHEME

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18ME35B/18MEB305

Third Semester B.E. Degree Examination, July/August 2021
Metal Casting and Welding

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Explain in detail any four types of pattern allowances. **(10 Marks)**
b. With neat sketches, explain investment moulding process. **(10 Marks)**

2 a. With neat sketches, explain shell moulding process. **(10 Marks)**
b. Explain Open Riser and Blind Riser with neat sketches. **(10 Marks)**

3 a. With neat sketches, explain working principle of Cupola furnace. **(12 Marks)**
b. With net sketches, explain working of Resistance Furnace. **(08 Marks)**

4 a. With neat sketches, explain the steps involved in slush casting process. **(10 Marks)**
b. With net sketch, explain continuous casting process. **(10 Marks)**

5 a. Explain induction degassing and stream droplet degassing methods with neat sketches. **(12 Marks)**
b. With neat sketches, explain any four casting defects. **(08 Marks)**

6 a. Describe the need of directional solidification in casting. **(06 Marks)**
b. State the advantages and limitations of casting process. **(08 Marks)**
c. With neat sketch, explain stir casting process. **(06 Marks)**

7 a. With neat sketch, explain metal inert gas welding process. Also state its advantages and limitation. **(10 Marks)**
b. With neat sketch, explain electron beam welding process, also state its advantages. **(10 Marks)**

8 a. State the advantages and limitations of welding processes. **(06 Marks)**
b. With neat sketch, explain hydrogen welding process. **(08 Marks)**
c. With neat sketch, explain explosive welding process. **(06 Marks)**

9 a. Explain the different zones in welding with neat sketch. **(06 Marks)**
b. Differentiate between brazing and soldering. **(08 Marks)**
c. With neat sketch, explain ultrasonic inspection method. **(06 Marks)**

10 a. With neat sketches, explain any five welding defects. **(10 Marks)**
b. With neat sketches, explain the types of flames that can be obtained during oxy-acetylene welding process. **(10 Marks)**

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18ME35A/MEA305

Third Semester B.E. Degree Examination, July/August 2021
Metal Cutting and Forming

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Sketch and explain Tool signature of Single point cutting tool. **(07 Marks)**
b. Determine the Shear Plane angle of Single Point cutting tool. **(10 Marks)**
c. What are the types of chips? **(03 Marks)**

2 a. Sketch and explain the parts of an Engine Lathe. **(10 Marks)**
b. What are the Lathe Operations? **(05 Marks)**
c. Differentiate between Engine Lathe and Capstan and Turret Lathe. **(05 Marks)**

3 a. Sketch and brief about the various Milling Operations. **(10 Marks)**
b. What are the methods of Indexing? **(05 Marks)**
c. Note the differences between drilling , boring and reaming operations. **(05 Marks)**

4 a. What are the differences between Shaper, Planar and Slotter? **(08 Marks)**
b. Sketch and explain Surface Grinding machine. **(12 Marks)**

5 a. What are the effect of Process Parameters on tool life? Explain. **(10 Marks)**
b. What are the functions of cutting fluids? **(05 Marks)**
c. What are the effect of Machining Parameters on Surface finish. **(05 Marks)**

6 a. What is Machinability and Machinability Index? Explain. **(08 Marks)**
b. The following equation for tool life is given for a turning operation ($VT^{(0.13)}.f^{(0.77)}.d^{(0.37)} = C$). A 60min tool life was obtained while cutting at V = 30m/min , f = 0.3mm/rev and depth of mt d = 25mm. Calculate the change in tool life, if the cutting speed , feed , depth of cut are increased by 25%, Individaully and also taken together. What will be their effect on tool life? **(12 Marks)**

7 a. Sketch and explain different forging equipments. **(12 Marks)**
b. Write a note on different forging defects. **(08 Marks)**

8 a. Sketch and explain the types of Rolling Mills. **(12 Marks)**
b. What are the variables in drawing process? **(08 Marks)**

9 a. Sketch and explain Sheet Metal Cutting Operation. **(12 Marks)**
b. Brief out the different variables in drawing process. **(08 Marks)**

10 a. Explain : i) Drawing Ratio ii) Thickness Ratio iii) Drawing Force iv) Blank holding force v) Ironing. **(10 Marks)**
b. Explain with neat sketches, Progressive and Combination dies. **(10 Marks)**

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CBCS SCHEME

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17ME33

Third Semester B.E. Degree Examination, July/August 2021
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions.***
2. Use of thermodynamic data book is permitted.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. Differentiate between open system and control volume. Give examples. **(06 Marks)**

b. With examples, define the following :
(i) Intensive property (ii) Extensive property
(iii) Path function (iv) Point function **(08 Marks)**

c. A constant volume gas thermometer containing a gas gives the reading of gas pressure of 1 bar and 1.5 bar at ice point and steam point respectively. Assuming $T = a + bP$, where P is in N/m^2, express the gas thermometer Celsius temperature T in terms of gas pressure. What is the temperature recorded by the thermometer when it registers a pressure of 1.2 bar. **(06 Marks)**

2 a. List out the similarities and dissimilarities between work and heat. **(06 Marks)**

b. Derive the work done expression for, (i) Isothermal process (ii) Isentropic process. **(06 Marks)**

c. A fluid is heated reversibly at a constant pressure of 1.013 bar until it has a specific volume of 0.1 m^3/kg. It is then compressed reversibly according to a law $PV = C$ to a pressure of 4.2 bar, then allowed to expand reversibly according to a law $PV^{1.3} = C$ to the initial conditions. The work done in the constant pressure process is 515 Nm and the mass of fluid present is 0.2 kg. Calculate the net work done on or by the fluid in the process. Sketch the cycle on P-V diagram. **(08 Marks)**

3 a. Describe Joule's experiment to verify First law of thermodynamics. **(06 Marks)**

b. Why PMMKI and PMMKII are impossible? **(06 Marks)**

c. A centrifugal pump delivers 50 kg of water per second. The inlet and outlet pressures are 1 bar and 4.2 bar. The suction is 2.2 m below the centre of the pump and delivery is 8.5 m above the centre of the pump. The suction and delivery pipe diameters are 20 cm and 10 cm respectively. Determine the capacity of the electric motor to run the pump if pump efficiency is 85%. **(08 Marks)**

4 a. Show that reversible heat engine has higher efficiency than irreversible heat engine. **(10 Marks)**

b. A refrigerator produces 2 tonnes of ice at 0°C per day from water maintained at 0°C. It rejects heat to atmosphere at 27°C. The power to the refrigerator is supplied by an angine which absorbs heat from a source, which is maintained at 227°C by burning fuel of calorific value 20×10^3 KJ/kg. Find the consumption of fuel per hour and the power developed by the engine. Assume both the devices to run on Carnot cycle. Take latent heat of ice as 335 KJ/kg. **(10 Marks)**

5 a. Clearly explain the factors that make a process irreversible. **(10 Marks)**

b. What is internal and external irreversibility? **(04 Marks)**

c. Show that entropy change is an irreversible process. **(06 Marks)**

6 a. State and prove Clausius inequality. **(08 Marks)**

b. The heat engine receives 300 kJ/min of heat from a source at 327°C and rejects heat to a sink at 27°C. Three hypothetical amounts of heat rejections are given below:

(i) 200 kJ/min, (ii) 150 kJ/min (iii) 100 kJ/min

Using entropy concept, state which of these cases is a reversible, irreversible or an impossible one. **(06 Marks)**

c. A perfect gas of mass 1.7 kg and volume 1.5 m^3/kg are compressed reversibly and polytropically from pressure 1 bar to 7.5 bar in a cylinder. The index of compression is 1.25, R = 0.540 kJ/kg K, $C_V = 1.687$ kJ/kgK. Calculate the work done, heat transfer and change in entropy. **(06 Marks)**

7 a. Define the following:

(i) Available and Unavailable energy.

(ii) Availability.

(iii) II law efficiency. **(06 Marks)**

b. Draw pressure-temperature diagram for a pure substance. Explain its salient features. **(07 Marks)**

c. 15 kg of water is heated in an insulated tank by a churning process from 300 K to 340 K. If the surrounding temperature is 300 K, find the loss in availability for the process. **(07 Marks)**

8 a. With a neat sketch, explain the working of Throttling calorimeter. What are its advantages and disadvantages? **(10 Marks)**

b. A certain quantity of steam in a closed vessel of fixed volume of 0.14 m^3 exerts pressure of 10 bar and 250°C. If the vessel is cooled so that the pressure falls to 3.6 bar, determine (i) final quality of steam (ii) final temperature (iii) change in internal energy (iv) heat transferred during the process. Take $C_p = 2.1$ kJ/kgK. **(10 Marks)**

9 a. State the following :

(i) Dalton's law of additive pressures.

(ii) Amagat's law of volume additives. **(04 Marks)**

b. Define the psychrometric properties given below:

(i) Wet bulb temperature

(ii) Dew point temperature.

(iii) Specific humidity

(iv) Relative humidity

(v) Degree of saturation

(vi) Dry bulb depression. **(09 Marks)**

c. A mixture of ideal gases consists of N_2 of 3 kg and CO_2 of 5 kg at a pressure of 300 KPa and temperature of 20°C. Find (i) Mole fraction of each constituent (ii) Gas constant of mixture (iii) Molecular weight of mixture (iv) Partial pressures and volumes. **(07 Marks)**

10 a. Write a note on : (i) Law of corresponding states (ii) Compressibility chart. **(06 Marks)**

b. With usual notations, write the Vander-Waal's equation of state. What is the significance of constants 'a' and 'b'. **(06 Marks)**

c. Determine the pressure in a steel vessel having a volume of 15 lit and containing 3.4 kg of N_2 at 400°C using,

(i) Ideal gas equation (ii) Vanderwaal's equation.

Also calculate the compressibility factor by using the answer obtained from the Vanderwaal's equation of state. **(08 Marks)**

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17ME34

Third Semester B.E. Degree Examination, July/August 2021
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Define the following:
(i) Elasticity (ii) Ductility (iii) Poison's ratio
(iv) Shear stress (v) Hooks law **(10 Marks)**

b. Derive an expression for the extension of a tapering bar whose diameter D_1 at one end tapers linearly to a diameter D_2 in a length L, under an-axial pull 'P' and Young's modulus E. **(06 Marks)**

c. A bar having cross-sectional area 300 mm^2 is subjected to axial forces as shown in Fig.Q1(c). Find the total elongation of the bar. Take E = 84 GPa.

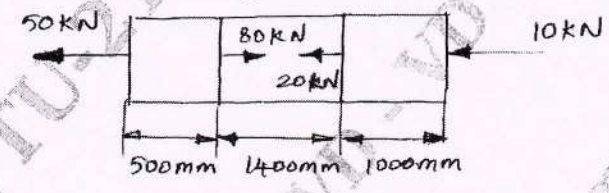

Fig.Q1(c) **(04 Marks)**

2 a. Derive a relation between Young's modulus and Modulus of rigidity. **(10 Marks)**

b. A copper bar of length 160 mm is placed on a rigid support in vertical position. Clearance between the upper support and top surface of the member is 0.1 mm as shown in the Fig.Q2(b). Determine:
(i) Increase in temperature required for the bar to touch the upper support.
(ii) Temperature rise required to induced compressive stress of 100 MPa.
(iii) Stress induced in the bar when its temperature is increased by 90°C and the upper support yields by 0.12 mm.
(iv) Stress induced in the bar when the temperature is increased by 30°C, assume that there is no clearance between upper support and top surface of the bar. Take E_c = 120 GPa and $\alpha_c = 18 \times 10^{-6}$/°C.

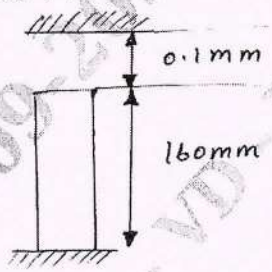

Fig.Q2(b) **(10 Marks)**

3 a. Derive an expression for normal stress and shear stress acting on a inclined plane. **(10 Marks)**

b. A point in a strained member is subjected to tensile stresses 100 MPa and 70 MPa along two mutually perpendicular directions. The point is also subjected to a shear stress 50 MPa such that shear force on vertical face give rise to anticlockwise couple. Determine:
(i) Stresses acting on a plane whose normal is at an angle of 120° with the reference to the 100 MPa stress plane.
(ii) Magnitude of principal stresses and maximum shear stresses
(iii) Orientations of the principal plane and maximum and minimum shear stress planes. Solve the problem using Mohr's circle method. **(10 Marks)**

4 a. Derive an expression for Hoop stress and longitudinal stress for thin cylinder. **(08 Marks)**

b. A thin cylindrical vessel of 1000 mm diameter and 3000 mm length has a metal wall of thickness 10 mm. It is subjected to an internal fluid pressure of 3 N/mm^2. Find the circumferential and longitudinal stresses in the wall. Determine the change in the length, diameter and volume of the cylinder. Assume $E = 2.1 \times 10^5$ N/mm^2 and Poisson's ratio = 0.3. **(12 Marks)**

5 For the beam shown in the Fig.Q5, draw shear force and bending moment diagrams. Locate the point of contraflexure, if any.

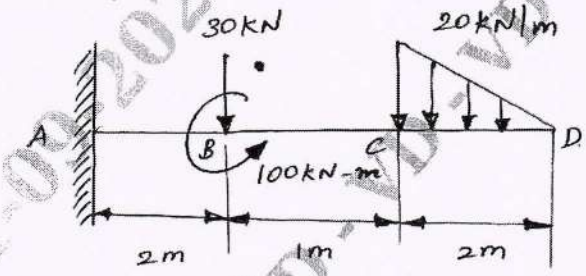

Fig.Q5 **(20 Marks)**

6 a. Derive the deflection equation, $EI\frac{d^2y}{dx^2} = M$. **(06 Marks)**

b. A T section of flange 120 × 12 mm and overall depth is 200 mm with 12 mm web thickness is loaded, such that, at a section it has a moment of 20 kN-m and shear force of 120 kN. Sketch the bending and shear force distribution diagram. **(14 Marks)**

7 a. Derive an expression for torque and shear stress of a shaft. **(08 Marks)**

b. A 2m long hollow cylinder shaft has 80 mm outer diameter and 10 mm wall thickness. When the torsional load on the shaft is 6 kN-m, determine:

(i) Maximum shear stress induced

(ii) Angle of twist

(iii) Also draw the distribution of shear stress in the wall of the shaft. Take G = 80 GPa. **(12 Marks)**

8 a. Derive a Euler's crippling load for a column when both of its ends are hinged. **(10 Marks)**

b. A 2m long column has a square cross-section of side 40 mm. Taking FOS = 4. Determine the safe load for the end conditions.

(i) Both ends are hinged

(ii) One end fixed and other end is free

(iii) Both ends are fixed.

Take E = 210 GPa. **(10 Marks)**

9 a. Derive an expression for strain energy due to shear stresses. **(10 Marks)**

b. Explain:

(i) Maximum principal stress theory

(ii) Maximum shear stress theory **(10 Marks)**

10 a. Derive an expression for the strain energy in bending and strain energy in torsion. **(16 Marks)**

b. A solid circular shaft is 4 m long has a diameter of 80 mm. Find the torsional strain energy stored in it when it is subjected to a torque of 200 N-m. Take G = 80 GPa. **(04 Marks)**

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CBCS SCHEME

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18ME36B/18MEB306

Third Semester B.E. Degree Examination, July/August 2021
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Explain with a neat sketch International Prototype Meter. **(07 Marks)**
b. Discuss the following standards of measurement:
(i) Line standard (ii) Wavelength standard (iii) End standard **(06 Marks)**
c. Explain the classification of standards. **(07 Marks)**

2 a. Explain with a sketch working of Auto Collimator. **(07 Marks)**
b. Build dimension of 49.3115 mm and 68.208 mm using M112 set slip gauges. **(06 Marks)**
c. Explain the process of wringing of slip gauges. **(07 Marks)**

3 a. Explain with a sketch Hole base system and Shaft base system. **(07 Marks)**
b. What is a fit? Explain different types of fits. **(07 Marks)**
c. Differentiate between Inter Changeability and Selective assembly. **(06 Marks)**

4 a. Determine the tolerances on a hole and shaft for a running fit 50H796. Given:
(i) 50 mm lies between 30-50 mm
(ii) $i = 0.45 \sqrt[3]{D} + 0.001D$
(iii) Fundamental deviation for 'H' hole = 0
(iv) Fundamental deviation for 'g' shaft = $-2.5\ D^{0.34}$
(v) IT7 = 16i, IT6 = 10i **(07 Marks)**
b. Explain the needs and characteristics of comparators. **(06 Marks)**
c. Explain with a sketch construction and working of LVDT. **(07 Marks)**

5 a. Explain with a sketch working of Tool Maker's microscope. **(07 Marks)**
b. Sketch and explain the two-wire method of measuring the effective diameter of a screw thread. **(07 Marks)**
c. Derive the expression for Best Size Wire. **(06 Marks)**

6 a. Explain with a neat diagram construction and working of coordinate measuring machine. **(08 Marks)**
b. Explain: (i) Runout (ii) Concentricity (iii) Involute profile (iv) Composite error **(12 Marks)**

7 a. Explain with an example Generalized measurement system. **(08 Marks)**
b. Explain: (i) Accuracy (ii) Threshold (iii) Hysteresis (iv) Sensitivity **(12 Marks)**

8 a. Explain with a neat sketch Ballast circuit. **(10 Marks)**
b. Explain with a neat sketch working of Cathode Ray Oscilloscope (CRO). **(10 Marks)**

9 a. Explain with a neat sketch working of proving ring. **(10 Marks)**
b. Explain with a sketch McLeod Gauge. **(10 Marks)**

10 a. Explain with a sketch Wheatstone Bridge arrangement for strain measurement. **(10 Marks)**
b. What is a thermocouple? Explain the law of thermocouples. **(10 Marks)**

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CBCS SCHEME

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18ME42

Fourth Semester B.E. Degree Examination, July/August 2021
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions.***
2. ***Use of thermodynamics data hand book is permitted.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. Derive an expression for efficiency of diesel cycle. **(08 Marks)**

b. The compression ratio in an air-standard Otto cycle is 10. At the beginning of the compression stroke, the pressure is 100 kPa and temperature is 15°C, the heat transfer to the air per cycle is 1800 kJ/kg of air. Determine:
(i) The pressure and temperature at all the salient points.
(ii) Thermal efficiency
(iii) Mean effective pressure **(12 Marks)**

2 a. Explain the process of combustion in C.I. engine with the help of P-θ diagram. **(08 Marks)**

b. In a test of a 4-cylinder, 4-stroke engine 75 mm bore and 100 mm stroke, the following results were obtained at full throttle at a particular constant speed and with fixed fuel supply of 6.0 kg/hr.

B.P. with all cylinders working	15.6 KW
B.P with cylinder no.1 cutoff	11.1 KW
B.P with cylinder no.2 cutoff	11.03 KW
B.P with cylinder no.3 cutoff	10.88 KW
B.P with cylinder no.4 cut off	10.66 KW

If the calorific value of the fuel is 83,600 kJ/kg and clearance volume is 0.0001 m^3, calculate:
(i) Mechanical efficiency
(ii) Indicated Thermal efficiency
(iii) Air standard efficiency **(12 Marks)**

3 a. For a simple gas turbine cycle, the optimum pressure ratio for maximum work output of cycle is $R_p = \left\{ \eta_C \eta_t \frac{T_3}{T_1} \right\}^{\frac{\gamma}{2(\gamma-1)}}$. Prove. **(08 Marks)**

b. A gas turbine unit has a pressure ratio of 6:1 and maximum temperature in the cycle is 610°C. The efficiencies of compressor and turbine are 0.8 and 0.82 respectively. Calculate the overall efficiency of the gas turbine cycle. **(12 Marks)**

4 a. With the help of schematic and T-S diagrams, explain the methods of improving the efficiency of gas turbine cycle. **(10 Marks)**

b. In an air-standard Brayton cycle the air enters the compressor at 0.1 MPa and 15°C. The pressure loading the compressor is 1.0 MPa and maximum temperature in the cycle is 1100°C.
(i) Determine compressor work, turbine work and efficiency.
(ii) If an ideal regenerator is incorporated into the cycle determine compressor work, turbine work and efficiency. **(10 Marks)**

5 a. Explain with T-S diagrams, why Rankine cycle is used as an ideal cycle for power generation when compared to Carnot cycle. **(10 Marks)**

b. In a Rankine cycle, steam leaves the boiler and enters the turbine at 4 MPa and 400°C. The condenser pressure is 10 kPa. Determine cycle efficiency. **(10 Marks)**

6 a. With the help of neat diagram, explain the working of reheat cycle and derive an expression for the efficiency of the cycle. **(10 Marks)**

b. In a reheat cycle, steam leaves the boiler and enters the turbine at 4 MPa and 400°C. After expansion in the turbine to 400 kPa, the steam is reheated to 400°C and then expanded in the low pressure turbine to 10 kPa. Determine cycle efficiency. **(10 Marks)**

7 a. With P-H diagram and T-S diagram, explain the effect of super heating and sub cooling, on simple saturated refrigeration cycle. **(08 Marks)**

b. A R-12 plant is to develop 5 tons of refrigeration. The condenser and evaporator temperature are 40°C and –10°C respectively. Determine:

(i) COP of refrigerator
(ii) COP of heat pump
(iii) Power required by compressor **(12 Marks)**

8 a. With the help of sketch and psychrometric chart, explain the working of summer air conditioning system for Mangalore city. **(10 Marks)**

b. Air at 20°C, 40% RH is mixed adiabatically with air at 40°C, 40% RH in the ratio of 1 kg of former with 2 kg latter. Find the final condition of air. **(10 Marks)**

9 a. Derive an expression for volumetric efficiency of a single stage air compressor interms of pressure ratio, clearance volume and 'n' polytropic index. **(08 Marks)**

b. A single stage, double acting compressor has a free air delivery of 14 m^3/min measured at 1.013 bar and 15°C. The pressure and temperature in the cylinder during suction is 0.95 bar and 32°C. The delivery pressure is T bar and index of compression and expansion is 1.3. The clearance volume is 5% of swept volume, find: (i) Indicated power (ii) Volumetric efficiency. **(12 Marks)**

10 a. Explain different shapes of nozzles. **(06 Marks)**

b. Starting from steady flow energy equation, derive an expression for velocity of steam coming out of nozzle. **(06 Marks)**

c. Steam at a pressure of 20 bar and 25°C expands to an exit pressure of 4 bar in a convergent-divergent nozzle. Assuming frictionless flow upto throat and considering frictionless factor of 0.85 from throat to exit. Determine:

(i) Mass flow rate of steam for a throat area of 30 cm^2.
(ii) Exit area of the nozzle. **(08 Marks)**

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CBCS SCHEME

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17ME42

Fourth Semester B.E. Degree Examination, July/August 2021
Kinematics of Machines

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Differentiate between
(i) Higher and Lower pair
(ii) Mechanism and Machine
(iii) Kinematics and Dynamics **(06 Marks)**

b. With neat sketch explain the types of joints in a kinematic chain. **(06 Marks)**

c. What are the inversions? With sketch describe various inversions of 4 bar chain. **(08 Marks)**

2 a. With a neat proportionate sketch, explain crank and slotted lever quick return motion mechanism. **(10 Marks)**

b. Derive an expression for necessary condition for current steering and explain Ackerman steering gear with neat sketch. **(10 Marks)**

3 In a 4 bar mechanism, the dimensions of the links are under: AB = 50mm, BC = 66mm, CD = 56mm, AD = 100mm. At the instant when $\angle DAB = 60°$, the link AB has an angular velocity of 10.5 rad/s in the counter-clockwise direction. Determine
(i) Angular velocities of links BC and CD
(ii) Velocity of the point E on the link BC when BE = 40mm.
(iii) Velocity of rubbing at pins A, B, C and D when the radii of the pins are 30, 40, 25 and 35mm respectively. **(20 Marks)**

4 a. Explain the method of finding acceleration of slider crank mechanism using Klen's construction **(08 Marks)**

b. State and prove Kennedy's theorem. **(06 Marks)**

c. Write a note on Corioli's component of acceleration. **(06 Marks)**

5 In an IC engine mechanism, crank radius is 50mm and connecting rod length is 200mm. The crank is rotating at 100 rad/s clockwise. At a particular instant the crank is at 40° from TDC position. For this position of the mechanism, find out the velocity of piston using complex algebra method. **(20 Marks)**

6 a. Derive the expression for Freudenstein's equation for 4 bar mechanism. **(12 Marks)**

b. Explain function generation for slider crank mechanism. **(08 Marks)**

7 a. Obtain an expression for the minimum number of teeth on pinion to avoid interference. **(10 Marks)**

b. A pinion with 120mm pitch diameter meshes with a gear of 400mm pcd. The teeth are of module 2mm and pressure angle of 25°. If the addendum of each wheel is 6mm find the angle by which the pinion turns to maintain contact. Also find the maximum sliding velocity, assume pinion is the driver and it rotates at 200 rpm. **(10 Marks)**

8 An epicyclic gear train has a fixed annular wheel A concentric with sun wheel C. The gear A has a 72 teeth and C has 32 teeth. A planet wheel B gears with A and C and is carried on an arm F which rotates about the centre of A at 18 rpm. Determine the speed of gears B and C. **(20 Marks)**

9 The following data relate to a cam profile which operates a knife edge follower rising with SHM and lowering with UARM.
Minimum radius of cam 30mm
Line of stroke of follower is offset 15mm from the axis of the cam.
Lift of the follower 45mm
Angle of ascent 70°
Angle of descent 120°
Angle of dwell in highest position of follower is 45°
Speed of cam 200 rpm in CW direction.
Draw the profile of the cam and determine maximum velocity and acceleration during lift of the follower. **(20 Marks)**

10 A symmetrical cam with convex flanks operates a flat-faced follower. The lift is 8mm, base circle radius is 25mm and the nose radius is 12mm. If the total angle of cam action is 120°, find the radius of the convex flank. Determine the maximum velocity and the maximum acceleration when the cam shaft rotates at 500 rpm. **(20 Marks)**

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CBCS SCHEME

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17ME43

Fourth Semester B.E. Degree Examination, July/August 2021
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions.
2. Use of Thermodynamics data hand book is permitted.

1 a. With the help of P-V and T-S diagrams, derive an expression for the air standard efficiency of a diesel cycle. **(10 Marks)**

b. An engine of 250mm bore and 375mm stroke works on otto cycle. The clearance volume is $0.00263m^3$. The initial pressure and temperature are 1 bar and 50°C. If maximum pressure is 25 bar find: i) Air standard efficiency of the cycle ii) Mean effective pressure. **(10 Marks)**

2 a. Derive an expression for the optimum pressure ratio for the maximum network output in an Brayton cycle. **(08 Marks)**

b. What are methods of improving the efficiency of Brayton cycle? **(02 Marks)**

c. The following data refers to an open cycle gas turbine. Pressure ratio = 5, Maximum temperature = 1075K, Minimum temperature = 290K, C_p for gas = 1.15kJ/kg.K, γ for air = 1.4 and γ for gas = 1.33, calorific value of the fuel = 45000kJ/kg, Efficiency of the compressor = 0.85, Efficiency of the turbine = 0.9, Efficiency of combustion = 0.95, Mass flow rate = 5kg/sec, Find: i) Thermal efficiency of the plant ii) Power output of the plant iii) Air to fuel ratio. **(10 Marks)**

3 a. Discuss the effect of i) Boiler pressure ii) Condenser pressure iii) Superheat on the performance of Rankine cycle. with the help of T-S diagram. **(09 Marks)**

b. With a schematic diagram and its P-V and T-S diagrams explain the Rankine cycle and also derive its thermal efficiency. **(11 Marks)**

4 a. With a schematic diagram and its T-S diagram, explain the working of reheat vapour cycle of deduce an expression for cycle efficiency. **(10 Marks)**

b. A steam turbine working of a Rankine cycle is supplied with dry saturated steam at 25 bar and the exhaust takes place at 0.2 bar. For a steam flow rate of 10 kg/s, determine,
i) Quality of steam at the end of expansion
ii) Turbine shaft work
iii) Power required to operate the pump
iv) Work ratio. **(10 Marks)**

5 a. Explain the following terms with reference to a combustion process:
i) Stoichiometric air ii) Enthalpy of formation iii) Enthalpy of combustion
iv) Adiabatic flame temperature v) Enthalpy of reaction. **(10 Marks)**

b. The products of combustion of an unknown hydrocarbon C_xH_y have the following composition as measured by an Orsat apparatus. CO_2 = 8%, CO = 0.9%, O_2 = 8.8%, N_2 = 82.3%. Determine: i) The composition of fuel ii) The air-fuel ratio iii) The percentage of excess air used. **(10 Marks)**

6 a. Define indicated power. Explain briefly how the frictional power of a multicylinder engine is determined using Morse test. State the assumptions made. **(10 Marks)**

b. A two stroke diesel engine was motored when meter reading was 1.5kW. Test on the engine was carried out for one hour and data observed were, brake torque = 120N-m, rpm = 600, fuel used = 2.5kg, cooling water = 818kg, CV of fuel = 40.3MJ/kg, Rise in temperature of cooling water = 10°C, room temperature = 27°C, A:F used = 32:1, exhaust gas temperature = 347°C, C_p for exhaust gases = 1.05kJ/kg.K. Determine, brake power, indicated power, mechanical efficiency and thermal efficiency. Draw heat balance sheet on minute and percentage basis. **(10 Marks)**

7 a. With a neat sketch, explain the working of vapour absorption refrigeration system. **(10 Marks)**

b. A food storage chamber requires a refrigeration system of 10 Ton capacity with an evaporator temperature of -10°C and condenser temperature of 30°C. The refrigerant F-12 is sub cooled by 5°C before entering the throttle valve and the vapour is superheated by 6°C before entering the compressor. The specific heats of vapour and liquid are 0.7327 and 1.235 respectively. Determine: i) The refrigerating capacity per kg ii) Mass of refrigerant circulated per minute iii) COP. **(10 Marks)**

8 a. Define the following: i) Dry bulb temperature ii) Wet bulb temperature iii) Specific humidity iv) Saturated air v) Degree of saturation. **(10 Marks)**

b. Represent the following processes on a psychrometric chart i) Sensible heating ii) Dehumidification. **(04 Marks)**

c. Atmospheric air at 101.325kPa has 30°C DBT and 15°C DPT, without using the psychrometric chart using the property values from the tables, calculate:
i) Partial pressure of air ii) Specific humidity iii) Relative humidity. **(06 Marks)**

9 a. Derive an expression for volumetric efficiency of a single stage air compressor interms of pressure ratio, clearance ratio and the index of expansion and compression. **(10 Marks)**

b. A single stage double acting reciprocating compressor delivers 0.25m^3/s. of air measured at 1.013 bar and 27°C. The delivery pressure is 7bar. At the beginning of compression, air is at 0.98 bar and 40°C. The clearance volume is 4% of swept volume. The stroke to bore ratio is 1:3. Compressor runs at 300rpm. Calculate, the volumetric efficiency cylinder dimensions and indicated power if the index of compression and expansion is 1.3. **(10 Marks)**

10 a. Show that the optimum intermediate pressure of a two stage reciprocating air compressor for minimum work is the geometric mean of the suction and discharge pressures. **(10 Marks)**

b. Mention the types of nozzles. Explain any one. **(04 Marks)**

c. A two stage reciprocating air compressor works between pressure limits of 1 bar and 8 bar and draw in air at 15°C at the rate of 467 litres per minute. The compression in both stages is isentropic and inter cooling is perfect. Estimate minimum power supplied. **(06 Marks)**

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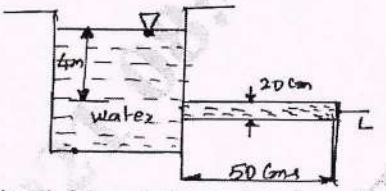
6 a. Determine the rate of flow of water through a pipe of diameter 20cm and length 50m when one end of the pipe is connected to a tank and other end of the pipe is open to the atmosphere. Consider all minor losses and take f = 0.009 in the formula $h_f = \frac{4fLV^2}{2gd}$, refer the Fig.Q.6(a). **(10 Marks)**

Fig.Q.6(a)



b. Lubricating oil of specific gravity 0.85 and dynamic viscosity 0.1N-s/m^2 is pumped through a 3cm diameter pipe. If the pressure drop per metre length of the pipe is 15kPa. Determine:
i) The mass flow rate of oil kg/min
ii) Shear stress at the pipe wall
iii) Reynolds number of the flow and
iv) The power required per 40m length of the pipe to maintain the flow. **(10 Marks)**

7 a. What is the meaning of Boundary layer separation? What is the effect of pressure gradient on boundary layer separation? **(10 Marks)**

b. Using Rayleigh's method, show that the power 'P' developed by a Hydraulic turbine is given by $P = \rho N^3 D^5 \phi\left[\frac{gH}{N^2D^2}\right]$, where ρ = density of the liquid, N = rotational speed of the turbine in rpm, D = Diameter of the runner, H = Working Head, g = gravitational acceleration. **(10 Marks)**

8 a. The rate of discharge Q of a centrifugal pump is dependent upon density of the fluid 'ρ', pump speed N in rpm, diameter of the impeller 'D', pressure 'P', viscosity of the fluid 'μ'. Using Bucking Ham's π theorem method, show that

$$Q = ND^3\phi\left[\frac{P}{\rho N^3D^5}, \frac{\mu}{\rho ND^2}\right]$$ **(10 Marks)**

b. A kite 0.8m × 0.8m weighing 3.924N assumes an angle of 12° to the horizontal. The string attached to the kite makes an angle of 45° to horizontal. The pull on the string is 24.525N, when the wind is flowing at a speed of 30km/hr. Find the corresponding coefficient of drag and lift. Take density of air = 1.25kg/m^3. **(10 Marks)**

9 a. Explain stagnation properties. Obtain an expression for velocity of sound for adiabatic process. **(10 Marks)**

b. A projectile travels in air of pressure 15N/mm^2 at 10°C at a speed of 1500km/hr. Find the Mach number and Mach angle. Assume γ = 1.4 and R = 287J/kg K. **(05 Marks)**

c. What are the normal and oblique shocks? **(05 Marks)**

10 a. Starting from fundamental, show the velocity of propagation of elastic wave in an isothermal medium is given by $C = \sqrt{RT}$. **(06 Marks)**

b. Define the following terms: i) Mach number ii) Mach cone iii) Zone of action iv) Subsonic flow v) Supersonic flow. **(10 Marks)**

c. Explain the meaning of CFD and its applications. **(04 Marks)**

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CBCS SCHEME

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17ME44

Fourth Semester B.E. Degree Examination, July/August 2021
Fluid Mechanics

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. State and prove Pascal's law. **(10 Marks)**

b. The right limb of a simple U tube manometer containing Hg is open to the atmosphere. While the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of pipe is 12cms below the level of Hg in the right limb. Find the pressure of liquid or fluid in the pipe if the difference of Hg level in two limbs is 20cm. **(10 Marks)**

2 a. A caisson for closing the entrance to a dry done is of trapezoidal form 16 m wide at the top and 10m wide at the bottom and 6m deep. Find the total pressure and centre of pressure are the caisson, if the water on the outside is just with the tap and dock is empty. **(10 Marks)**

b. The velocity distribution of flow over a plate is parabolic with vertex 30cms from the plane, where the velocity is 180cm/s. If the viscosity of the fluid of 0.9N-s/m^2 find the velocity gradient and shear stresses at distances of 0.15cms and 30cms from the plane. **(10 Marks)**

3 a. Derive continuity equation in Cartesian coordinates for fluid flow in 3-dimensions. **(10 Marks)**

b. Differentiate between:
   i) Study flow and Unsteady flow
   ii) Viscous flow and Turbulent flow. **(05 Marks)**

c. Define and explain stream function and velocity potential function. **(05 Marks)**

4 a. State assumption in Bernoulli's equation and derive the relation. **(08 Marks)**

b. Differentiate between venturimeter and orificemeter. **(04 Marks)**

c. A 30cm × 15cm venturimeter is inserted in a vertical pipe line carrying oil of specific gravity 0.85, the flow of oil is upwards. Throat section is 50cm above inlet section of venturimeter. The oil mercury differential manometer gives a reading of 30cm of mercury. Find the rate of oil flow in lts/sec and the pressure difference between inlet and throat section. Assume C_d 0.96. Neglect all losses. **(08 Marks)**

5 a. Derive an expression for loss of head due to sudden enlargement. **(10 Marks)**

b. For laminar flow between the stationary parallel plates. Obtain an expression for velocity distribution. **(10 Marks)**

CBCS SCHEME

USN | | | | | | | | | | |

17ME46B/17MEB406

Fourth Semester B.E. Degree Examination, July/August 2021
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1	a.	What is metrology? Explain the objectives of metrology.	(05 Marks)
	b.	Explain subdivision of standards.	(07 Marks)
	c.	With a neat sketch, explain International prototype meter.	(08 Marks)
2	a.	Explain the wringing phenomena of slip gauges.	(05 Marks)
	b.	With a neat sketch, explain the working of sine centre.	(07 Marks)
	c.	With a neat sketch, explain the working of autocollimator.	(08 Marks)
3	a.	State and explain Taylor's principle of gauge design.	(05 Marks)
	b.	With neat sketches, explain different types of fit.	(07 Marks)
	c.	Explain the principle of interchangeability and selective assembly.	(08 Marks)
4	a.	Define comparator. What is the need of a comparator?	(05 Marks)
	b.	Explain with a neat sketch the working principle of mechanical optical comparator.	(07 Marks)
	c.	Explain with a neat sketch the working principle of solex pneumatic gauge.	(08 Marks)
5	a.	With a neat sketch, explain screw thread terminology.	(05 Marks)
	b.	Derive an expression for measurement of effective diameter by two wire method.	(07 Marks)
	c.	With a neat sketch, explain the working of Tools maker's microscope.	(08 Marks)
6	a.	With a neat sketch, explain gear teeth terminology.	(05 Marks)
	b.	With a neat sketch, explain the working of coordinate measuring machine.	(07 Marks)
	c.	With a neat sketch, explain the working of laser interferometer.	(08 Marks)
7	a.	Explain generalized measurement system, with a block diagram.	(05 Marks)
	b.	Define: (i) Accuracy (ii) Calibration (iii) Error (iv) Threshold (v) Hysteresis (vi) Least count (vii) Range	(07 Marks)
	c.	Explain with a neat sketch, electronic transducers.	(08 Marks)
8	a.	With a block diagram, explain telemetring system.	(05 Marks)
	b.	With a neat block, explain stylus type oscillography.	(07 Marks)
	c.	With a circuit diagram, explain Ballast circuit.	(08 Marks)
9	a.	With a neat sketch, explain the working of prony brake dynamometer.	(10 Marks)
	b.	With a neat sketch, explain McLeod gauge.	(10 Marks)
10	a.	Define thermocouple. State the laws of thermocouple and explain.	(08 Marks)
	b.	Define strain gauge. With a neat sketch, explain Wheatstone bridge circuit.	(08 Marks)
	c.	Write short notes on: (i) Thermo couple material (ii) Seebeck effect	(04 Marks)

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