CBCS SCHEME

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17ME32

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Explain crystal imperfections with necessary diagrams. **(12 Marks)**

b. Draw the neat sketches of HCP and FCC structures. Also find out APF of the above structures. **(08 Marks)**

OR

2 a. Explain R.R. MOORE Fatigue testing technique with neat diagram and plot S-N curves for MS, Aluminium and Copper. **(10 Marks)**

b. Explain three stages of creep with the help of creep curve and also explain creep properties. **(10 Marks)**

Module-2

3 a. Explain types of solid solutions and factors governing the formation of best substitutional solid solutions (Hume-Rothery Rules). **(10 Marks)**

b. Explain Gibb's phase rule and lever rule with the help of suitable examples. **(10 Marks)**

OR

4 a. What is meant by homogeneous and heterogeneous nucleations? Derive the equation for critical radius in homogeneous nucleation. **(10 Marks)**

b. Draw the Iron-carbon diagram, mark all the pahses on it, write invariant reactions and invariant points. **(10 Marks)**

Module-3

5 a. Draw the T-T-T diagram with the help of transformation curves. Explain the structure of Martensite, Bainite and Retained Austenite. **(12 Marks)**

b. Explain Annealing and normalizing with the help of necessary graphs and diagrams. **(08 Marks)**

OR

6 a. Explain in detail the surface hardening like, carburizing, cyaniding, nitriding flame hardening and induction hardening. **(16 Marks)**

b. Explain the concept of Austempering and Martempering. **(04 Marks)**

Module-4

7 a. Write note on structure, properties and applications of ceramics. **(12 Marks)**

b. Write note on mechanical and electrical behavior of ceramics. **(08 Marks)**

OR

8 a. Explain two plastic processing methods with neat diagrams. **(12 Marks)**

b. Write note on smart materials and shape memory alloys. **(08 Marks)**

Module-5

9 a. Write note on matrix materials and reinforcement materials. **(10 Marks)**

b. Write advantages, limitations and applications of composites. **(10 Marks)**

OR

10 a. Write note on any two polymer matrix composites production methods with neat diagrams. **(12 Marks)**

b. Derive the equation to calculate Young's modulus in iso-strain condition. **(08 Marks)**

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CBCS SCHEME

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17ME33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Thermodynamics Hand Book permitted.

Module-1

1 a. Can you define and give examples to the following? i) Closed system, ii) open system, iii) isolated system. **(06 Marks)**

b. Can you distinguish between the following:
i) Microscopic and Macroscopic point of study
ii) Intensive and Extensive properties
iii) Work and Heat
iv) Path and Point functions. **(08 Marks)**

c. State and explain Zeroth law of thermodynamics. **(06 Marks)**

OR

2 a. Can you define thermodynamic definitions of work and heat? Write three important similarities between them. **(05 Marks)**

b. Can you derive expressions for work done of the following types of processes?
i) The process which follow the law, $P = C$
ii) The process which follow the law, $PV^{\gamma} = C$. **(06 Marks)**

c. Air at 1.02 bar, 22°C, initially occupying a cylinder volume of $0.015m^3$, is compressed reversibly and adiabatically by a piston to a pressure of 6.8 bar. Calculate: i) The final temperature ii) The final volume iii) The work done. **(09 Marks)**

Module-2

3 a. Write the first law statements for a system undergoing:
i) a cycle ii) a process iii) a steady flow process. **(06 Marks)**

b. Prove that internal energy – a property. **(04 Marks)**

c. Air flows steadily at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of 1 bar and a specific volume of 0.85 m^3/kg, and learning at 4.5 m/s with a pressure of 6.9 bar and a specific volume of $0.16m^3$/kg. The internal energy of air leaving is 88kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 59 kJ/s. Calculate the power required to drive the compressor and the inlet and outlet pipe cross sectional areas. **(10 Marks)**

OR

4 a. Will you prove that two statements of second law of thermodynamics are equivalent? **(05 Marks)**

b. Can you explain carnot heat engine cycle with the help of P-V and T-S diagrams? **(07 Marks)**

c. A heat source S_1 can supply 6000 kJ/min at 300°C and another heat source S_2 can supply 60,000 kJ/min at 100°C. Which source between the two would you choose to supply energy to a carnot engine, that is to produce larger amount of power if the surroundings are at 27°C? Which engine is more efficient? **(08 Marks)**

Module-3

5 a. Can you define and give examples for reversible and irreversible processes? List the factors which makes the process irreversible. **(06 Marks)**

b. Will you prove that entropy a property of a system? **(06 Marks)**

c. A reversible heat engine converts one-sixth of the heat input into work. When the temperature of the sink is reduced by 62°C, its efficiency is doubled. Find the temperature of the source and the sink. **(08 Marks)**

OR

6 a. Derive an expression for change in entropy during constant pressure process. **(06 Marks)**

b. Explain the principle of increase of entropy. **(06 Marks)**

c. In a shell and tube heat exchanger 45kg of water per minute is heated from 60°C to 115°C by hot gases which enter the heat exchanger at 225°C. If the flow rate of gases is 90 kg/min, find the net change of entropy of the universe. C_p (water) = 4.18 kJ/kg.K; C_p(gas) = 1 kJ/kg.k. Assume that there are no losses. **(08 Marks)**

Module-4

7 a. Define available and unavailable energy and prove that the available portion of heat Q withdrawn from an infinite source is $(Q-T_0\Delta s)$. Where T_0 is dead state temperature and ΔS is change in entropy during the process. **(07 Marks)**

b. Obtain an expression for availability of a non-flow process. **(06 Marks)**

c. One kg of air at pressure P_1 and temperature 900K is mixed with one kg of air at the same pressure but at 500K. Determine the loss in availability if the atmospheric temperature is 300K. **(07 Marks)**

OR

8 a. Explain P-T diagram for water. **(06 Marks)**

b. Explain the method of determining the dryness fraction of the given sample of stream using throttling calorimeter with a neat sketch. **(07 Marks)**

c. Determine the enthalpy and internal energy of 2kg of steam at a pressure of 15 bar and 0.85 dryness. Also determine the heat supplied at constant pressure if the final condition of the steam is 70°C of superheat. Take Cp_s (superheated) = 2.25 kJ/kg. **(07 Marks)**

Module-5

9 a. Define the following terms: Mass fraction, Mole fraction, Specific humidity, Dry Bulb Temperature, Dew Point Temperature. **(05 Marks)**

b. Derive and expression for molecular weight and gas constant of a mixture of ideal gases in terms of mass fractions. **(06 Marks)**

c. A vessel of $0.2m^3$ capacity contains 2kg of CO_2 and 1.5kg of N_2 at 300K. Determine: i) Pressure in the vessel ii) Mole fraction of each constituent iii) R and M of the mixture. **(09 Marks)**

OR

10 a. Explain the reasons for deviations of Van-der Waal's equation from ideal gas equation. **(06 Marks)**

b. Explain the following:
   i) Law of corresponding states
   ii) Compressibility factor
   iii) Gibbos-Dalton's law. **(06 Marks)**

c. A container of $3m^3$ capacity contains 10kg of CO_2 at 27°C. Estimate the pressure exerted by CO_2 by using:
   i) Perfect gas equation
   ii) Van-der Waal's equation
   iii) Beattie Bridgeman equation. **(08 Marks)**

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CBCS SCHEME

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17ME34

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

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

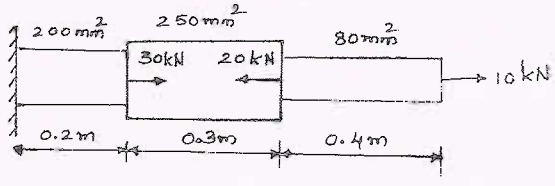
Module-1

1 a. Explain principle of superposition. **(03 Marks)**

b. Derive an expression for Young's Modulus (E) interms of bulk modulus (K) and Poisson's ratio (π). **(07 Marks)**

c. A stepped bar is subjected to forces as shown in Fig.Q.1(c). Determine the stress induced in different portions and Net deformation in the stepped bar. Take $E = 2\times10^5 \frac{N}{mm^2}$. **(10 Marks)**

Fig.Q.1(c)



OR

2 a. Derive an expression for the total elongation of tapered bar varying diameter from d_1 to d_2 subjected to axial load 'P'. **(10 Marks)**

b. A steel bar is placed between two copper bar, each having same area and length as the steel bar. These are rigidly connected together at a temperature of 25°C. When the temperature is raised to 325°C. The length of the bar is increased by 1.5mm compute the original length and find the stresses in each bar. Take E_{steel} = 210GPa, E_{cu} = 100GPa, $\alpha_{steel} = 12 \times 10^{-6}$/°C, α_{cu} = 17.5 × 10-6/°C. **(10 Marks)**

Module-2

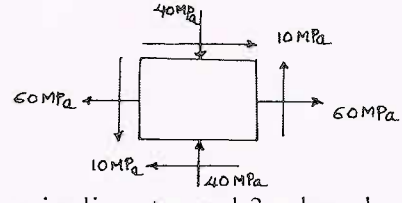
3 a. Derive the expression for normal stress and shear stress on a plane inclined at 'θ' angle to the vertical axis in a biaxial stress system with shear stress. **(10 Marks)**

b. Determine the wall thickness necessary for a thick steel cylinder shell having 200mm inner diameter to withstand an internal pressure of 40MPa. Permissible tensile stress in the material is 100MPa. Also sketch the variation of hoop stress and radial stress across the thickness. **(10 Marks)**

OR

4 a. A plane element subjected to stress shown in Fig.Q.4(a). Determine principal stresses, Max shear stress and their plane. Use Mohr's circle method. **(10 Marks)**

Fig.Q.4(a)



b. A cylindrical thin drum 800mm in diameter and 3m long has a shell thickness of 10mm. If the drum is subjected to an internal pressure of 25 bar. Calculate the change in diameter, change in length and change in volume. Take E = 200GPa, π = 0.25. **(10 Marks)**

Module-3

5 a. Explain different types of beams and loads. **(05 Marks)**

b. Draw SFD and BMD for the beam shown in Fig.Q.5(b).

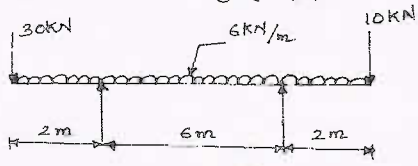


Fig.Q.5(b)

(15 Marks)

OR

6 a. Prove the relations $\frac{M}{I}=\frac{\sigma}{y}=\frac{E}{R}$ with usual notations. **(10 Marks)**

b. A cantilever beam of square section 200mm × 200mm, 2m long just fails in bending, when a load of 20kN is placed at its free end. A beam of the same material having a rectangular cross-section 150mm × 300mm. Simply supported over a span of 3m is to be used under uniformly distributed load 'W' $\frac{N}{m}$. What can be maximum value of W? **(10 Marks)**

Module-4

7 a. List all the assumptions and derive the torsion formula in standard form $\frac{T}{J}=\frac{\tau}{R}=\frac{G\theta}{L}$. **(10 Marks)**

b. A hollow shaft having diameter ratio of 0.4, transmits 562.5kW power at 100rpm. Determine cross-sectional dimensions of the shaft, if shear stress is not exceed 60MPa and twist in length of 2.5m should not exceed 1.3°. Maximum torque transmitted is 25% higher than average torque G = 90GPa. **(10 Marks)**

OR

8 a. Derive an expression for critical load in a column subjected to compressive load, when one end is fixed and the other end free. **(10 Marks)**

b. A 1.5m long column has a circular cross-section of 50mm diameter. One end of the column is fixed and other end is free. Take factor of safety as 3, calculate the safe load using

i) Rankine's formula, take yield stress = 560 N/mm^2 and $a=\frac{1}{1600}$

ii) Euler's formula, Young's modulus = 1.2×10^5 N/mm^2. **(10 Marks)**

Module-5

9 a. Explain Factor of safety. **(04 Marks)**

b. Explain maximum normal stress theory and maximum shear stress theory. **(08 Marks)**

c. A bar of 5m long and 50mm diameter hangs vertically and it has collar attached to it to the lower end rigidly. Determine maximum stresses induced when

i) Weight of 3000N falls through a height of 100mm on the collar.

ii) Weight of 30kN falls through a height of 10mm on the collar. Take = 2×10^5 N/mm^2. **(08 Marks)**

OR

10 a. Derive the expression for strain energy due to shear stress and bending. **(10 Marks)**

b. The stresses induced at a critical point in a machine component made of steel (σ_y = 380MPa) are as follows: $\sigma_x=100\frac{N}{mm^2}$, $\sigma_y=40\frac{N}{mm^2}$, $\tau_{xy}=80\frac{N}{mm^2}$ calculate factor of safety by i) Rankine's theory ii) Guest's theory. **(10 Marks)**

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CBCS SCHEME

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17ME35B/17MEB305

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Machine Tools and Operations

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Handbook, charts and tables are not required.

Module-1

1 a. Describe minimum ten different operations, which can be carried out on a Lathe. **(05 Marks)**

b. Explain with neat sketch, about the parts of Lathe, in detail. **(05 Marks)**

c. Explain the construction and specification in detail by drawing neat figures of (i) SPINDLE (ii) Tail-Stock of the lathe (iii) Carriage assembly (iv) Capstan and Turret Lathe. **(10 Marks)**

OR

2 a. Explain in detail, by drawing a neat sketch, about the
i) Working principal of a milling machine
ii) Construction of milling machine. **(05 Marks)**

b. Discuss in detail about UNIVERSAL MILLING MACHINE by drawing a neat figure of
i) With fixed head
ii) With SWIVELLING HEAD. **(15 Marks)**

Module-2

3 Explain in detail by drawing adequate sketches regarding :

a. Lathe setting for thread cutting **(05 Marks)**

b. Any six drilling machine operations. **(15 Marks)**

OR

4 Explain in detail by drawing neat sketches:

a. SLOT and GROOVE MILLING

b. PROFILE MILLING

c. GEAR MILLING

d. THREAD MILLING. **(20 Marks)**

Module-3

5 a. Evaluate machining time. What will be effect on machining time if cutting speed is increased by 50%? While in a turning operation following data is observed. D = 200mm, L = 600mm, cutting speed = V = 600 mm/sec, feed (f) = 0.4mm/rev. **(10 Marks)**

b. Evaluate time required for 100 job by assuming 02 minutes, for handling of each job. When a steel shaft of 100 mm diameter and 300mm long turned on LATHE. Speed of sindle = 3m/sec. Feed (f) = 0.3mm/rev. **(10 Marks)**

OR

6 a. Evaluate machining time, if number of teeth on the cutter is 4 and feed is 0.2mm/tooth. Other values are as follows, A plain surface of 50mm wide and 700 mm long is to be FACE-MILLED on a vertical spindle milling machine. The machining allowance is 3mm, to be removed in one pass. Take cutter diameter as 120mm and cutting speed (V) = 180 m/min. **(10 Marks)**

b. Evaluate the machining parameters of a solid cylinder which is to be ground longitudinally on a cylindrical grinding machine. The length of the cylinder is 300mm and 60mm diameter. The allowance per side is 0.3mm. The grinding wheel diameter and width is 600mm and 63 mm respectively. Given cutting speed is 30m/min. **(10 Marks)**

Module-4

7 a. Explain tool signature or tool designation is used to denote a standardized system of specifying the principal tool angles of a single point cutting tool. Draw neat sketch for both system i) AMERICAN SYSTEM ii) OPTHOGONAL SYSTEM [Explain in detail]. **(10 Marks)**

b. Derive an expression for CHIP THICKNESS RATIO in orthogonal cutting operation for a single point cutting tool. **(10 Marks)**

OR

8 a. Evaluate the following parameters :

i) Chip thickness
ii) Shear plane angle
iii) Coefficient of friction on tool face
iv) Shear force on shear plane
v) Energy consumed in KW min per cubic centimeter of metal removed for a tool with 18° rake angle is making an orthogonal cut, 3mm wide, at a speed of 36 mpm and feed of 0.25mm. The chip thickness ratio is 0.60, cutting force is 1392N and feed force as 363N. **(10 Marks)**

b. Analyze and prove that $\frac{T_s}{P_c} = \frac{(1-\mu\gamma)\gamma}{1+\gamma^2}$ when the RAKE-ANGLE is zero during orthogonal cutting. **(10 Marks)**

Module-5

9 a. Describe the all eight factors which affect the life of cutting tool. **(10 Marks)**

b. Evaluate the change in tool life, if the cutting speed, feed, depth of cut are increased by 20% individually and also taken together. What will be their effect on the tool life? When the following equation for tool life is given for a turning operation $VT^{0.13} f^{0.77} = C$ A 60 min tool life was obtained, while cutting at V = 30 m/min, f = 0.30 mm/rev and depth of cut (d) = 2.5mm. **(10 Marks)**

OR

10 a. Evaluate: i) The most economical cutting speed and ii) Tool-life for maximum production, when, in a turning operation, it was observed that the tool life was 150min, the cutting speed was 20 m/min. As the speed was increased to 25m/min the tool life dropped to 25.2 minutes. If the time required to change the tool was 2 minutes and if the cost of regrinding the tool was ten (10) times the cost of turning per minute. **(10 Marks)**

b. Evaluate the following:

i) Total cost for producing 500 components.

ii) Optimum cutting speed for minimum cost and corresponding tool life.

iii) Cutting speed for maximum production and corresponding tool life.

For machining of a component on a lathe machine the following datas are obtained:

i) Machining constant (C) = 80

ii) Total changing time = 5min

iii) Total regrinding time = 3 min

iv) Total depreciation cost = Rs.1.2/regrind

v) Operating cost = Rs.0.25/min

vi) Labour + overheads per min = Rs.0.2

vii) Work loading and unloading time = 30sec

viii) Feed = 0.25mm/rev

ix) Exponent(n) = 0.25

x) Length of workpiece = 500mm

xi) Diameter of workpiece = 60mm

xii) Number of passes of complete machining = 4

xiii) Cutting speed = 30m/min

xiv) Idle time = 4 minute/piece

xv) Total grinding cost = Rs.1/grind. **(10 Marks)**

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CBCS SCHEME

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17ME36B

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Write legibly and draw neat diagrams.

Module-1

1 a. Define Metrology. State the objectives of Metrology. **(04 Marks)**
b. Explain with a neat sketch Imperial yard material standard. **(10 Marks)**
c. State the principle and the procedure of measuring angle using sine bar. **(06 Marks)**

OR

2 a. Explain with sketches the 'Wringing Phenomenon' of slip Gauges. **(10 Marks)**
b. What are Standards? Name and explain the various sub-divisions of Standards. **(10 Marks)**

Module-2

3 a. Explain the principle of interchangeability and selective assembly. **(10 Marks)**
b. Name the two system of fits. Explain the hole-basis type of system with neat sketch. **(10 Marks)**

OR

4 a. Explain with neat sketch, the principle and working of a Solex Pressure Gauge. **(10 Marks)**
b. State and explain with sketches the Taylor's principle of design of gauges. **(10 Marks)**

Module-3

5 a. How will you measure the effective diameter of screw threads using 2-wire method? **(10 Marks)**
b. Explain the constructional features and applications of co-ordinate measuring machines. **(10 Marks)**

OR

6 a. Explain any one method of gear tooth thickness measurement with sketch. **(10 Marks)**
b. What is a Laser? Explain any one type of Laser interferometer with sketch. **(10 Marks)**

Module-4

7 a. Explain with sketch the general concept of a measuring system. **(10 Marks)**
b. State the internet problems in mechanical transducers. **(04 Marks)**
c. Explain with sketch 'Threshold and Hysteresis' with respect to a measurement system. **(06 Marks)**

OR

8 a. Explain with sketch the simple current sensitive circuit of a intermediate modifying device. **(10 Marks)**

b. Explain the construction of an oscillograph. State its advantages. **(10 Marks)**

Module-5

9 a. Explain with sketch the construction and working of Prony brake dynamometer. **(10 Marks)**

b. Explain with sketch the Bridgeman type of pressure gauge. **(10 Marks)**

OR

10 a. Explain the terms: i) Poisson's Ratio ii) Gauge factor. **(02 Marks)**

b. State the procedure of mounting of strain gauges. **(08 Marks)**

c. State and explain the two laws of thermocouple with sketches. **(10 Marks)**

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CBCS SCHEME

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15ME/MA34

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Derive an expression for the extension of a uniformly tapering rectangular bar when it is subjected to an axial load P. **(08 Marks)**

b. Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter of 25mm and length 1.6m, if the longitudinal strain in a bar during a tension test is four times the lateral strain. Find the change in volume, when the bar is subjected to a hydrostatic pressure of 100N/mm^2. Take E = 1 × 10^{5}N/mm^2. **(08 Marks)**

OR

2 a. A mild steel rod of 20mm diameter and 300mm long is enclosed centrally inside a hollow copper tube of external diameter 30mm and internal diameter of 25mm. The ends of the tube and rods are brazed together, and the composite bar is subjected to an axial pull of 40kN. If E for steel and copper is 200GN/m^2 and 100 GN/m^2 respectively. Find the stresses developed in the rod and tube. Also find the extension of the rod. **(08 Marks)**

b. A steel bar is placed between two copper bars each having the same area and length as the steel bar at 15^{0}C. At this stage , they are rigidly connected together at both the ends. When the temperature is raised to 315^{0}C, the length of the bars increase by 1.5mm. Determine the original length and final stresses in the bars. Take $E_s = 2.1 \times 10^5$ N/mm^2 ; $E_c = 1 \times 10^5$ N/mm^2 ; $\alpha_s = 0.000012$ per ^{0}C ; $\alpha_c = 0.0000175$ per ^{0}C. **(08 Marks)**

Module-2

3 a. Define Principal planes. Starting from the expression of normal and tangential stresses acting on inclined plane in an element subjected to 2D – stress state, derive the expressions for the magnitude and location of principal stresses. **(08 Marks)**

b. The direct stresses acting at a point in a strained material are as shown in fig. Q3(b). Find the normal , tangential and the resultant stresses on a plane 30^0 to the plane of the major principal stress. Find also the obliquity of the resultant stresses. **(08 Marks)**

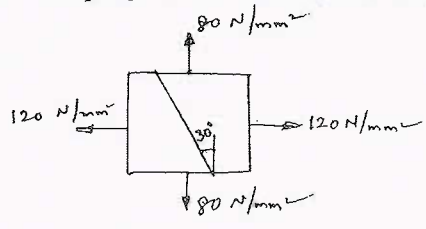


Fig.Q3(b)

OR

4 a. A thick walled cylindrical pressure vessel has inner and outer radii of 200mm and 250mm respectively. The material of the cylinder has an allowable stress of 75 MN/m^2. Determine the maximum internal pressure that can be applied and draw the sketch of radial pressure and circumferential stress distribution. **(08 Marks)**

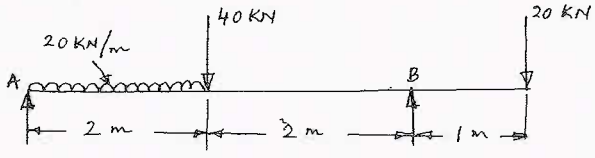
b. Derive expressions for circumferential Loop stress and longitudinal stress in thin cylinder. State the assumptions made in the derivation. **(08 Marks)**

Module-3

5 a. Obtain the expressions for shear force and bending moment at a section of a cantilever beam carrying gradually varying load from zero at the free end to W per unit length at the fixed end. Draw the shear force and bending moment diagrams. **(06 Marks)**

b. Draw the shear force and bending moment diagrams for the overhanging beam shown in fig.Q5(b). Clearly indicate point of contra flexure. **(10 Marks)**

Fig.Q5(b)



OR

6 a. Derive the relation $\frac{M}{I} = \frac{\sigma_b}{Y} = \frac{E}{R}$ with usual notations and list the basic assumptions. **(10 Marks)**

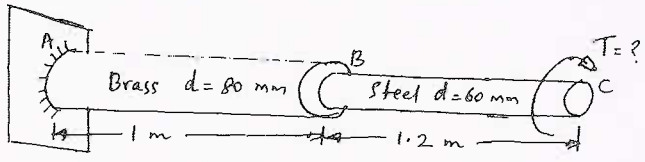
b. A simply supported beam of span 5m has a cross section 150mm × 250mm. If the permissible stress is 10N/mm^2, find the maximum concentrated load P applied at 2m from one end, it can carry. **(06 Marks)**

Module-4

7 a. Determine the diameter of a solid shaft which will transmit 300 KW at 250 rpm. The maximum shear stress should not exceed 30N/mm^2 and twist should not be more than 1 in a shaft length of 2m. Take modulus of rigidity = 1×10^5N/mm^2. **(08 Marks)**

b. The allowable shear stress in brass is 80N/mm^2 and in steel 100N/mm^2. Find the maximum torque that can be applied in the stepped shaft shown in fig. Q7(b). Find also the total rotation of free end with respect to the fixed end if G_{brass} = 40 kN/mm^2 and G_{steel} = 80kN/mm^2. **(08 Marks)**

Fig.Q7(b)

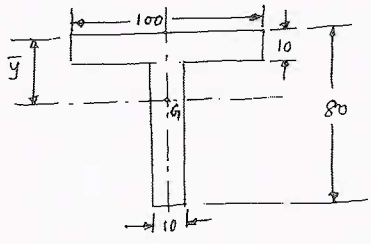


OR

8 a. Find an expression for crippling load for a column with one end fixed and other end free. **(08 Marks)**

b. Determine the buckling load for a strut of T – section , the flange width being 100mm, overall depth 80mm and both flange and stem 10mm thick as shown in fig. Q8(b). The strut is 3m long and is hinged at both ends. E = 200GN/m^2. **(08 Marks)**

Fig.Q8(b)



Module-5

9 a. Using Castiglione's first theorem, find the deflection at the free end of a cantilever beam carrying a concentrated load at the free end. Assume uniform flexural rigidity. **(06 Marks)**

b. Derive an expression for strain energy stored in a body due to torsion. **(10 Marks)**

OR

10 a. Write short notes on :

i) Maximum Principal stress theory ii) Maximum shear stress theory. **(10 Marks)**

b. A bolt is subjected to an axial pull of 12kN together with a transverse shear force of 6kN. Determine the diameter of the bolt by using Maximum principal stress theory. Take Elastic limit in tension = 300 N/mm^2 , Factor of safety = 3. **(06 Marks)**

CBCS SCHEME

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18ME32

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 the following terms:
(i) Stress (ii) Strain (iii) Young's Modulus (iv) Poisson's ratio (v) Hooke's law. **(05 Marks)**

b. Derive an expression for the total elongation of a tapered circular bar cross section of diameter 'D' and 'd', when subjected to an axial load 'P'. **(05 Marks)**

c. A brass bar having cross sectional area of 1000 mm^2, is subjected to axial forces shown in Fig. Q1 (c). Find the total elongation of the bar. Take E = 100 GN/m^2. **(10 Marks)**

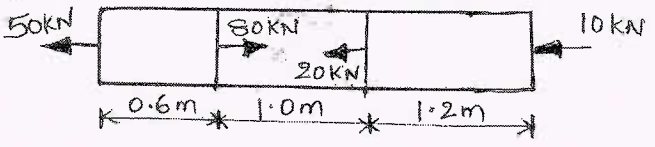


Fig. Q1 (c)

OR

2 a. Draw stress strain diagram for mild-steel and mark all the salient points. **(04 Marks)**

b. A concrete column of cross sectional area 400mm × 400mm is re-inforced by 4 longitudinal 50 mm diameter steel bars placed at each corner. If the column carries a comprehensive load of 300 kN, determine (i) Loads carried (ii) Stress produced in the concrete and Steel bars. **(08 Marks)**

c. A steel rod 15 m long at a temperature of 15°C. Find the free expansion of length when the temperature is raised to 65°C. Find the temperature stresses produced, when
(i) The expansion of the rod is prevented.
(ii) The rod is permitted to expand by 6 mm.
Take $\alpha = 12\times10^{-6}$ /° C and $E = 2\times10^{5}$ N/mm^2 **(08 Marks)**

Module-2

3 The state of stress at a point in a strained material is shown in Fig. Q3. Determine
a) The direction of the principal planes.
b) The magnitude of principal stresses.
c) The magnitude of the maximum shear stress and its direction.
d) Draw Mohr's circle and verify the results obtained analytically.

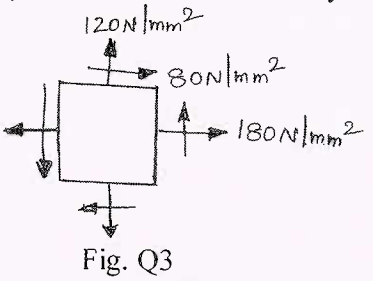


Fig. Q3 **(20 Marks)**

OR

4 a. Differentiate between thin and thick cylinders. **(04 Marks)**

b. Derive an expression for circumferential stress and longitudinal stress for a thin cylinder subjected to an internal pressure 'P'. **(06 Marks)**

c. A thick cylinder of 400 mm internal diameter and 100 mm thickness contains a fluid at a pressure 80 N/mm^2. Find hoop stresses across the section. Also sketch the radial and hoop stress distribution across the section. **(10 Marks)**

Module-3

5 Draw shear force and Bending Moment Diagrams for the beam shown in Fig. Q5. Locate the point of contraflexure. **(20 Marks)**

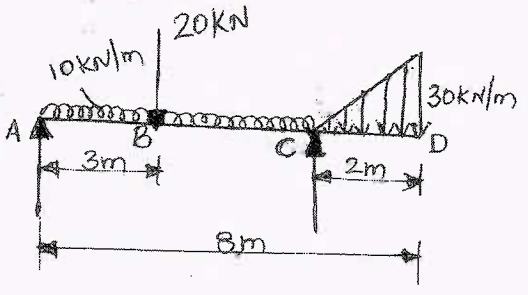
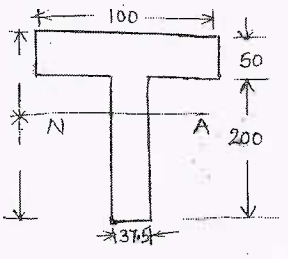


Fig. Q5

OR

6 a. Prove the relation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ with usual notations. **(10 Marks)**

b. The T-section of a beam is shown in Fig. Q6 (b). The material of the beam has yield strength of 250 MPa. Determine maximum moment of resistance that the beam can support if yielding is to be avoided. **(10 Marks)**



Note : All dimensions are in mm.

Fig. Q6 (b)

Module-4

7 a. A mild steel shaft 120 mm diameter is subjected to a maximum torque of 20×10^6 N-mm and a maximum bending moment of 12×10^6 N-mm at a particular section. Find the factor of safety (FoS) according to the maximum stress theory, if the elastic limit in simple tension is 220 N/mm^2. **(10 Marks)**

b. Prove that a hollow shaft is stronger and stiffer than the solid shaft of the same material, length and weight. **(10 Marks)**

OR

8 a. Derive the torsional equation for a circular shaft with usual notations. State the assumptions made. **(10 Marks)**

b. A hollow shaft is to transmit 300 kW power at 80 rpm. If the shear stress is not to exceed 60 N/mm^2 and internal diameter is 0.6 times the external diameter. Find the external and internal diameters, assuming that the maximum torque is 1.4 times the mean. **(10 Marks)**

Module-5

9 a. Derive an expression for a critical load in a column subjected to compressive load, when both ends are fixed. **(10 Marks)**

b. A 2 m long column has a square cross section of side 40 mm. Taking the factor of safety as 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.
(iv) One end fixed and other end is hinged.

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

OR

10 a. Derive an expression for a critical load in a column subjected to compressive load, when both ends are hinged. **(10 Marks)**

b. The bar with circular cross section shown in Fig. Q10 (b) is subjected to a load of 10 KN. Determine the strain energy stored in it. Take $E = 2.1 \times 10^5$ N/mm^2 **(10 Marks)**

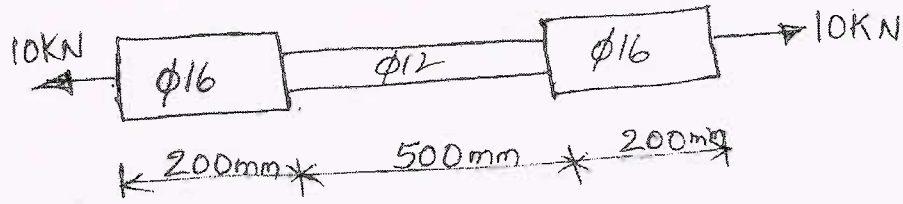


Fig. Q10 (b)

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CBCS SCHEME

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18ME33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 hand book and steam tables is permitted.
3. Assume missing data suitably.

Module-1

1 a. Differentiate between micro and macroscopic approach. **(04 Marks)**

b. Define the following terms with neat sketch:
(i) Open system
(ii) Closed system
(iii) Isolated system
(iv) Quasi-static process **(08 Marks)**

c. The temperature 'T' on a thermometric scale is defined as $T = a\ln(K) + b$, where a and b are constants. The values of K are found to be 1.83 and 6.78 at 0°C and 100°C, respectively. Calculate the temperature for value of K = 2.42. **(08 Marks)**

OR

2 a. Define:
(i) Thermodynamic equilibrium
(ii) Zeroth law of thermodynamics **(04 Marks)**

b. With neat sketch explain the working principle of:
(i) Electrical resistance thermometer
(ii) Thermocouple **(08 Marks)**

c. Two Celsius thermometer 'A' and 'B' agree at ice point and steam point, and related by the equation $t_A = L + Mt_B + Nt_B^2$, where L, M and N are constants. When both thermometers are immersed in a fluid, 'A' registers 26°C, while 'B' registers 25°C. Determine the reading of 'A' when 'B' reads 37.4°C. **(08 Marks)**

Module-2

3 a. Define thermodynamic work and heat. **(04 Marks)**

b. Write an expression for displacement of work for the following process with P-V diagrams.
(i) Constant pressure
(ii) Constant volume
(iii) Constant temperature
(iv) Polytropic process **(08 Marks)**

c. A quantity of gas is compressed in a piston-cylinder from a volume of 0.8611 m^3 to a final volume of 0.1721 m^3. The pressure in (bar) and as a function of volume (m^3) is given by:

$$P = \left(\frac{0.8611}{V} - \frac{8.6067 \times 10^{-5}}{V^2} \right)$$

(i) Find the amount of work done in KJ.
(ii) If the atmospheric pressure is 1 bar, acting on the other side of piston is considered. Find the net work done in KJ. **(08 Marks)**

OR

4 a. State 1st law of thermodynamics. Derive an expression for 1st law of thermodynamics for open system (SFEE). **(10 Marks)**

b. The working fluid, in a steady flow process at a rate of 220 kg/min. The fluid rejects 100 KJ/s of heat passing through the system. The condition of the fluid at inlet and outlet are given as $\overline{V}_1$ = 220 m/s, p_1 = 6.0 bar, u_1 = 2000 KJ/kg, υ_1 = 0.36 m^3/kg and p_2 = 1.2 bar, $\overline{V}_2$ = 140 m/s, u_2 = 1400 kJ/kg, υ_2 = 1.3 m^3/kg. The suffix 1 and 2 indicates at inlet and outlet conditions respectively. Determine the power capacity of the system in MW. **(10 Marks)**

Module-3

5 a. Define the following terms:
(i) Thermal reservoir
(ii) Heat engine
(iii) Kelvin-Plank statement of 2nd law
(iv) Clausius statement of 2nd law
(v) Heat pump **(10 Marks)**

b. A heat engine working on a Carnot cycle absorbs heat from three thermal reservoirs at 1000 K, 800 K and 600 K, respectively. The engine does 10 KW of net work and rejects 400 kJ/min of heat to a heat sink at 300 K. If the heat supplied by the reservoir at 1000 K is 60% of heat supplied by the reservoir at 600K. Find the quantity of heat supplied by each reservoirs. **(10 Marks)**

OR

6 a. Define entropy and prove that it is a point function. **(04 Marks)**

b. Discuss the Clausius Inequality. **(08 Marks)**

c. A steel ball mass of 10 kg at 627°C is dropped in 100 kg of oil at 30°C. The specific heat of steel and oil are 0.5 kJ/kgK and 3.5 kJ/kgK, respectively. Calculate the entropy change of steel, oil and the universe. **(08 Marks)**

Module-4

7 a. With neat sketch, explain available and Unavailable energy on T-S diagram. **(06 Marks)**

b. Explain the concept of second law of efficiency. **(06 Marks)**

c. A Carnot engine works between the temperature limits 225°C and 25°C in which water is used as the working fluid. If heat is supplied to the saturated liquid at 225°C, until it is converted into saturated vapour, determine per kg of water.
(i) Amount of heat absorbed by the fluid
(ii) Available energy
(iii) Unavailable energy
(Take latent heat of water = 1858.5 kJ/kg) **(08 Marks)**

OR

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

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

Module-5

9 a. Define:
(i) Mole fraction
(ii) Mass fraction
(iii) Dalton's law
(iv) Amgat's law of volume additives **(10 Marks)**

b. A mixture of gases contain 1 kg of CO_2 and 1.5 kg of N_2. The pressure and temperature of the mixture are 3.5 bar and 27°C. Determine:
(i) Mole fraction of each constituent
(ii) Partial pressure
(iii) Partial volume
(iv) Volume of mixture
(v) Density of mixture **(10 Marks)**

OR

10 a. State and explain the following terms:
(i) Compressibility factor
(ii) Reduced properties
(iii) Real gases
(iv) Relative humidity **(08 Marks)**

b. With usual notations, write the Vandeer Waal equation and explain the terms involved in it. **(04 Marks)**

c. Determine the pressure exerted by CO_2 in a container of 1.5 m^3 capacity when it contains 5 kg at 27°C:
(i) Using ideal gas relation
(ii) Using Vandeer Waal's equation
[Take a = 364.3 kPa $(m^3/kg.mol)^2$; b = 0.0427 $(m^3/kg.mol)$ for Vandeer Waal's constants] **(08 Marks)**

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CBCS SCHEME

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18ME34

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Define APF. Calculate the APF for BCC Unit cell. **(07 Marks)**

b. Explain edge dislocation and screw dislocation. **(08 Marks)**

c. State and explain Fick's 1st law of diffusion. **(05 Marks)**

OR

2 a. Define Stiffness , Yield strength , Toughness and Ultimate tensile strength. **(08 Marks)**

b. Explain Plastic deformation by Slip and twinning. **(06 Marks)**

c. Explain strain hardening and solid state hardening process of strengthening of metals. **(06 Marks)**

Module-2

3 a. Draw and explain the S – N curve. **(04 Marks)**

b. Derive and expression for stress relaxation. **(04 Marks)**

c. Draw the Iron carbon diagram indicating the phase temperatures. Explain the different phases in Iron carbon diagram. **(12 Marks)**

OR

4 a. State and explain Hume Rothery Rules. **(06 Marks)**

b. Explain the effect of any 4 alloying elements in steel. **(06 Marks)**

c. Two metals A & B are alloyed in the proportion of 60% A and 40% B. The melting temperature of A & B are 650^0C and 450^0C. When they are alloyed together they do not form any compound or intermediate phase, but form an Eutetic of composition 40% A and 60% B which solidifies at 300^0C. The maximum and minimum solid solubilities of B in A and A in B are 10% at 300^0C and remains constant till 0^0C. Assume solidus , liquidus and solves lines to be straight.

i) Draw the equilibrium diagram and label all the fields.

ii) The temperature at which solidification start and complete.

iii) Percentage of Eutectic at room temperature. **(08 Marks)**

Module-3

5 a. Define Heat treatment and give its classification. **(06 Marks)**

b. Explain how a TTT diagram is drawn. **(08 Marks)**

c. Explain Austempering and Martempering. **(06 Marks)**

OR

6 a. Draw the TTT diagram for Eutectoid steel and explain it. **(07 Marks)**

b. With neat sketch, explain induction hardening process. **(05 Marks)**

c. Explain the composition , properties and uses of Gray Cast Iron, White Cast Iron and SG Iron and Malleable Iron. **(08 Marks)**

Module-4

7 a. Define Composite. Give its classification. **(06 Marks)**

b. Explain metal matrix composites and ceramic matrix composites. **(06 Marks)**

c. List the advantages, disadvantages and applications of composite materials. **(08 Marks)**

OR

8 a. Derive an expression for Young's modulus for ISO stress and ISO strain condition. **(12 Marks)**

b. With neat sketch, explain Pultrusion process. **(08 Marks)**

Module-5

9 a. Define Ceramic. Explain the types of ceramics. **(05 Marks)**

b. Differentiate between Thermoplastic and Thermosetting plastics. **(05 Marks)**

c. With neat sketch, explain Processing of plastic by Injection Moulding method. **(10 Marks)**

OR

10 a. Explain the different Non – destructive testing methods used for accessing residual life. **(10 Marks)**

b. Define Smart Material. Explain the types of smart materials. **(10 Marks)**

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CBCS SCHEME

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18ME35A/18MEA305

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Name and explain with example the different types of chips formed during metal cutting. **(06 Marks)**

b. Draw Merchant's circle diagram and state the assumptions made in establishing the relationship among the various forces. **(08 Marks)**

c. During an orthogonal cutting process the following observations were made-chip thickness = 0.62mm feed 0.2 mm rake angle 15°. Calculate the chip reduction coefficient and shear angle. **(06 Marks)**

OR

2 a. Differentiate between Turret lathe and Capstan lathe. **(06 Marks)**

b. Draw the tool layout for producing a hexagonal headed bolt on a capstan lathe from a hexagonal bar stock. Assume the dimensions. **(08 Marks)**

c. Write the functions of following lathe accessories :
(i) Live centre (ii) Dead centre (iii) Steady rest (iv) Follower rest
(v) Dogs and face plates. **(06 Marks)**

Module-2

3 a. With sketch write the comparison between up milling and down milling. **(06 Marks)**

b. Sketch and explain radial drilling machine highlighting its advantages and disadvantages. **(08 Marks)**

c. What is indexing? Name the different methods of indexing and explain compound indexing. **(06 Marks)**

OR

4 a. Differentiate Shaper and Planer? **(06 Marks)**

b. With sketch explain the external centreless grinding highlighting the feed mechanism. **(08 Marks)**

c. How the shapers are classified? How a vertical shaper is different from slotter. **(06 Marks)**

Module-3

5 a. Write a note on functions and types of cutting fluids used in metal cutting. **(06 Marks)**

b. Explain the various mechanisms responsible for different forms of tool wear. **(08 Marks)**

c. A cast iron plate of dimensions 450×150×60 mm, is to be rough shaped along its wider face. Calculate the machining time taking cutting speed = 10 mpm, return speed = 15 mpm, approach length = 30mm, over travel length = 30 mm, allowance on either side of the plate width = 6mm and feed per cycle = 15mm. **(06 Marks)**

OR

6 a. Which are the different forms of wear on the cutting edge of a tool? With appropriate sketch explain. **(06 Marks)**

b. Explain the critical cutting parameters which effect the tool life. **(08 Marks)**

c. The tool life for a HSS tool is expressed by the relation $VT^{1/7} = C_1$ and for Tungsten-Carbide $VT^{1/5} = C_2$. If the tool life for cutting speed of 24 mpm is 128 min, compare the life of the two tools at a speed of 30 mpm. **(06 Marks)**

Module-4

7 a. List the differences between cold working and hot working. **(06 Marks)**

b. What is forging? Explain the working of board hammer with sketch. **(08 Marks)**

c. With sketch explain : (i) Two high rolling mill (ii) Planetary rolling mill. **(06 Marks)**

OR

8 a. How the extrusion process is classified? Write a note on the difference between direct and indirect extrusion. **(06 Marks)**

b. With neat sketch explain the wire drawing process. **(08 Marks)**

c. Explain the defects in extruded products. **(06 Marks)**

Module-5

9 a. With a neat sketch explain V-bending and edge bending operations. **(06 Marks)**

b. What do you mean by dies? Write brief note on (i) Progressive dies (ii) Combination dies. **(08 Marks)**

c. With neat sketch explain shearing of sheet metal. **(06 Marks)**

OR

10 a. What is stripper? With neat sketch explain fixed plate stripper. **(06 Marks)**

b. With a neat labeled sketch explain the parts of open back inclinable press. **(08 Marks)**

c. Calculate the bending force for the 90° bend part from the steel sheet with air bending. The bend length is 30 cm, the material thickness is 2.5 mm and beam length is 25mm. The tensile strength of the material is 32 kN/cm^2. Die opening factor = 1.33. **(06 Marks)**

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CBCS SCHEME

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18ME36B/18MEB306

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 meter as per (i) Material Standard (ii) Wavelength standard. **(04 Marks)**

b. Describe with neat sketches wringing phenomenon of slip gauges. **(06 Marks)**

c. Three 100 mm end bars are measured on a level comparator by first wringing them together and comparing with 300mm bar. There was an error of 0.03mm and three bars together have total error of 0.064mm less than the standard bar. Bar A is 0.02 mm layer than bar B and 0.025mm longer than bar C. Determine the actual dimensions of all end bars. **(10 Marks)**

OR

2 a. Explain the working principle of auto collimator with the aid of a neat sketch. Also write its applications. **(08 Marks)**

b. Write the limitations of line standard and end standard. **(04 Marks)**

c. Select the size of angle gauges required to build the following angles. Also sketch the arrangement (i) 35° 32′ 36″ (ii) 57° 34′ 9″ . **(08 Marks)**

Module-2

3 a. What is meant by interchangeability? State its advantages. **(06 Marks)**

b. Explain hole basis system in detail. **(06 Marks)**

c. Explain with neat sketch, working of a dial indicator. **(08 Marks)**

OR

4 a. Briefly explain GO-Gauge and NO-GO Gauge. **(06 Marks)**

b. Define tolerance. Also explain grades of tolerance. **(06 Marks)**

c. Determine the dimensions of the shaft and hole for a fit 30 H8 d10, given the following data:
(i) Diameter 30 falls in the diameter range 18 - 30.
(ii) Upper deviation for shaft is $-16D^{0.44}$.
(iii) $i = 0.45D^{0.33} + 0.001D$
(iv) Tolerance for IT8 = 25i
(v) Tolerance for IT10 = 64i **(08 Marks)**

Module-3

5 a. Explain with a neat sketch, measurement of effective diameter of a screw thread by 2-wire method. **(10 Marks)**

b. With a neat sketch, explain the construction and working of tool maker's microscope what are its applications. **(10 Marks)**

OR

6 a. With a neat sketch, explain the terminology of spur gear. **(10 Marks)**

b. Explain how Gear tooth vernier caliper is used to measure gear tooth thickness. **(10 Marks)**

Module-4

7 a. Define Measurement. Differentiate between direct method and Indirect method of measurement. Briefly explain generalized measuring system with the aid of a block diagram. **(10 Marks)**

b. Classify transducers, giving examples in each category. **(10 Marks)**

OR

8 a. Explain the following term :
(i) Sensitivity (ii) Repeatability (iii) Linearity (iv) Threshold (v) Least count. **(10 Marks)**

b. Explain the working of cathode ray oscilloscope. **(10 Marks)**

Module-5

9 a. State the laws governing the functioning of thermocouple. **(04 Marks)**

b. Explain with a neat sketch, working of a proving ring. **(08 Marks)**

c. Explain the working of optical pyrometer. **(08 Marks)**

OR

10 a. Classify dynamometers. **(04 Marks)**

b. Explain the working of a prony brake. **(08 Marks)**

c. Explain the working of McLeod gauge. **(08 Marks)**

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CBCS SCHEME

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15ME42

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Kinematics of Machines

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following terms with examples: (i) Kinematic chain (ii) Mechanism (iii) Lower pair and Higher pair **(06 Marks)**

b. Sketch and explain the following mechanisms :
(i) Drag link mechanism. (ii) Geneva wheel. **(10 Marks)**

OR

2 a. What are quick return motion mechanisms? Where are they used? Sketch and explain the functioning of Whitworth mechanism. **(08 Marks)**

b. Derive an expression for necessary condition of correct steering and explain Ackerman steering gear with neat sketch. **(08 Marks)**

Module-2

3 A four bar mechanism ABCD is made up of four links, pin jointed at the ends. AD is a fixed link which is 180 mm long. The links AB, BC and CD are 90 mm, 120 mm and 120 mm long respectively. At certain instant, the link AB (crank) makes an angle of 60° with the link AD. If the link AB rotates at uniform speed of 100 rpm clockwise determine,
(i) Angular velocity of the links BC and CD
(ii) Angular acceleration of the links CD and CB by using Graphical method. **(16 Marks)**

OR

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

b. In a reciprocating engine, the length of crank is 250 mm and length of connecting rod is 1000 mm. The crank rotates at an uniform speed of 300 rpm in clockwise direction and the crank is inclined at 30° with inner dead centre. The C_g (centre of gravity) of the connecting rod is 400 mm from the crank end. By Klein's construction determine (i) Velocity and acceleration of piston (ii) Angular velocity and angular acceleration of connecting rod (iii) Velocity and acceleration at the centre of gravity of the connecting rod. **(10 Marks)**

Module-3

5 Using Complex algebra derive expressions for velocity and acceleration of the piston, angular acceleration of connecting rod of a reciprocating engine mechanism. With these expression determine the above quantities, if the crank length is 50 mm, connecting rod is 200 mm, crank speed is constant at 3000 rpm and crank angle is 30°. **(16 Marks)**

OR

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

b. Design a four-link mechanism to coordinate three positions of the input and the output links as follows:

$\theta_1 = 20^\circ$	$\phi_1 = 35^\circ$
$\theta_2 = 35^\circ$	$\phi_2 = 45^\circ$
$\theta_3 = 50^\circ$	$\phi_3 = 60^\circ$

Using Freudenstein's equation for four bar mechanism. **(08 Marks)**

Module-4

7 a. Derive an expression for minimum number of teeth necessary for a gear to avoid interference. **(08 Marks)**

b. A pair of gears 40 and 30 teeth respectively are of 25° involute form. Addendum = 5 mm. Module = 2.5 mm. If the smaller wheel is the driver and rotate at 1500 rpm, find the velocity of sliding at the point of engagement at pitch and at the point of dis-engagement, length of path of contact and length of arc of contact. **(08 Marks)**

OR

8 a. Explain with neat sketch of an epicyclic gear train. **(04 Marks)**

b. In an epicyclic gear train, the internal wheels 'A', 'B' and the compound wheel 'C' and 'D' rotate independently about the axis 'O'. The wheels 'E' and 'F' rotates on a pin fixed to the arm 'G', 'E' gears with 'A' and 'C', and 'F' gears with 'B' and 'D'. All the wheels have same pitch and the number of teeth on 'E' and 'F' are 18, C = 28, D = 26.

(i) Sketch the arrangement.
(ii) Find the number of teeth on 'A' and 'B'.
(iii) If the arm 'G' makes 150 rpm CW and 'A' fixed, find speed of 'B'.
(iv) If the arm 'G' makes 150 rpm CW and wheel 'A' makes 15 rpm CCW, find the speed of 'B'. **(12 Marks)**

Module-5

9 A cam with a base circle radius of 35 mm is rotating at a uniform speed of 100 rpm in anticlockwise direction. Draw the profile for the disc cam with reciprocating knife edge follower on the centre line of the cam shaft for the following follower motion:

(i) Follower to move upward 30 mm with Simple Harmonic Motion (SHM) in 0.1 sec.
(ii) Follower to dwell in next 0.15 sec.
(iii) Follower to move upward to another 30 mm with Simple Harmonic Motion (SHM) in 0.15 sec.
(iv) Follower to return to its starting position with Uniform Acceleration and Retardation (UARM) in the remaining period of one complete revolution of the cam shaft. However, the acceleration period is twice the retardation period.

Determine the maximum velocity and acceleration of the follower during its return stroke. **(16 Marks)**

OR

10 a. Define the terms:

(i) Base circle
(ii) Lift or Stroke
(iii) Pitch point.
(iv) Cam profile. **(04 Marks)**

b. Derive an expression, for displacement velocity and acceleration when the flat faced follower is in contact with any point on the nose. **(12 Marks)**

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CBCS SCHEME

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15ME43

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 handbook is permitted.***

Module-1

1 a. With suitable assumptions, P-V and T-S diagrams, derive an expression for the air standard efficiency of a diesel cycle in terms of compression ratio and cut off ratio. **(10 Marks)**

b. A certain quantity of air at a pressure of 1 bar and temperature of 70°C is compressed isentropically until the pressure is 7 bar in an Otto cycle engine. 465 kJ of heat per kg of air is now added at constant volume. Determine: (i) Compression ratio of the engine (ii) Temperature at the end of compression (iii) Temperature at the end of heat addition. **(06 Marks)**

OR

2 a. Derive an expression for optimum pressure ratio for maximum specific work output for an ideal gas turbine cycle. **(06 Marks)**

b. A gas turbine unit has a pressure ratio of 6:1. The maximum cycle temperature is 610°C. The isentropic efficiencies of compressor and turbine are 0.8 and 0.82 respectively. Calculate the power output in KW of an electric generator geared to the turbine when the air enters the compressor at 15°C at the rate of 16 kg/s. Take C_p = 1.005 kJ/kgK and γ = 1.4 for compression, combustion and expansion processes. **(10 Marks)**

Module-2

3 a. With a neat schematic diagram, P-V and T-S diagrams, explain the working of Rankine cycle. Derive the thermal efficiency expression for the same. **(08 Marks)**

b. A 40 MW steam power plant working on Rankine cycle operates between boiler pressure of 40 bar and condenser pressure of 0.1 bar. The steam leaves the boiler and enters the steam turbine at 400°C. The isentropic efficiency of the turbine is 85%. Determine: (i) The cycle efficiency (ii) The quality of exhaust steam from the turbine (iii) Steam flow rate in kg/hr considering pump work. **(08 Marks)**

OR

4 a. With a schematic diagram and T-S diagram, explain the working of regenerative vapour cycle with open feed water heaters. Derive the thermal efficiency expression for the same. **(08 Marks)**

b. A steam power plant operates on a reheat cycle. Steam in boiler at 150 bar, 550°C expands through high pressure turbine. It is reheated at a constant pressure of 40 bar to 550°C and expands through low pressure turbine to a condenser at 0.1 bar. Find: (i) Quality of steam at turbine exhaust (ii) Cycle efficiency (iii) Steam rate in kg/KWhr **(08 Marks)**

Module-3

5 a. Define the following:
i) Stoichiometric air ii) Excess air iii) Enthalpy of formation
iv) Internal energy of combustion v) Combustion efficiency **(10 Marks)**

b. Find the stoichiometric air fuel ratio for the combustion of Propane (C_3H_8) on molar and mass basis. **(06 Marks)**

OR

6 a. Explain how the frictional power of a multi cylinder engine is determined using Morse Test. **(06 Marks)**

b. During a test on a single cylinder 4-stroke cycle oil engine, the following observations were made: Bore = 30 cm, Stroke = 45 cm, duration of trial = 1 hour, total fuel consumption = 7.6 kg/hr, Speed = 200 rpm, Calorific value of fuel = 45000 kJ/kg, MFP = 6 bar. Net brake load = 1470 N, Brake drum diameter = 1.8 m, Rope diameter = 3 cm, Mass of cooling water circulated = 550 kg/hr, water enters at 15°C and leaves at 60°C, exhaust gas temperature = 300°C, ambient temperature = 20°C. Calculate: (i) Indicated power and brake power (ii) Mechanical efficiency. Draw the heat balance sheet on minute basis. Take mass of air = 360 kg/hr, C_{pg} = 1.1 kJ/kgK. **(10 Marks)**

Module-4

7 a. With a neat sketch, explain the working of a vapour absorption refrigeration system. **(06 Marks)**

b. An air refrigeration plant 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, pressure loss in the inter cooler = 12 kPa, pressure loss in the cold chamber = 3 kPa, temperature of air at compressor inlet = 6°C, temperature of air at turbine inlet = 27°C, compressor and turbine efficiency = 0.85. Determine: (i) COP (ii) Power required to produce one TR (iii) Air circulation rate/TR. **(10 Marks)**

OR

8 a. Define the following terms:
(i) Specific humidity (ii) Relative humidity
(iii) Degree of saturation (iv) Dry bulb temperature. **(08 Marks)**

b. Following data refers to an air conditioning system to be designed for an industrial process for hot and wet climate:
Outside conditions = 30°C DBT, 75% RH
Required inside conditions = 20°C DBT, 60% RH
Amount of free air circulated = $20 m^3$/min
The required condition is to be achieved first by cooling and dehumidifying and then by heating. Find: (i) Capacity of the cooling coil in TR (ii) Capacity of the heating coil in KW (iii) Amount of water vapour removed per hour. **(08 Marks)**

Module-5

9 a. Derive an expression for the volumetric efficiency of a reciprocating air compressor. **(08 Marks)**

b. A single stage single acting compressor delivers 0.6 kg/min of air at 6 bar. The temperature and pressure at the end of suction stroke of the compressor are 100 mm and 150 mm respectively. The clearance is 3% of the 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 efficiency of the motor is 0.85 (iii) speed of the compressor. **(08 Marks)**

OR

10 a. Explain the following types of flows in a nozzle: (i) Frictionless adiabatic flow (ii) Frictional adiabatic flow (iii) Super saturated flow **(06 Marks)**

b. The inlet condition to a steam nozzle is 10 bar and 250°C. The exit pressure is 2 bar. Assuming isentropic expansion and negligible inlet velocity, determine: (i) throat area (ii) exit velocity (iii) exit area of the nozzle. Assume the index of expansion for super heated steam at inlet = 1.3 and mass flow rate of steam = 0.2 kg/s. **(10 Marks)**

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CBCS SCHEME

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15ME44

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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. Define the following properties of fluid with their units:
i) Specific volume ii) Viscosity iii) Vapour pressure
iv) Compressibility v) Newtonian fluid vi) Gauge pressure **(06 Marks)**

b. State and prove Pascal's law. **(06 Marks)**

c. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.80 and having vacuum pressure is flowing. The other end is open to atmosphere. Estimate the vacuum pressure in pipe if the difference of mercury level in the two limbs is 40 cm and the height of the fluid in the left limb from the center of pipe is 15 cm below. **(04 Marks)**

OR

2 a. Define the following:
i) Center of pressure ii) Buoyancy
iii) Meta center iv) Meta centric height **(04 Marks)**

b. Develop an expression for total force and depth of center of pressure for an inclined surface submerged in water. **(08 Marks)**

c. A solid cylinder of diameter 4.0 m has a height of 3m. Evaluate the meta centric height of the cylinder when floating in water with its axis vertical. The specific gravity of the cylinder is 0.60. **(04 Marks)**

Module-2

3 a. Compare:
i) Steady and unsteady flow
ii) One dimensional and two dimensional flow
iii) Stream line and path line **(06 Marks)**

b. Derive continuity equation in 3-D Cartesian coordinates. **(06 Marks)**

c. The velocity potential function is given by $\phi = 5(x^2 - y^2)$. Estimate the velocity components at the point (4, 5). **(04 Marks)**

OR

4 a. Explain impulse momentum equation. **(02 Marks)**

b. Derive an expression for Bernoulli's equation from first principles with assumptions made. **(10 Marks)**

c. Determine the velocity of the flow of an oil through a pipe when the difference of mercury level in a differential U-tube manometer connected to the two toppings of the pitot tube is 100 mm. Take coefficient of pitot tube 0.98 and specific gravity of oil = 0.80. **(04 Marks)**

Module-3

5 a. Define Reynold's number. Explain its importance. **(04 Marks)**

b. Analyze couette flow of fluid between two parallel plates. **(08 Marks)**

c. An oil of viscosity 10 poise flow between two parallel fixed plates which are kept at a distance of 50 mm apart. Estimate the rate of flow of oil between the plates. If the drop of pressure in a length of 1.2 m be 3.0 N/cm^2. The width of oil plate is 200 mm. **(04 Marks)**

OR

6 a. Differentiate between major loss and minor loss in pipes. **(06 Marks)**

b. What do you understand by (i) pipe in series (ii) pipes in parallel (iii) equivalent size of the pipe? **(06 Marks)**

c. Estimate the head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. The rate of flow of water through the pipe is 250 lit/s. **(04 Marks)**

Module-4

7 a. Explain: (i) Boundary layer thickness (ii) Displacement thickness (iii) Momentum thickness. **(06 Marks)**

b. Illustrate the method of preventing the separation of boundary layer. **(04 Marks)**

c. An airfoil of Chord length 2m and of span 15m has an angle of attack as 6°. The air foil is moving with a velocity of 80 m/s in air where density is 1.25 kg/m^3. Estimate the weight of the airfoil and the power required to drive it. The values of coefficient of drag and lift corresponding to angle of attack are given as 0.03 and 0.5 respectively. **(06 Marks)**

OR

8 a. Explain dimensionless numbers: (i) Euler number (ii) Reynolds number (iii) Fraud number (iv) Weber number **(04 Marks)**

b. Analyze the Rayleigh's method of dimensional analysis. **(06 Marks)**

c. The frictional torque 't' of a disc of diameter 'D' rotating at a speed 'N' in a fluid at viscosity 'μ' and density 'ρ' in a turbulent flow is given by $T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. Prove this by the method of dimensions. **(06 Marks)**

Module-5

9 a. List and explain the basic thermodynamic relations of a perfect gas. **(08 Marks)**

b. What is Mach number? Explain its significance in compressible flow. **(04 Marks)**

c. A projectile travels in air of pressure 15 N/cm^2 at 10°C at speed of 1500 km/hr. Formulate the Mach number and Mach angle. Assume ν = 1.4 and R = 287 J/kg-K. **(04 Marks)**

OR

10 a. List applications, advantages and limitations of CFD. **(08 Marks)**

b. Explain with neat sketch stagnation properties of compressible flows. **(04 Marks)**

c. Evaluate the stagnation pressure, temperature, and density at the stagnation point on the nose of a plane which is flying at 800 km/hour through still air having a pressure 8.0 N/cm^2 (abs) and temperature 10°C. Take R = 287 J/kg and K = 1.4. **(04 Marks)**

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15ME46B/15MEB406

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the term Metrology. State and explain the objectives of metrology. **(06 Marks)**

b. Discuss the characteristics of Line standards and End standards. **(10 Marks)**

OR

2 a. With a neat sketch, explain the working principle of Sine bar and mention its limitations. **(08 Marks)**

b. Build the angle gauges for the given angles :
i) $37^0\ 9'\ 18''$ ii) $35^0\ 32'\ 36''$ by using following table :

Degree	1	3	9	27
Minutes	1	3	9	27
Seconds	3	6	18	30

(08 Marks)

Module-2

3 a. Design a general type GO and Not GO gauges for component having 25 H_7/f_8 fit being given with usual notations.
i) i (microns) = $0.43\sqrt[3]{D} + 0.001D$ (D in mm)
ii) Upper deviation for f shaft = $-5.5\ D^{0.41}$.
iii) 25mm falls in the dia step of 18 and 30.
Take wear allowance as 10% of the gauge tolerance also determine
i) Type of fit ii) Allowance for the above fit. **(12 Marks)**

b. State the Taylor's principle for the design of limit gauge. **(04 Marks)**

OR

4 a. List the characteristics of comparators and what are the advantages of mechanical comparators. **(08 Marks)**

b. With a neat sketch, explain principal of optical comparator. **(08 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 neat sketches : i) Three wire method ii) Best size wire. **(08 Marks)**

OR

6 a. Illustrate the principle of Interferometry. **(08 Marks)**

b. With a neat sketch, explain the Tool maker's microscope. With the applications. **(08 Marks)**

Module-4

7 a. Define the following terms : i) Accuracy ii) Precision iii) Threshold iv) Calibration v) Sensitivity vi) Repeatability. **(06 Marks)**

b. Define Error. How Errors are classified? **(04 Marks)**

c. Explain any two mechanical transducers. **(06 Marks)**

OR

8 a. With a neat sketch, explain the cathode ray oscilloscope. **(08 Marks)**

b. What are Piezo – Electric transducers? Explain with neat sketches modes of operation of piezoelectric crystals. **(08 Marks)**

Module-5

9 a. With the help of neat sketch, explain working principle of proxy brake dynamometer. **(08 Marks)**

b. Describe with a neat sketch, Mcleod vaccum gauge. **(08 Marks)**

OR

10 a. What is Thermocouple? State the laws of thermo couple. **(08 Marks)**

b. Explain : i) Bonded resistance strain gauge ii) Piezo resistive strain gauge. **(08 Marks)**

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17ME42

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Kinematics of Machines

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain: (i) Kinematic pair (ii) Types of links (iii) Grashaf's criterian **(06 Marks)**

b. Explain with neat sketches:
(i) Ratchet and Pawl mechanism
(ii) Toggle mechanism **(10 Marks)**

c. Define: (i) Inversion (ii) Degree of freedom
(iii) Mechanism (iv) Kinematic chain **(04 Marks)**

OR

2 a. Explain the construction and working of Peaucillier's mechanism with a neat sketch. Prove that it generates an exact straight line. **(10 Marks)**

b. With neat sketch, explain Geneva wheel mechanism. **(10 Marks)**

Module-2

3 The crank of a slider crank mechanism is 480 mm long and rotates at 20 rad/sec in the counter clockwise direction. It has a connecting rod of 1600 mm long. Determine the following when the crank is at 60° from the 1 DC. Determine:
(i) Velocity of slider
(ii) Angular velocity of connecting rod
(iii) Position and velocity of a point "P" on the connecting rod and having least absolute velocity. **(20 Marks)**

OR

4 a. Explain Klein's construction for slider crank mechanism. **(10 Marks)**

b. Define instantaneous centre and state, explain the types of instantaneous centres. **(10 Marks)**

Module-3

5 Using complex algebra derive expression for velocity and acceleration of the piston and angular acceleration of connecting rod for a reciprocating engine mechanism. Use these expressions to find the above, if the crank length is 50 mm, connecting rod is 200 mm long crank angle is 30°. The crank rotates at a constant speed of 3000 rpm. **(20 Marks)**

OR

6 In a four bar mechanism ABCD, link AB = 300 mm, BC = 360 mm, CD = 360 mm and the fixed link AD is 600 mm. The angle BAD = 60°. The link AB has an angular velocity of 10 rad/sec and angular acceleration of 30 rad/sec both clockwise. Determine the angular velocity and angular acceleration of link BC and CD by using complex algebra method. **(20 Marks)**

Module-4

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

b. A 2.5 mm module, 20° pinion with 36 teeth drives a gear with 60 teeth. If the centre distance is increased by 0.65 mm. Calculate:
(i) The radii of the operating pitch circle
(ii) The operating pressure angle
(iii) Backlash produced **(10 Marks)**

OR

8 An epicyclic gear train, the internal wheels A, B and the compound wheel C and D rotate independently about the axis "O". The wheel E and F rotate on pin fixed to the arm G. E gears with A and C, and F gears with B and D. All the wheels have same pitch and the number of teeth on E and F are 18, C = 28, D = 26.
(i) Sketch the arrangement
(ii) Find the number of teeth on A and B
(iii) If arm G makes 150 rpm CW and A is fixed, find speed of B. **(20 Marks)**

Module-5

9 Construct the profile of a cam to suit the following specification.
Cam shaft diameter = 40 mm
Least radius of CAM = 25 mm
Diameter of roller = 25 mm
Angle of lift = 120°
Angle of fall = 150°
Lift of the follower = 40 mm
Number of pauses are two of equal interval between motions. During the lift the motion is SHM. During the fall the motion is UARM. The speed of the cam shaft is uniform. The line of stroke is center of the cam. **(20 Marks)**

OR

10 a. Define the following terms related to cam:
(i) Lift
(ii) Dwell
(iii) Pressure angle
(iv) Base angle **(08 Marks)**

b. Derive an expression for displacement, velocity and acceleration for a circular arc cam operating a flat faced follower when the contact is on the circular flank. **(12 Marks)**

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17ME43

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 thermodynamics data hand book is permitted.***

Module-1

1 a. Show the compression ratio (r_c) for maximum work should be per kg of air in an Otto cycle between upper and lower limits of absolute temperature T_3 and T_3 is given $r_c = \left(\frac{T_3}{T_1}\right)^{\frac{1}{2(\gamma-1)}}$ and also show that $T_2, T_4 = (T_1\ T_3)^{1/2}$ **(10 Marks)**

b. Compression ratio of diesel cycle is 14 and cut off ratio is 2.2 at beginning of cycle, air is 0.98 bar and 100°C. Find: (i) The temperature and pressure at salient points (ii) Air standard efficiency. **(10 Marks)**

OR

2 a. With a neat sketch, explain the working of Ramjet. **(10 Marks)**

b. In an open cycle gas turbine plant, air enters the compressor at 1 bar and 27°C. The pressure after compression is 4 bar. The isentropic efficiencies of the turbine and the compressor are 85% and 80% respectively. Air fuel ratio is 80:1 calorific value of the fuel used is 42000 kJ/kg. Mass flow rate of air is 2.5 kg/sec. Determine the power output from the plant and the cycle efficiency. Assume the value of Cp = 1.005 kJ/kgK and γ = 1.4. **(10 Marks)**

Module-2

3 a. Discuss with the help of T-S diagram the effect of Boiler pressure, condenser pressure and super heat on the performance of a Rankine cycle. **(10 Marks)**

b. A 40 MW steam power plant working on Rankine cycle operator between boiler pressure of 40 bar and condenser pressure of 0.1 bar. Steam leaves the boiler and enters the turbine at 400°C. The isentropic efficiency of steam turbine is 84%. Determine:
i) Efficiency ii) Quality of exhaust iii) Steam flow rate in kg/hr. **(10 Marks)**

OR

4 a. A steam power plant operates on a theoretical reheat cycle. Steam at boiler outlet 150 bar, 550°C expands through the high pressure turbine. It is reheated at a constant pressure of 40 bar to 550°C and expands through the low pressure turbine to a condenser at 0.1 bar. Draw T-S and h-s diagrams. Find:
(i) Quality of steam at turbine exhaust
(ii) Cycle efficiency
(iii) Steam rate in kg/KWh. **(10 Marks)**

b. With the help of neat diagram, explain the working of regenerative Rankine cycle and derive the efficiency of the cycle. **(10 Marks)**

Module-3

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

b. Methane (CH_4) is burned with atmospheric air. The analysis of the products on a dry basis is as follows: $CO_2 = 10\%$, $O_2 = 2.37\%$, $CO = 0.53\%$, $N_2 = 87.10\%$.
(i) Determine the combustion equation
(ii) Calculate the air-fuel ratio
(iii) Percent theoretical air **(10 Marks)**

OR

6 a. Explain the following:
(i) Heat balance sheet
(ii) Morse test **(10 Marks)**

b. A single cylinder 4-stroke diesel engine give the following results while running on full load, area of indicator diagram = 300 mm^2, length of diagram = 40 mm. The spring constant = 1 bar/mm, speed of the engine = 400 rpm, load on the brake = 370 N, spring balance reading = 50 N, diameter of brake drum = 1.2 m, fuel consumption = 2.8 kg/hr, calorific value fuel = 41800 kJ/kg, diameter of cylinder = 160 mm, stroke = 200 mm. Calculate IP, BP, Brake mean effective pressure, brake specific fuel consumption, brake thermal efficiency, indicator thermal efficiency. **(10 Marks)**

Module-4

7 a. With a neat sketch, describe clearly the working of a Bell-Coleman cycle. **(06 Marks)**

b. Write a brief note on properties of refrigerants. **(04 Marks)**

c. For food-storage purpose, a refrigeration plant of 10.5 TR is required at an evaporation temperature of −12°C and condenser temperature of 27°C. The refrigerant is ammonia. It is sub-cooled by 6°C before entering the expansion valve. The vapour is 0.95 dry as it leaves the evaporator coil. The compression is adiabatic using p-h chart. Calculate:
(i) Condition of vapour at outlet of the compressor
(ii) Condition of vapour at entrance to evaporator
(iii) CoP
(iv) Power required in KW.
Neglect throttling and clearance effect. **(10 Marks)**

OR

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

b. An air-conditioning plant is to be designed for a small office for winter conditions. Outdoor condition = 10°C DBT and 8°C WBT. Required indoor conditions = 20°C DBT and 60% RH. Amount of air circulation = 0.3 m^3/min/person seating capacity of the office = 50. The required condition is achieved first by heating and then by adiabatic humidifying. Find the followings:
(i) Heating capacity of the coil in KW and the surface temperature required if the bypass factor of the coil is 0.32
(ii) The capacity of the humidifier. **(10 Marks)**

Module-5

9 a. Define the following with respect to a compressor:
i) Isothermal efficiency ii) Adiabatic efficiency iii) Mechanical efficiency
iv) Overall efficiency v) Volumetric efficiency **(10 Marks)**

b. An air compressor takes in air at 1 bar and 20°C and compresses the same according to the law $PV^{1.2} = C$. It is the delivered to a receiver at a constant pressure of 10 bar.
Determine:
(i) Temperature at the end of compression
(ii) Work done and heat transferred during compression per kg of air R = 0.287 kJ/kgK.
(10 Marks)

OR

10 a. Prove the maximum flow rate of steam per unit area through a nozzle occurs when the ratio of pressure at throat to the inlet pressure is equal to $P_2/P_1 = \left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$ where n is polytropic index of expansion. **(10 Marks)**

b. Dry saturated steam at a pressure of 11 bar enters a convergent divergent nozzle and leaves at a pressure of 2 bar. If the flow is adiabatic frictionless. Determine: (i) Exit velocity of steam (ii) Ratio of cross-section area at exit and at throat. Assume the index of adiabatic expansion to be 1.135. **(10 Marks)**

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17ME44

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 the following fluid properties :
i) Density ii) Specific weight iii) Specific volume iv) Specific gravity. **(04 Marks)**

b. The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 6 poise. The shaft is of diameter 0.4m and rotates at 190 rpm. Calculate the power lost is the bearing for a sleeve length of 90mm. The thickness of the of film is 1.5mm. **(08 Marks)**

c. A U tube manometer is used to measure the pressure of oil of specific gravity 0.85 flowing in a pipe line. It left end is connected to the pipe and the right limb is open to the atmosphere. The under of pipe is 100mm below the level of mercury (specific gravity of mercury = 13.6) in the right limb. If the difference of mercury level in the two limbs is 160mm. Determine the absolute pressure of the oil in the pipe. **(08 Marks)**

OR

2 a. Derive an expression for total pressure force and depth of centre of pressure for an inclined plane surface submerged in liquid. **(10 Marks)**

b. Determine the total pressure and centre of pressure on an isosceles triangular plate of base 4m and altitude 4m where if immersed vertically in an oil of specific gravity 0.9 the base of the plate coincides with the free surface of oil. **(06 Marks)**

c. Define the terms : i) Buoyancy ii) Centre of buoyancy
iii) Meta centre iv) Meta centric height. **(04 Marks)**

Module-2

3 a. Derive continuity equation is Cartesian co-ordinates for a fluid flow in 3 dimensions. **(08 Marks)**

b. Distinguish between :
i) Steady and unsteady flow
ii) Uniform and non uniform flow
iii) Laminar and turbulent flow. **(06 Marks)**

c. Obtain a stream function to the following velocity components $u = x + y$ and $v = x - y$. **(06 Marks)**

OR

4 a. The water is flowing through taper pipe of length 100m having diameters 600mm at upper end and 300mm at the longer end at the rate of 50 litres/sec. The pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. **(08 Marks)**

b. Derive an expression for discharge through a triangular notch. **(06 Marks)**

c. An oil of specific gravity 0.8 is flowing through venturimeter having inlet diameter 20cm and throat diameter 10cm. The oil mercury differential nanometer shows a reading of 25cm. calculate the discharge of oil through horizontal venturimeter. Take $C_d = 0.98$. **(06 Marks)**

Module-3

5 a. Derive an expression for velocity distribution for Hagen – Poiseuille flow occurring in a circular pipe. Hence prove that the maximum velocity is twice the average velocity of the flow. **(10 Marks)**

b. A fluid viscosity 0.7Ns/m^2 and specific graivity 1.3 is flowing through a circular pipe of diameter 100mm, the maximum shear stress. At the pipe wall is given as 196.2N/m^2. Find i) the pressure gradient ii) the average velocity iii) Reynolds number of the flow. **(10 Marks)**

OR

6 a. Derive the Darcy Weisbach equation. **(08 Marks)**

b. Differentiate between major and minor energy losses. **(04 Marks)**

c. An oil of specific gravity 0.7 is flowing through a pipe of diameter 300mm at the rate of 500 litre/sec. find the head lost due to friction and power required to maintain. The flow for a length of 1000m. Take v = 0.29 stokes. **(08 Marks)**

Module-4

7 a. Write a short note on boundary layer separation and method to control it. **(08 Marks)**

b. A flat plate 1.5m × 1.5m moves at 50km/hr in stationary air of density 1.15kg/m^3. If the coefficient of drag and left are 0.15 and 0.75 respectively. Determine :
i) the lift force ii) the drag force iii) the resultant force iv) power required to keep the plate in motion. **(08 Marks)**

c. State the difference between stream lined body and bluff body with neat sketch. **(04 Marks)**

OR

8 a. What is dimensional homogeneity? Explain with examples. **(04 Marks)**

b. What is similitude? Explain the following : i) Geometric similarity ii) Dynamic similarity **(08 Marks)**

c. Show by Buckingham's π theorem that the frictional torque T of a disc of diameter D rotating at speed N in a fluid of viscosity μ and density 'ρ' in a flow is given by $T = D^5N^2\rho\phi\left[\frac{\mu}{D^2N\rho}\right]$. **(08 Marks)**

Module-5

9 a. Define : i) Mach number ii) Subsonic flow iii) Sonic flow iv) Supersonic flow. **(08 Marks)**

b. An Airplane is flying at an height of 15km. where the temperature is -50°C. The speed of the plane is corresponding to M = 2.0. Assuming K = 1.4 and R = 287 J/kg K. find the speed of plane. **(06 Marks)**

c. A projectile is travelling in air having pressure and temperature as 8.829 N/cm^2 and 2°C if the mach angle is 40° find the velocity of the projectile Take K = 1.4 and R = 287 J/kg K. **(06 Marks)**

OR

10 a. Explain the meaning of CFD and its application. **(06 Marks)**

b. Define the following terms and write the relevant equation for the same i) stagnation temperature ii) stagnation pressure. **(08 Marks)**

c. Find the velocity of bullet fired in standard air. If the mach angle is 30°.
Take R = 287.14 J/kg K and K = 1.4 for air. Assume temperature is 15°C. **(06 Marks)**

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17ME45B/17MEB405

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 the classification of machine tool. **(08 Marks)**

b. Explain with neat sketch working principle of horizontal milling machine. **(12 Marks)**

OR

2 a. With neat sketch explain the working principle of center type cylindrical grinding machine. **(12 Marks)**

b. Explain with neat sketch, quick return mechanism of shaper. **(08 Marks)**

Module-2

3 a. Explain the various machining parameters involved during turning operation on lathe machine. **(08 Marks)**

b. Explain the following milling operations:
(i) Face milling (ii) Slab milling
(iii) Slotting (iv) Straddle milling **(12 Marks)**

OR

4 a. With a neat sketch, explain principle of broaching process. **(05 Marks)**

b. Explain with example working motion for following machining processes:
(i) Shaping (ii) Planning (iii) Slotting
(iv) Drilling (v) Lathe **(15 Marks)**

Module-3

5 a. Explain the salient features of the following cutting tool materials:
(i) CBN (ii) Ceramics (iii) Cemented Carbides **(12 Marks)**

b. What are the properties of a good cutting fluid? **(08 Marks)**

OR

6 a. What is meant by tool signature? Explain each term of a tool designated as:
8 – 12 – 10 – 7 – 5 – 15 – 1.5 **(10 Marks)**

b. Find the machining time required for machining a surface 600 × 800 mm on a shaping machine. Assume cutting speed as 8m/min. The ratio of return to cutting stroke is 1:4 and the feed is 2 mm/double stroke. The clearance at each end is 70 mm. **(10 Marks)**

Module-4

7 a. Derive an expression for shear angle in terms of chip thickness ratio and rake angle for orthogonal cutting. **(12 Marks)**

b. What are the conditions favorable for built-up-edge formation? **(08 Marks)**

OR

8 a. A 12 mm hole is to be drilled through a 20 mm thick plate. The cutting speed is 12 m/min and the feed rate is 0.12 mm/rev. Estimate the machining time. Take the over travel plus clearance of the tool as 5 mm. **(10 Marks)**

b. The following details relates to an orthogonal cutting operation. Feed = 1.25 mm/rev, chip thickness = 2 mm, rake angle of tool = 10°. Calculate :

(i) Chip thickness ratio and shear angle

(ii) If the shear strength is 6000 kg/cm^2, width of cut = 10 mm, cutting speed = 30 mpm and coefficient of friction = 0.9, determine the following:

(1) shearing force (2) friction angle (3) cutting force **(10 Marks)**

Module-5

9 a. What is tool wear? Why does the tool fail during cutting? Explain giving reasons. **(10 Marks)**

b. Write short notes on Taylor's tool life equation. **(10 Marks)**

OR

10 a. List the cutting conditions which have an important influence upon metal cutting in machining. **(12 Marks)**

b. A 50 mm bar of steel was turned at 284 rpm and tool failure occurred after 10 min. The speed was changed to 232 rpm and the tool failed in 60 min of cutting time. What cutting speed should be used to obtain 30 mins of tool life? **(08 Marks)**

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17ME45B/17MEB405

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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 the classification of machine tool. **(08 Marks)**

b. Explain with neat sketch working principle of horizontal milling machine. **(12 Marks)**

OR

2 a. With neat sketch explain the working principle of center type cylindrical grinding machine. **(12 Marks)**

b. Explain with neat sketch, quick return mechanism of shaper. **(08 Marks)**

Module-2

3 a. Explain the various machining parameters involved during turning operation on lathe machine. **(08 Marks)**

b. Explain the following milling operations:
(i) Face milling (ii) Slab milling
(iii) Slotting (iv) Straddle milling **(12 Marks)**

OR

4 a. With a neat sketch, explain principle of broaching process. **(05 Marks)**

b. Explain with example working motion for following machining processes:
(i) Shaping (ii) Planning (iii) Slotting
(iv) Drilling (v) Lathe **(15 Marks)**

Module-3

5 a. Explain the salient features of the following cutting tool materials:
(i) CBN (ii) Ceramics (iii) Cemented Carbides **(12 Marks)**

b. What are the properties of a good cutting fluid? **(08 Marks)**

OR

6 a. What is meant by tool signature? Explain each term of a tool designated as:
8 – 12 – 10 – 7 – 5 – 15 – 1.5 **(10 Marks)**

b. Find the machining time required for machining a surface 600 × 800 mm on a shaping machine. Assume cutting speed as 8m/min. The ratio of return to cutting stroke is 1:4 and the feed is 2 mm/double stroke. The clearance at each end is 70 mm. **(10 Marks)**

Module-4

7 a. Derive an expression for shear angle in terms of chip thickness ratio and rake angle for orthogonal cutting. **(12 Marks)**

b. What are the conditions favorable for built-up-edge formation? **(08 Marks)**

OR

8 a. A 12 mm hole is to be drilled through a 20 mm thick plate. The cutting speed is 12 m/min and the feed rate is 0.12 mm/rev. Estimate the machining time. Take the over travel plus clearance of the tool as 5 mm. **(10 Marks)**

b. The following details relates to an orthogonal cutting operation. Feed = 1.25 mm/rev, chip thickness = 2 mm, rake angle of tool = 10°. Calculate :

(i) Chip thickness ratio and shear angle

(ii) If the shear strength is 6000 kg/cm^2, width of cut = 10 mm, cutting speed = 30 mpm and coefficient of friction = 0.9, determine the following:

(1) shearing force (2) friction angle (3) cutting force **(10 Marks)**

Module-5

9 a. What is tool wear? Why does the tool fail during cutting? Explain giving reasons. **(10 Marks)**

b. Write short notes on Taylor's tool life equation. **(10 Marks)**

OR

10 a. List the cutting conditions which have an important influence upon metal cutting in machining. **(12 Marks)**

b. A 50 mm bar of steel was turned at 284 rpm and tool failure occurred after 10 min. The speed was changed to 232 rpm and the tool failed in 60 min of cutting time. What cutting speed should be used to obtain 30 mins of tool life? **(08 Marks)**

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CBCS SCHEME

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17ME46B/17MEB406

Fourth Semester B.E. Degree Examination, Dec.2019/Jan.2020
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? **(06 Marks)**

b. Differentiate line and end standards with examples. **(06 Marks)**

c. Four length bars A, B, C, D of approximately 250mm each are to be calibrated with standard calibrated metre bar which is actually 0.0008mm less than a metre. It is also found that, bar 'B' is 0.0002mm longer than bar 'A', bar 'C' is 0.0004mm longer than bar 'A' and bar 'D' is 0.0001mm shorter than bar 'A'. The length of all four bars put together is 0.0003mm longer than the calibrated standard metre. Determine the actual dimensions of each bar. **(08 Marks)**

OR

2 a. Explain with neat sketches wringing phenomena of slip gauges. **(06 Marks)**

b. Build the following lengths by using M-112 set of slip gauges and write their combinations:
i) 29.875mm ii) 101.345mm iii) 78.3665mm **(09 Marks)**

c. Explain with neat sketches how a sine bar can be used to measure an unknown angle. **(05 Marks)**

Module-2

3 a. Define tolerance with types. **(06 Marks)**

b. Define fit. Explain different types of fits with sketches. **(08 Marks)**

c. Discuss hole and shaft basic system with neat sketches. **(06 Marks)**

OR

4 a. List essential considerations and materials used for construction of gauges. **(04 Marks)**

b. Determine the tolerances on the hole and the shaft for a precision running fit designated by $50H_7g_6$. Given:
i) 50mm lies between 30-50 mm
ii) i(Microns) = $0.45 (D)^{1/3} + 0.001D$
iii) Fundamental deviation for, H = 0
iv) Fundamental deviation for "g" shaft = $-2.5D^{0.34}$.
v) $IT_7 = 16i$ and $IT_6 = 10i$ **(08 Marks)**

c. Explain with neat sketches double ended plug and snap gauges. **(08 Marks)**

Module-3

5 a. Explain terminology of screw thread. **(06 Marks)**

b. Derive an equation for measuring effective diameter of screw thread by using 2-wire method. **(08 Marks)**

c. With neat sketch, explain tool Maker's microscope. **(06 Marks)**

OR

6 a. Illustrate the principle of interferometry with sketches. **(10 Marks)**

b. Explain construction and working of co-ordinate measuring machine. **(10 Marks)**

Module-4

7 a. Explain the concept of generalized measurement system with block diagram with bourdon pressure gauge as an example. **(08 Marks)**

b. Define the following terms: i) Precision ii) Hysterisis iii) Sensitivity **(06 Marks)**

c. Explain linear variable differential transducer (LVDT) with neat sketch. **(06 Marks)**

OR

8 a. Explain with a block diagram telemetering receiving system. **(04 Marks)**

b. Explain with a neat sketch cathode ray oscilloscope. **(08 Marks)**

c. What are X-Y plotters? With block diagram explain working of X-Y plotters. **(08 Marks)**

Module-5

9 a. Explain working of proving ring with neat sketch. **(06 Marks)**

b. With a neat sketch, explain the working of prony brake dynamometer. **(08 Marks)**

c. Discuss the working of McLeod gauge. **(08 Marks)**

OR

10 a. State and explain the laws of thermocouple. **(06 Marks)**

b. Discuss the construction and working of an optical pyrometer. **(10 Marks)**

c. Describe the steps to be taken for the preparation of specimen and mounting and strain gauges. **(04 Marks)**

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18ME32

Third Semester B.E. Degree Examination, Aug./Sept.2020
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) Hooke's law (ii) True stress **(04 Marks)**

b. Derive an expression for the extension of uniformly tapering rectangular bar subjected to axial load P. **(06 Marks)**

c. A stepped bar of steel, held between two supports as shown in Fig.Q1(c), is subjected to loads $P_1 = 80$ kN and $P_2 = 60$ kN. Find the reactions developed at the ends A and B.

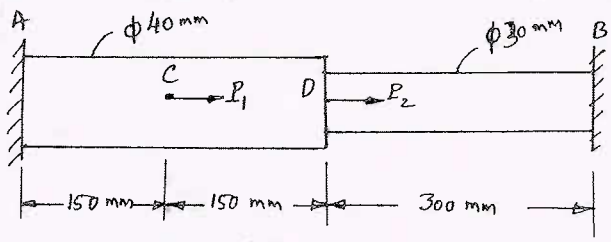

Fig.Q1(c) **(10 Marks)**

OR

2 a. A steel bar is placed between two copper bars, each having the same area and length and the steel bar at 15°C. At this stage, they are rigidly connected together at both the ends. When the temperature is raised to 315°C, the length of the bars increases by 1.5mm. Determine the original length and find stresses in the bars. Take $E_s = 2.1\times10^5$ N/mm^2, $E_c = 1\times10^5$ N/mm^2. $\alpha_S = 0.000012$/°C, $\alpha_C = 0.0000175$/°C. **(10 Marks)**

b. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(10 Marks)**

Module-2

3 a. Derive an expression for the normal stress and shear stress on plane inclined at 'θ' to the vertical axis in two dimensional stress system with shear. Also prove that the sum of normal stresses on any two mutually perpendicular planes are always constant. **(12 Marks)**

b. A thin cylinder, 2 m long and 200 mm in diameter with 10mm thickness is filled completely with a fluid, at an atmospheric pressure. If an additional 25mm^3 fluid is pumped in, find the longitudinal and loop stress developed. Also find the change in the diameter, if $E = 2\times10^5$ N/mm^2 and Poisson's ratio = 0.3. **(08 Marks)**

OR

4 a. At a point in a loaded elastic member, there are normal stresses of 60 MPa and 40 MPa, (both tensile) at right angles to each other with positive searing stress of 20 MPa. Draw the Mohr's circle diagram and find (i) Principal stresses and their planes (ii) Maximum shear stress and its plane. **(10 Marks)**

b. The internal and external diameters of a thick cylinder are 300mm and 500mm respectively. It is subjected to an external pressure of 4 N/mm^2. Find the internal pressure that can be applied if the permissible stress in cylinder is limited to 13 N/mm^2. Sketch the variation of hoop stress and radial stress across the thickness of the cylinder. **(10 Marks)**

Module-3

5 a. A cantilever of length 2 m carries an uniformly distributed load of 1 kN/m run over a length of 1.5m from the free end. Draw the shear force and bending moment diagrams for the cantilever. **(06 Marks)**

b. Draw the shear force and bending moment diagrams for the overhanging beam carrying uniformly distributed load of 2 kN/m over the entire length and a point load of 2 kN as shown in Fig.Q5(b).

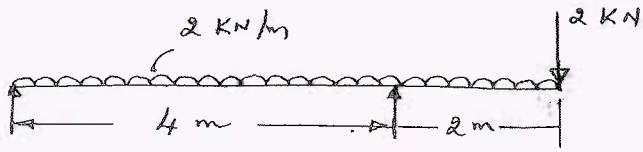

Fig.Q5(b) **(14 Marks)**

OR

6 a. Derive an expression for the shear stress distribution across the rectangular section of width 'b' and depth 'd'. Draw the figure showing the shear stress variation across the section. Also show that the maximum shear stress is 1.5 times the average shear stress. **(10 Marks)**

b. A 200mm × 80mm I-beam is to be used as a simply supported beam of 6.75m span. The web thickness is 6mm and the flanges are of 10mm 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)**

Module-4

7 a. A shaft is subjected to a maximum torque of 14 kN-m and a maximum bending moment of 10 kN-m at a particular section. Determine the diameter of the shaft according to maximum shear stress theory if the elastic limit in simple tension is 180 MPa. **(08 Marks)**

b. Derive the equation $\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$ with usual notations. State the assumptions. **(12 Marks)**

OR

8 a. A solid shaft is to transmit 192 kW at 450 rpm. Taking allowable stress for the shaft material as 70 MPa, find the diameter of the solid shaft. What percentage of saving in weight would be obtained, if this shaft was to be replaced by hollow shaft, whose internal diameter is 0.8 times its external diameter? The length of the shaft, power to be transmitted and the speed are equal in both cases. **(10 Marks)**

b. The allowable shear stress in brass is 80 N/mm^2 and in steel 100 N/mm^2. Find the maximum torque that can be applied in the stepped shaft as shown in Fig.Q8(b). Find also the total rotation of free end with respect to the fixed end if G_b = 40 kN/mm^2 and G_s = 80 kN/mm^2.

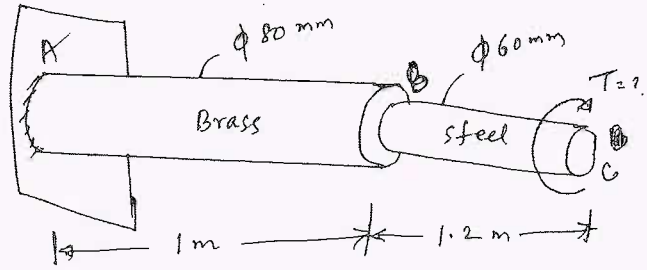

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. Derive an expression for Euler's buckling load in long elastic column when both ends are fixed. State the assumptions. **(10 Marks)**

b. Derive an expression for strain energy stored in a beam under bending. Also find the strain energy in a cantilever beam carrying a point load at the free end. **(10 Marks)**

OR

10 a. Determine the buckling load for a strut of tee section, the flange width being 100mm, over all depth 80mm and both flange and stem 10mm thick. The strut is 3m long and is hinged at both ends. Take E = 200 GN/m^2. **(10 Marks)**

b. State and prove Castigliano's first theorem. **(10 Marks)**

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Third Semester B.E. Degree Examination, Aug./Sept.2020
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 Thermodynamics data hand book permitted.

Module-1

1 a. Define the following with example:
i) Closed system ii) Open-system iii) Isolated system iv) Intensive-property
v) Extensive property. **(10 Marks)**

b. The temperature 't' on a thermometric scale is defined interms of a property 'P' by the relation t = alnp + b, where 'a' and 'b' are constants. The temperature of the Ice point and steam point are assigned numbers '0' and '100' respectively. Experiment gives values of 'P' as 1.86 and 6.81 at the Ice point and steam point respectively. Evaluate the temperature corresponding to a reading of P = 2.5 on the thermometers. **(10 Marks)**

OR

2 a. State Zeroth law of thermodynamics and explain in detail. **(04 Marks)**

b. Define Quasistatic process. What are its characteristics? **(06 Marks)**

c. The Emf in millivoltmeter in a thermocouple with the test junction at t°C on a gas thermometer scale and reference junction at Ice point is given by $e = (0.0367t + 1.33 \times 10^{-4}t^2)$mV. The millivoltmeter is calibrated at Ice and steam points. What will this thermometer read in a place where the gas thermometer reads 50°C? **(10 Marks)**

Module-2

3 a. Explain the pdv work and prove that work is a path function. **(05 Marks)**

b. Explain path and point function. **(05 Marks)**

c. A closed system undergoes a Quasistatic process according to the law $P = \left(V^2 + \frac{8}{V}\right)$, where 'P' is in N/cm^2 and 'V' is in m^3. Calculate work-done when 'V' changes from 10 to 30m^3. **(10 Marks)**

OR

4 a. Briefly describe internal energy in a property of the system. **(04 Marks)**

b. Derive the steady flow energy equation for a single stream of fluid entering and leaving the control volume. **(06 Marks)**

c. A turbine operates under steady flow conditions receiving steam at the following state; pressure is 1.2MPa, temperature is 188°C, enthalpy is 2785kJ/kg velocity is 34m/s and elevation is 3m. The steam leaves the turbine at the following state: pressure is 200MPa, enthalpy is 2512kJ/kg velocity is 100m/s and elevation is 0m. Heat is lost to the surroundings at a rate of 0.29kJ/s. If the steam flow rate is 0.42kg/s. Determine the power output from the turbine. **(10 Marks)**

Module-3

5 a. Establish the equivalence of Kelvin-Planck and Clausius statement. **(08 Marks)**

b. What is perpetual motion of II-kind? Explain. **(04 Marks)**

c. In a heat engine, the temperature of the source and sink are 700°C and 50°C respectively. The heat supplied is 5MJ/min. Find the power developed by the engine. **(08 Marks)**

OR

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

b. State and explain Clausius inequality. **(08 Marks)**

c. 2.5kg of air at a pressure of a 2bar and 26°C forms a closed system, which undergoes a constant pressure process with a heat addition of 650kJ. Calculate: i) Find temperature ii) Change in internal energy iii) Work transfer iv) Change in entropy. **(08 Marks)**

Module-4

7 a. Derive the expression of maximum work obtainable from two finite bodies at temperatures of T_1 and T_2. **(10 Marks)**

b. $1.2m^3$ of air is heated reversibly at a constant pressure from 300°K to 600°K and is then cooled reversibly at constant volume back to initial temperature. If the initial pressure is 1 bar. Calculate net heat flow and overall change in entropy. Also represent the process on T-S diagram. Take $C_p = 1.005\frac{kJ}{kg°K}$; $R = 0.287\frac{kJ}{kg°K}$; $C_v = 0.7165\frac{kJ}{kg°K}$. **(10 Marks)**

OR

8 a. With neat sketch, explain the method of measurement of dryness fraction of steam using separating throttling calorimeter. **(10 Marks)**

b. Define the terms i) Sensible heat ii) Dryness fraction. **(04 Marks)**

c. Find the entropy of one kg of superheated steam at 25bar and a temperature of 290°C. The specific heat of the superheated steam is 2.1kJ/kg°K. **(06 Marks)**

Module-5

9 a. State the i) Gibb's Dalton's law of partial pressure ii) Amagat's law. **(04 Marks)**

b. A tank has a volume of $5m^3$ and contains 20kg of an ideal gas having a molecular mass of 25. The temperature is 15°C. What is the pressure? **(06 Marks)**

c. A vessel of $2.5m^3$ capacity contains 1kg-mole of Nitrogen (N_2) at 100°C. Evaluate the specific volume and pressure. If the gas is cooled to 30°C, calculate the final pressure, change in specific internal energy and specific enthalpy. The ratio of specific heats is 1.4. One kg-mole of Nitrogen is 28kg. **(10 Marks)**

OR

10 Define the following:

i) Ideal and real gas

ii) State and explain the Vander Waal's equation of state

iii) Compressibility factor

iv) Law of corresponding states

v) Beattie-Bridgeman equation. **(20 Marks)**

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18ME34

Third Semester B.E. Degree Examination, Aug./Sept.2020
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. Define APF. Calculate APF for HCP cell. **(08 Marks)**

b. Differentiate edge dislocation and screw dislocation. **(06 Marks)**

c. State and explain Fick's I and II law of diffusion. **(06 Marks)**

OR

2 a. Define: (i) Ductility (ii) Tensile strength (iii) Hardness (iv) Toughness (v) Resilliance **(10 Marks)**

b. A cylindrical specimen of steel having an original diameter of 12.5 mm is tensile tested to fracture, and the fracture strength is 450 MPa, if the cross sectional diameter at fracture is 10.5 mm, determine:
(i) Ductility in term of percentage reduction in area
(ii) True stress at fractures **(10 Marks)**

Module-2

3 a. Differentiate between ductile and brittle fractures with sketches. **(06 Marks)**

b. What is fatigue? What are the factors affecting the fatigue life? **(08 Marks)**

c. What is creep? Explain creep curve. **(06 Marks)**

OR

4 a. Draw Fe-Fe_3C diagram and indicate the phase temperatures and also write the invariant reaction. **(12 Marks)**

b. Define homogeneous and heterogeneous nucleation. Obtain an expression for critical radius of nucleation. **(08 Marks)**

Module-3

5 a. What is Heat treatment? What are the purpose of Heat treatment? **(06 Marks)**

b. Differentiate between annealing and normalizing. **(06 Marks)**

c. Explain Austempering and Martempering with neat sketch. **(08 Marks)**

OR

6 a. With a neat sketch explain Nitriding process and applications. **(08 Marks)**

b. Discuss the precipitation hardening of AC 4 percentage weight copper alloy. **(06 Marks)**

c. Give the compositions and applications of Grey Cast Iron. **(06 Marks)**

Module-4

7 a. What are composite materials? What are advantages, limitations and application of composite materials? **(08 Marks)**

b. What is the role of (i) matrix (ii) reinforcement (iii) interface in a composite **(12 Marks)**

OR

8 a. Derive the rule of mixtures for the modulus of elasticity of a fiber reinforced composite when a stress (σ) is applied along the axis of fibers. **(08 Marks)**

b. With a neat sketch explain injuction moulding. **(06 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. Take $E_{carbonfibres} = 3.86 \times 10^4$ kgf/mm^2 and $E_{epoxy} = 4.28 \times 10^2$ kgf/mm^2. **(06 Marks)**

Module-5

9 a. Define ceramic. Explain briefly the types of ceramics. **(06 Marks)**

b. Differentiate the thermo plastics and thermo setting plastics. **(06 Marks)**

c. Define smart material. Explain briefly the types of smart material. **(08 Marks)**

OR

10 a. Explain briefly shape memory alloys – Nitinol. **(06 Marks)**

b. Write a note on piezoelectrical material. **(06 Marks)**

c. Explain use of Non-Destructive Testing (NDT) for residual life assessment. **(08 Marks)**

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18ME35A/18MEA305

Third Semester B.E. Degree Examination, Aug./Sept.2020
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. Explain the different between orthogonal cutting and oblique cutting **(06 Marks)**

b. Briefly explain the mechanism and types of chip formation. **(08 Marks)**

c. Briefly explain the elements of a single point with a neat sketch. **(06 Marks)**

OR

2 a. Derive an expression for shear plane angle with respect to orthogonal cutting. **(08 Marks)**

b. List and explain the various operations carried out on lathe machine. **(12 Marks)**

Module-2

3 a. Define Milling. Explain with a neat sketch the vertical milling machine. **(10 Marks)**

b. Define Drilling. With a neat sketch explain a radial drilling machine. **(10 Marks)**

OR

4 a. Sketch and explain the fundamental parts of a horizontal shaping machine. **(10 Marks)**

b. With a neat sketch explain the centerless grinding machine. **(10 Marks)**

Module-3

5 a. Define tool wear. Explain crater wear and flank wear. **(08 Marks)**

b. Define tool life and explain the factors which affect the tool life. **(08 Marks)**

c. Briefly explain the different types of cutting fluids. **(04 Marks)**

OR

6 Write the short notes on the following :

a. Choice of feed

b. Tool life for minimum cost

c. Minimum production time

d. Choice of Cutting Speed. **(20 Marks)**

Module-4

7 a. How sheet metal operations are classified? Explain with a neat sketch. **(14 Marks)**

b. A 90° bend is to be made from steel sheet by air bending process. The bend length is 30cm, thickness of sheet 3mm and width 4cm. The ultimate tensile strength of the sheet material is 400 N/mm^2. Calculate the bending force. Suppose if the bend is to be made by edge bending process, with die and punch radius = 10mm. Find the bending force required. (Assume die opening factor k = 1.33 for Air bending and 0.67 for edge bending). **(06 Marks)**

OR

8 a. How are dies classified? Explain with figures working of progressive and compound die arrangements in sheet metal working. **(12 Marks)**

b. List and explain variables that affect during deep drawing. **(08 Marks)**

Module-5

9 a. With a neat sketch explain the classification of metal working process on the basis of force applied. **(10 Marks)**

b. With a neat sketch, explain different types of rolling mill arrangements. **(10 Marks)**

OR

10 a. Differentiate between direct and indirect extrusion process. **(06 Marks)**

b. Explain the different types of rolling defects. **(05 Marks)**

c. Mention the advantages, disadvantages and applications of forging. **(09 Marks)**

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18ME35B/18MEB305

Third Semester B.E. Degree Examination, Aug./Sept.2020
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. Define manufacturing process. With a suitable sketch explain the classification of it. **(10 Marks)**

b. What is pattern? Explain various pattern allowances. **(10 Marks)**

OR

2 a. Explain the working of sand singer with a neat sketch. **(10 Marks)**

b. With neat sketches, explain shell moulding. **(10 Marks)**

Module-2

3 a. With a neat sketch explain cupola furnace showing different zones. **(10 Marks)**

b. With a neat sketch, explain constructional features and working of corcless induction furnace. **(10 Marks)**

OR

4 a. With a neat sketch explain continuous casting process. **(10 Marks)**

b. What is die casting? Explain hot chamber die casting with a diagram. **(10 Marks)**

Module-3

5 a. Explain different sand casting defects, its causes and remedies. **(10 Marks)**

b. What is directional solidification? Explain the methods for controlling the same. **(10 Marks)**

OR

6 a. Explain various methods of degasification. **(10 Marks)**

b. With a neat sketch, explain stir casting process listing advantages and disadvantages. **(10 Marks)**

Module-4

7 a. How welding process is classified? **(04 Marks)**

b. Describe the working of submerged arc welding with a neat sketch. **(08 Marks)**

c. With a neat sketch, explain atomic hydrogen welding. **(08 Marks)**

OR

8 a. With a neat sketch, explain laser beam welding. List advantages and disadvantages. **(10 Marks)**

b. With a neat sketch explain, Thermit welding process. List the applications. **(10 Marks)**

Module-5

9 a. Explain the formation of different zones in welding with a neat sketch. **(08 Marks)**

b. Compare soldering and brazing process, mention advantages, disadvantages and applications. **(10 Marks)**

c. What are the functions of electrode coating? **(02 Marks)**

OR

10 a. Explain fluorescent penetrant method of inspection with neat sketches. **(08 Marks)**

b. Explain types of flames in oxy-acetylene welding. **(06 Marks)**

c. With a neat sketch, explain ultrasonic inspection method. **(06 Marks)**

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18ME36B/18MEB306

Third Semester B.E. Degree Examination, Aug./Sept.2020
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. Describe with a neat sketch, the constructional features of an "International Proto type Meter". **(07 Marks)**

b. Distinguish between line and end standards. **(05 Marks)**

c. Discuss the procedure for calibration of End Bars. **(08 Marks)**

OR

2 a. Build up a length of 35.4875 using M_{112} set use two protector slips of 2.5mm each. **(06 Marks)**

b. With a neat sketch, explain the working of sine bar and mention its limitations. **(07 Marks)**

c. With a neat sketch, explain the working of autocollimator. **(07 Marks)**

Module-2

3 a. Define the terms:
i) Limits ii) Tolerance iii) Allowance. **(06 Marks)**

b. With neat sketches explain different types of fit. **(07 Marks)**

c. Discuss 'hole based' and 'shaft based' system of fits which is preferred why. **(07 Marks)**

OR

4 a. Define comparator. What is need of a comparator? **(05 Marks)**

b. With neat sketch and explain working of Sigma comparator. **(07 Marks)**

c. Sketch and explain working of LVDT. **(08 Marks)**

Module-3

5 a. Define: i) Pitch ii) Lead iii) Crest of the thread. **(06 Marks)**

b. Derive an expression for best wire size for screw thread measurement. **(07 Marks)**

c. With neat sketch explain the working of tools maker's microscope. **(07 Marks)**

OR

6 a. With a neat sketch explain gear teeth terminology. **(06 Marks)**

b. What is Runout and involute profile in gear system? **(06 Marks)**

c. Sketch and explain Parkinson's gear tester. **(08 Marks)**

Module-4

7 a. Define: i) Accuracy ii) Precision iii) Loading effect iv) Calibration v) Error vi) Repeatability. **(06 Marks)**

b. Explain the working of generalized measurement system with block diagram taking one of the example. **(08 Marks)**

c. What is the significance of measurement system? **(06 Marks)**

OR

8 a. What is transducer? Sketch and explain principle of electronic transducer. What are the advantages of electronic transducer? **(08 Marks)**

b. With a circuit diagram, explain Ballast circuit. **(06 Marks)**

c. With a neat sketch, explain stylus type oscillography. **(06 Marks)**

Module-5

9 a. Explain measurement of force using system unequal arm balance. **(06 Marks)**

b. With a neat sketch, explain working of Prony brake dyanamometer. **(07 Marks)**

c. With a neat sketch, explain McLeod gauge. **(07 Marks)**

OR

10 a. What is thermocouple? Give the laws of thermocouple. **(06 Marks)**

b. With a neat sketch, explain the working principle of optical pyrometer. **(08 Marks)**

c. Define strain gauge. With a neat sketch explain WheatStone bridge circuit. **(06 Marks)**

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CBCS SCHEME

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17ME33

Third Semester B.E. Degree Examination, Aug./Sept.2020
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note : i) ***Answer any FIVE full questions, choosing ONE full question from each module.***
ii) ***Use of Thermodynamic handbook is permitted.***

Module-1

1 a. Define a Thermodynamic system. Differentiate between Open system , Closed system and Isolated system. **(06 Marks)**

b. Define Work in Thermodynamics. Derive an equation for displacement work in polytropic process. **(06 Marks)**

c. A temperature scale of certain thermometer is given by the relation $t = a\ln p + b$, where a and b are constants, P is thermometric property. If at ice point and steam point the thermometric properties are found to be 1.5 and 7.5 respectively. What will be the temperature corresponding to the thermometric property of 3.5 on Celsius scale. **(08 Marks)**

OR

2 a. Compare Heat and Work. **(06 Marks)**

b. State Zeroth Law of thermodynamics and explain its significance. **(06 Marks)**

c. The properties of a closed system change following the relation between pressure and volume as PV = 3.0, where P is in bar and V is volume m^3. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. **(08 Marks)**

Module-2

3 a. Explain the First law of thermodynamics as referred to closed system under going cyclic process. **(06 Marks)**

b. State Kelvin Plank and Clausius statement of II law of Thermodynamics. **(06 Marks)**

c. 12 kg of a fluid per minute goes through a reversible steady flow process. The properties of fluid at the inlet are $P_1 = 1.4$ bar , $V_1 = 0.04 m^3/kg$, $C_1 = 120 m/s$ and $u_1 = 920$ kJ/kg and at the exit $P_2 = 5.6$ bar , $V_2 = 0.2 m^3/kg$, $C_2 = 180$ m/s and $u_2 = 720$ kJ/kg. During the passage the fluid rejects 60kJ/s of heat and rises through 60 meters. Determine the work done during the process. **(08 Marks)**

OR

4 a. Write down the general energy equation for steady flow system when applied for the following : i) Centrifugal water pump ii) Nozzle. **(06 Marks)**

b. Show that the Kelvin Plank statement and Clausius statement of II law of thermodynamics are equivalent. **(06 Marks)**

c. A reversible heat engine operated between two reservoirs at temperatures 700^0C and 50^0C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 50^0C and -25^0C. The heat transfer to the engine is 2500kJ and the net work output of the combined engine refrigerator plant is 400kJ. Determine the net heat transfer to the reservoir at 50^0C. **(08 Marks)**

Module-3

5 a. Mention the factors that makes a process Irreversible. **(06 Marks)**

b. Show that entropy is property and point function. **(06 Marks)**

c. Define Thermodynamic temperature scale and show that the efficiency of reversible heat engine does not depend on the working fluid. **(08 Marks)**

OR

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

b. Calculate the change in entropy of 1kg of air expanding polytropically in a cylinder behind a piston from 7 bar and 600^0C to 1.05bar. The index of expansion is 1.25. **(06 Marks)**

c. One kg of ice at -5^0C is exposed to the atmosphere which is at 20^0C. The ice melts and comes into thermal equilibrium with the atmosphere. Determine the entropy increase of the universe. Take specific heat of ice as 2.093 kJ/kg K, Latent heat of fusion of ice is 333.3 kJ/kg and specific heat of water is 4.187kJ/kg K. **(06 Marks)**

Module-4

7 a. Define : i) Critical point ii) Triple point. **(04 Marks)**

b. With a neat sketch, explain the working of a throttling calori meter. **(08 Marks)**

c. The following observations were taken with a separating and a throttling calorimeter arranged in series : Water separated = 2kg.
Steam discharged from the throttling calorimeter = 20.5kg.
Temperature of steam after throttling = 110^0C.
Initial pressure = 12 bar.
Pressure after throttling = 1 bar.
Estimate the Quality of steam. **(08 Marks)**

OR

8 a. Define i) Available energy ii) Unavailable energy iii) II Law efficiency. **(06 Marks)**

b. With the help of P – T and P – V diagrams, explain the different regions for a pure substance. **(06 Marks)**

c. 1 kg of air undergoes a polytropic compression from 1 bar 290K to 6 bar and 400K. If the temperature and pressure of the surroundings are 290K and 1 bar respectively, determine the irreversibility and the effectiveness. **(08 Marks)**

Module-5

9 a. Define i) Dalton Law of partial pressure ii) Amagat's Law of additive volumes. **(04 Marks)**

b. Derive an expression for Gas Constant (R) and Molecular Weight (M) of an Ideal gas mixture. **(08 Marks)**

c. The pressure and temperature of mixture of 4kg of O_2 and 6kg of N_2 are 4 bar and 27^0C respectively. For the mixture, determine the mole fraction of each component, specific gas constant and average molecular weight. **(08 Marks)**

OR

10 a. Define i) Dry bulb temperature ii) Wet bulb temperature iii) Relative humidity. **(06 Marks)**

b. Write a short note on Vander Waals equation. **(06 Marks)**

c. Determine the pressure of air at 205^0C having a specific volume of 0.00315 m^3/kg by means of i) Ideal gas equation ii) Vander Waals equation. **(08 Marks)**

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CBCS SCHEME

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17ME34

Third Semester B.E. Degree Examination, Aug./Sept.2020
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. Derive an expression for deformation of tapering bar having circular cross-section. **(08 Marks)**

b. Define:
i) True stress ii) Rigidity Modulus iii) Poisson's Ratio iv) Resilience. **(04 Marks)**

c. A steel tie rod 50mm in diameter and 5m long is subjected to a pull of 100kN. To what length the bar should be bored centrally so that the total extension will increase by 20% under the same pull, the bore being 25mm diameter. Take: E = 200GPa. **(08 Marks)**

OR

2 a. Establish the relationship between modulus of elasticity and bulk modulus in case of a cube subjected to three mutually perpendicular like tensile stresses of equal intensity 'P'. **(10 Marks)**

b. The composite bar shown in Fig.Q.2(b) is 0.2mm short of distance between the rigid support at room temperature. What is the maximum temperature rise which will not produce stresses in the bar? Find the stresses induced when temperature rise is 40°C.
Given: $\alpha_s = 12 \times 10^{-6}/°C$; $E_s = 210GPa$; $A_s : A_c = 5:4$; $\alpha_c = 17.5 \times 10^{-6}/°C$; $E_c = 120GPa$. **(10 Marks)**

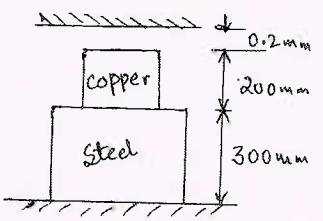

Fig.Q.2(b)

Module-2

3 a. Derive an expression for normal and shear stress on an inclined plane of member. **(08 Marks)**

b. An element with the stresses acting on it, is as shown in Fig.Q3(b) by Mohr's circle method. Determine:
i) Normal and shear stress acting on a plane whose normal is at an angle of 110° with respect to x-axis.
ii) Principal stresses and its locations.
iii) Maximum shear stresses and its location. **(12 Marks)**

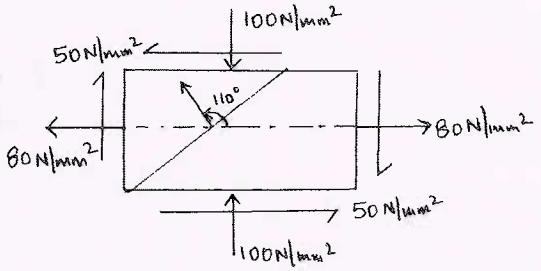

Fig.Q.3(b)

OR

4 a. Derive the expressions for circumferential and radial stresses in the wall of thick cylinder (Lame's equation). **(10 Marks)**

b. A pipe of 500mm internal diameter and 75mm thick is filled with a fluid at a pressure of $6N/mm^2$. 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. **(10 Marks)**

Module-3

5 a. Define point of contraflexure. Draw the SFD and BMD for overhanging beam shown in below Fig.Q.5(a) and locate the point of centraflexure. **(15 Marks)**

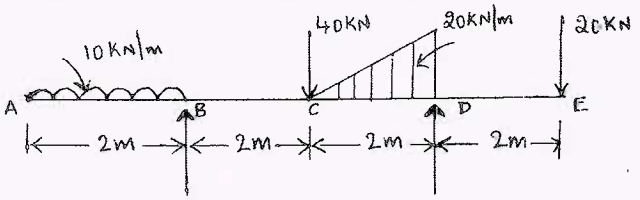

Fig.Q.5(a)

b. Explain the fire types of beam. **(05 Marks)**

OR

6 a. An I-section beam 350mm × 200mm has a web thickness of 12.5mm and a flange thickness of 25mm. It carries a shearing force of 200kN at a section. Sketch the shear stress distribution across the section. **(10 Marks)**

b. Derive an expression for differential equation for deflection curve. **(10 Marks)**

Module-4

7 a. Derive the relation for a circular solid shaft when subjected to torsion as given by $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{\ell}$ and state the assumptions. **(10 Marks)**

b. A hollow diameter circular shaft has to transmit 60kW at 210rpm such that the maximum shear stress does not exceed $60MN/m^2$, If the ratio of internal diameter to external diameter equal to 3/4 and the value of G = 84GPa, find the dimensions of the shaft and angle of twist in a length of 3m. **(10 Marks)**

OR

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

b. Derive an expression for Euler's crippling load for a column when one of its ends are hinged or pinned. **(10 Marks)**

Module-5

9 a. Explain Rankin's theory and Guest's theory. **(08 Marks)**

b. Find the deflection at the centre of simply supported beam of length '*l*' carrying UDL of 'W' per unit length over its entire length using castigliano's theorem. **(12 Marks)**

OR

10 a. Derive an expression for strain energy stored in an elastic bar when subjected to torque and bending moment. **(10 Marks)**

b. Determine the diameter of a bolt which is subjected to an axial pull of 9kN together with a transverse shear force of 4.5kN using maximum principal stress theory. Given: The elastic limit in tension = $225N/mm^2$, FOS = 3 and Poisson's Ratio = 0.3. **(10 Marks)**

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CBCS SCHEME

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17MEB306/17ME36B

Third Semester B.E. Degree Examination, Aug./Sept.2020
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 is Metrology? List the objectives of metrology and highlight the advantages of wavelength standards. **(10 Marks)**

b. Differentiate LINE and END standards. State the procedure to calibrate end bars with a standard bar. **(10 Marks)**

OR

2 a. What do you understand by Autocollimator? Explain. How is it used for measuring straightness? **(10 Marks)**

b. Explain the principle of sine bar and enlist the problems incurred in building slip gauges also discuss wringing process applied to slip gauges. **(10 Marks)**

Module-2

3 a. With neat diagram, explain the following:
i) Hole Basis system
ii) Shaft Basis system
iii) Tolerance
iv) Taylors principle. **(10 Marks)**

b. Sketch and explain plug gauges, snap gauges and suggest suitable gauge materials. **(10 Marks)**

OR

4 a. Explain the construction and working of LVDT, enlist the advantages, disadvantages with neat sketch. **(10 Marks)**

b. What are the characteristics required for a good comparator? Sketch and discuss about a mechanical comparator. **(10 Marks)**

Module-3

5 a. State the importance of effective diameter and derive an expression to measure effective diameter using 2 wire method. **(10 Marks)**

b. How do you measure pitch of a screw thread using Tool Malcer's microscope? Sketch and explain. **(10 Marks)**

OR

6 a. What do you understand by CMM? Sketch and explain the working principle of any one CMM with its advantages and applications. **(10 Marks)**

b. Explain the principle of interferrometry and write a note on laser interferometer. **(10 Marks)**

Module-4

7 a. With a block diagram, discuss about generalized measuring system and define:
i) Calibration ii) Hysteresis iii) System response time and delay. **(10 Marks)**

b. What is an Error? How do you classify Errors? List the reasons and suggest remedies for the same. **(10 Marks)**

OR

8 a. What is the necessity of intermediate modifying devices? What are the advantages of electrical modifying devices over mechanical devices and explain any one electrical circuit. **(10 Marks)**

b. What is CRO? Sketch and explain its working. **(10 Marks)**

Module-5

9 a. Explain the working principle of Rope Brake dynamometer with neat diagram. **(10 Marks)**

b. With a neat sketch discuss the working of Pirani gauge. **(10 Marks)**

OR

10 a. What is a thermocouple? State and explain different laws of thermocouple. **(10 Marks)**

b. Write a note on strain gauges referring to preparation, mounting and methods of strain measurement. **(10 Marks)**

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CBCS SCHEME

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15ME33

Third Semester B.E. Degree Examination, Aug./Sept.2020
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. What is thermodynamic equilibrium? Explain mechanical, chemical and thermal equilibrium. **(04 Marks)**

b. What are the similarities and dissimilarities between work and heat? **(04 Marks)**

c. The readings T_A and T_B of two Celsius thermometers A and B agree at ice and steam points, elsewhere the temperatures are related by $T_A = L + MT_B + NT_B^2$, where L, M and N are constants. When the two thermometer are immersed in a well stirred oil bath, A reads 51°C and B reads 50°C. Determine:

(i) What thermometer A reads when thermometer B reads 30°C?
(ii) What thermometer B reads when A reads 30°C?
(iii) Discuss the question which thermometer is correct.
Take ice point = 0°C and steam point = 100°C. **(08 Marks)**

OR

2 a. Define displacement work. Define an expression for displacement work for the case of polytropic process with PV^n = constant. **(05 Marks)**

b. Distinguish between following with an example for each:
(i) Intensive and extensive property
(ii) Point and path function **(04 Marks)**

c. A gaseous system undergoes three quasi-static process in sequence. The gas is initially at 5 bar, 0.01 m^3 is expanded at constant pressure. It is then further expanded according to the law $PV^{1.4}$ = constant to 2 bar, 0.025 m^3. The gas is then returned to its initial state following the process PV = constant. Show the process on PV diagram. Calculate the work interaction in each process and the network for the system. **(07 Marks)**

Module-2

3 a. Clearly write steady flow energy equation for an open system and explain the terms involved. **(04 Marks)**

b. Simplify steady flow energy equation for the following:
(i) Steam turbine (ii) Nozzle (iii) Boiler **(06 Marks)**

c. A gas undergoes a thermodynamic cycle consisting of the following process:
Process 1-2 : constant pressure P = 1.4 bars, $V_1 = 0.028\ m^3$, $W_{1\,2} = 10.5$ kJ.
Process 2-3 : compression with PV = constant, $U_3 = U_2$.
Process 3-1: constant volume, $(U_1 - U_3) = -26.4$ kJ.
There are no significant changes in KE and PE. Sketch the cycle on P-V diagram. Calculate the network for the cycle in kJ. Calculate the net heat transfer for process 1-2, and show that $\sum_{cycle} Q = \sum_{cycle} W$. **(06 Marks)**

OR

4 a. State and prove that Kelvin-Planck and Clausius statements of second law of thermodynamics are equivalent. **(09 Marks)**

b. A reversible heat engine operating between two thermal reservoirs at 800°C and 30°C respectively. It drives a reversible refrigerator operating between −15°C and 30°C. The heat input to the heat engine is 1900 kJ and net work output from the combined plant (engine and the refrigerator both) is 290 kJ. Calculate the heat absorbed by the refrigerant and total heat transferred to 30°C reservoir. **(07 Marks)**

Module-3

5 a. Define the terms reversible and irreversible process. List the factors that makes a process irreversible. Explain them briefly. **(06 Marks)**

b. With the help of suitable sketches, explain reversible heat engine cycle. Show that the efficiency of reversible heat engine is independent of the nature of working substance and depends upon the temperature limits between which it is operating. **(10 Marks)**

OR

6 a. State and prove Clausius inequality. What is its significance? **(04 Marks)**

b. State and prove principle of increase of entropy. **(04 Marks)**

c. One kg of ice at −5°C is exposed to atmosphere which is at 20°C. The ice melts and comes into thermal equilibrium with atmosphere. Determine change in entropy of the universe. Take C_p of ice = 2.093 kJ/kgK as latent geat of fusion of ice = 333.3 kJ/kg. **(08 Marks)**

Module-4

7 a. Briefly explain what is meant by
(i) Available energy
(ii) Unavailable energy
(iii) Dead state with respect to system. **(06 Marks)**

b. Derive Claperyon's equation. What are its uses and limitations? **(05 Marks)**

c. 2000 kJ/min of heat is supplied to a system at 500 K from a source at 1000 K. The temperature of the atmosphere is 27°C. Assuming the temperature of system and source remains constant during heat transfer, find:
(i) Change in entropy during heat transfer
(ii) The decrease in available energy after heat transfer. **(05 Marks)**

OR

8 a. Define the following terms as applied to a pure substance :
(i) Triple point
(ii) Critical point
(iii) Sub-cooled liquid state
(iv) Saturated liquid state
(v) Dryness fraction **(05 Marks)**

b. Explain with the help of diagram, how one could estimate the dryness fraction of steam using throttling calorimeter. What are limitations of this calorimeter? **(07 Marks)**

c. Select a point in a wet region and show the following processes starting from this common point on a h-s diagram for steam:
(i) Throttling of wet steam
(ii) Isobaric compression to superheated state
(iii) Isochoric heat addition till it becomes superheated steam
(iv) Isentropic compression till it becomes dry saturated. **(04 Marks)**

Module-5

9 a. Define the following terms:
(i) Perfect and semi-perfect gas
(ii) Specific humidity and relative humidity
(iii) Dew point temperature and dew point depression **(06 Marks)**

b. Write down the Vander Waal's equation of state. How does it differ from ideal gas equation? **(04 Marks)**

c. 0.5 kg of Nitrogen is cooled in a rigid vessel from 227°C to 27°C. The initial pressure is 15 Bar. Calculate the final pressure and change in internal energy, changer in enthalpy and entropy. Assume that nitrogen behaves as an ideal gas with C_p = 1.042 kJ/kgK and C_v = 0.745 kJ/kgK. Also show the process on PV and TS diagram. **(06 Marks)**

OR

10 a. Explain the following:
(i) Compressibility factor
(ii) Law of corresponding states
(iii) Psychrometric chart and its use **(10 Marks)**

b. Determine the specific volume of CO_2 at 200°C and 60 bar by using:
(i) Ideal gas equation
(ii) Compressibility chart
Take compressibility factor Z = 0.96. **(06 Marks)**

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CBCS SCHEME

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15ME/MA34

Third Semester B.E. Degree Examination, Aug./Sept.2020
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. Derive an expression for the total extension of the tapered circular bar of diameter d_1 and d_2, when it is subjected to an axial pull P. **(08 Marks)**

b. A stepped bar is subjected to an axial load is shown in Fig.Q.1(b). Determine the change in length of the bar. Take E = 200GPa for steel, E = 70GPa for Aluminium and E = 100GPa for copper. All dimensions are in mm. **(08 Marks)**

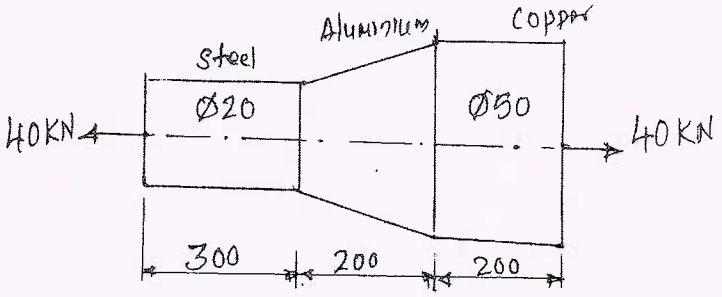

Fig.Q.1(b)

OR

2 a. Define:
i) Modulus of Elasticity
ii) Modulus of Rigidity
iii) Poisson's ratio
iv) Thermal stress. **(08 Marks)**

b. A steel rod of 20mm diameter and 300mm long is enclosed centrally inside a hollow copper tube of external diameter 30mm and internal diameter 25mm. The composite bar carries an axial load of 50kN. Take E_{steel} = 200GPa, E_{copper} = 100GPa. Determine:
i) Load carried by each material
ii) Stresses developed on each material. **(08 Marks)**

Module-2

3 a. Define or explain:
i) Principal plane
ii) Principal stresses
iii) Plane of maximum shear
iv) Maximum shear stress. **(08 Marks)**

b. The state of stress at a point in a strained material is shown in Fig.Q.3(b). Determine:
   i) Principal stresses and their planes
   ii) Maximum shear stress and its planes. **(08 Marks)**

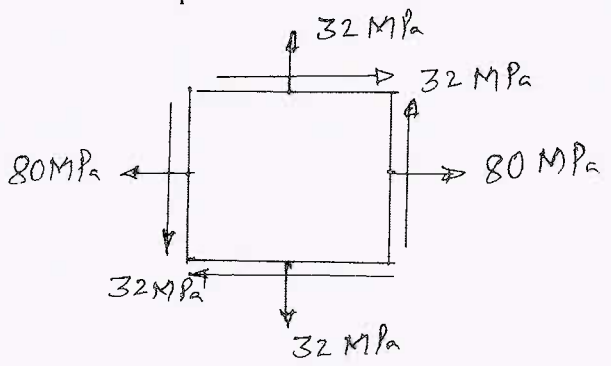

Fig.Q.3(b)

OR

4 a. Derive the expressions for circumferential and longitudinal stresses developed in thin cylinder subjected to internal pressure. **(06 Marks)**

b. A thick cylinder of internal diameter 200mm and external diameter 300mm is subjected to an internal pressure $14N/mm^2$. Find the maximum hoop stress developed. Also plot the variation of hoop stress and radial pressure across the thickness of the cylinder. **(10 Marks)**

Module-3

5 a. Define:
   i) Shear force
   ii) Bending moment
   iii) Point of contra flexure. **(06 Marks)**

b. Draw the shear force and bending moment diagrams for the beam shown in Fig.Q.5(b). **(10 Marks)**

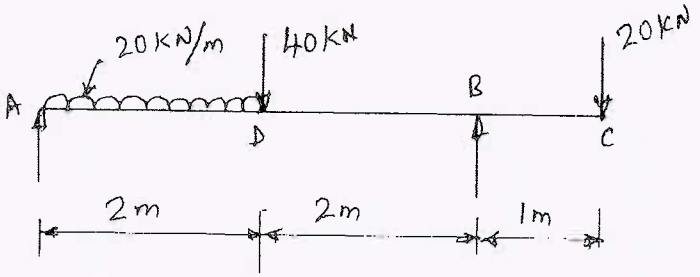

Fig.Q.5(b)

OR

6 a. Derive the relation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ with usual notations. **(08 Marks)**

b. A beam of symmetric I-section consists of flanges of 100mm × 10mm and a web of 180mm × 5mm. The beam is used as simply supported subjected to udl of 10kN/m. The beam is 10m long. Determine the maximum bending stress and sketch the variation along the depth of the section. **(08 Marks)**

Module-4

7 a. Derive the torsion equation with usual notations. **(08 Marks)**

b. Find the diameter of the shaft required to transmit 60kW at 150rpm, if the maximum torque is 25% more than the mean torque. The maximum permissible shear stress is 60MPa. Also find the angle of twist for a length of 4m. Take G = 80GPa. **(08 Marks)**

OR

8 a. Derive an expression for buckling load in a column subjected to an axial compressive load, when both ends are fixed. **(08 Marks)**

b. A hollow cast iron column whose outside diameter is 200mm and has a thickness of 20mm is 4.5m long and is fixed at both ends. Find the ratio of Euler's to Rankine's constants is 1/1600 and crushing strength as 550N/mm^2. **(08 Marks)**

Module-5

9 a. Define:

i) Strain energy

ii) Proof resilience

iii) Modulus of resistance. **(06 Marks)**

b. State Castigliano's first and second theorems. **(04 Marks)**

c. Calculate the strain energy stored in a bar 2m long, 50mm wide and 40mm thick when it is subjected to an tensile load of 60kN. Take E = 200GPa. **(06 Marks)**

OR

10 a. Determine the strain energy stored in a cantilever beam of length L subjected to a point load P at its free end and hence find the deflection of its free end. **(08 Marks)**

b. Explain maximum principal stress theory and maximum shear stress theory. **(08 Marks)**

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CBCS SCHEME

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17ME42

Fourth Semester B.E. Degree Examination, Aug./Sept. 2020
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:
(i) Kinematic chain (ii) Mechanism (iii) Structure (iv) Inversion
(v) Degree of freedom **(10 Marks)**

b. Describe with neat figures two inversions of double slider-crank mechanism. **(10 Marks)**

OR

2 a. With neat sketch, explain crank and slotted lever quick return motion mechanism. **(07 Marks)**

b. Draw a line diagram and explain peaucellier exact straight line mechanism. **(07 Marks)**

c. The length of the fixed link of a crank and slotted lever mechanism is 250 mm and that of the crank is 100 mm. Determine (i) Angle between extreme positions of slotted lever (ii) Ratio of the time of cutting stroke to that of the return stroke. **(06 Marks)**

Module-2

3 In the mechanism shown in Fig. Q3. The crank 2 rotates at 3000 rpm. Find the acceleration of point C in magnitude and direction. Also find the angular acceleration of link 3. OA = 50 mm, AB = 175 mm, AC = 75 mm and AB = 125 mm. **(20 Marks)**

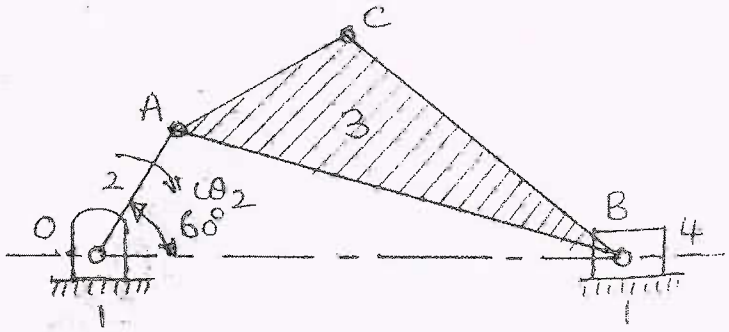

Fig. Q3

OR

4 a. State and Prove Kennedy's theorem. **(06 Marks)**

b. Determine the velocity and acceleration of the piston by Klein construction to the following specification: Stroke = 300 mm, Ratio of length of connecting rod to crank radius = 4, Speed of the engine = 300 rpm, Position of crank = 45° with inner dead centre. **(14 Marks)**

Module-3

5 The crank of an engine mechanism is 200 mm long and the ratio of connecting rod length to the crank radius is 4. Determine the acceleration of the piston when the crank has turned through an angle of 45° from the inner dead centre and rotating at a speed of 240 rpm counter clockwise direction by complex number approach. **(20 Marks)**

OR

6 a. Explain function generation for 4-bar mechanism. **(05 Marks)**

b. Design a 4 link mechanism, if the motion of input and output links are governed by a function $y = x^{1.5}$ and x varies from 1 to 4. Assume θ is vary from 30° to 120° and ϕ from 60° to 130°. The length of the fixed link is 30 mm. Use Chebyshev spacing of accuracy points. **(15 Marks)**

Module-4

7 a. State and prove law of gearing. **(06 Marks)**

b. Derive an expression for path of contact. **(06 Marks)**

c. The two spur gears 19 and 47 teeth are in mesh. The module is 6.5 mm and pressure angle is 20°. Determine the number of pair in contact and the angle turned by the larger gear when one pair of teeth in contact. **(08 Marks)**

OR

8 a. Explain reverted gear train with neat figure. **(05 Marks)**

b. An epicyclic gear train consists of a sunwheel (S), a stationary internal gear (E) and 3 Identical planet wheels (P) carried on a star shaped planet carrier (C). The size of different toothed wheels are such that the planet carrier C rotates at $\frac{1}{5}$ of the speed of the sun wheel. The minimum number of teeth on any wheel is 16. The drilling torque on the sunwheel is 100 N-m. Determine (i) The number of teeth on different wheels of train. (ii) Torque necessary to keep the internal gear stationary. **(15 Marks)**

Module-5

9 The following data relate to cam profile in which the roller moves with SHM during ascent and UARM during descent. Minimum radius of cam = 30 mm, Roller radius = 8 mm, Lift = 28 mm, Offset of the follower axis = 12 mm towards right, Angle of ascent = 90°, Angle of descent = 60°, Angle of dwell between ascent and descent = 45°, Speed of cam = 200 rpm in counter clockwise direction. Draw the profile of the cam and determine the maximum velocity and acceleration during outstroke and return stroke. **(20 Marks)**

OR

10 A suction valve of a 4-stroke petrol engine is operated by a symmetrical circular cam with a flat faced follower. The details are as follows, lift = 10 mm, least radius = 20 mm, nose radius = 2.5 mm, crank angle when suction valve opens after TDC = 4°, Crank angle when suction valve closes after BDC = 50°, Cam shaft speed = 600 rpm. Determine maximum velocity of the valve and its maximum acceleration and retardation. Also determine the minimum force exerted by the springs to overcome the inertia of moving parts weighing 250 gm. **(20 Marks)**

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CBCS SCHEME

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17ME43

Fourth Semester B.E. Degree Examination, Aug./Sept. 2020
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 thermodynamic data hand book is permitted.*

Module-1

1 a. State any 2 assumptions for Air Standard Cycle and obtain air standard efficiency expression for diesel cycle. **(10 Marks)**

b. An air standard limited pressure cycle has a compression ratio of 15 and compression begins at 0.1 MPa, 40°C. The maximum pressure is limited to 6 MPa and the heat added is 1.675 MJ/kg. Compute (i) The heat supplied at constant volume per kg of air (ii) The heat supplied at constant pressure per kg of air (iii) The cycle efficiency (iv) The cut-off ratio (v) The M.E.P of the cycle. **(10 Marks)**

OR

2 a. With the help of line diagram and T-S diagram, explain intercooling and reheating in gas turbine cycles. **(10 Marks)**

b. A gas turbine working on Brayton cycle receives air at 1 bar and 27°C . The air is compresed adiabatically to 6.2 bar with efficiency of the compressor being 88%. The fuel has a heating value of 44180 kJ/kg and the fuel air ratio is 0.017 kg fuel/kg air. The efficiency of the turbine is 90%. Calculate (i) Compressor work (ii) Turbine work and (iii) Thermal efficiency. **(10 Marks)**

Module-2

3 a. Explain the types of feed water heater using flow and T-S diagram. **(10 Marks)**

b. A turbine is supplied with steam at a pressure of 32 bar and temperature of 410°C. The steam then expands isentropically to a pressure of 0.08 bar. Find the dryness fraction at the end of expansion and thermal efficiency of the cycle.
If the steam is reheated at 5.5 bar to a temperature of 400°C and then expanded isentropically to a pressure of 0.08 bar, what will be the dryness fraction and thermal efficiency of the cycle. **(10 Marks)**

OR

4 a. Discuss the effect of condenser pressure and Boiler pressure in Rankine cycle. **(08 Marks)**

b. Write any two desirable characteristics of the working fluid used in vapour power cycle. **(02 Marks)**

c. A 40 MW steam power plant working on Rankine cycle operates between boiler pressure of 4 MPa and condenser pressure of 10 KPa. The steam leaves the boiler and enters the steam turbine at 400°C. The isentropic efficiency of the steam turbine is 85%.
Determine (i) The cycle efficiency (ii) The quality of exhaust steam from the turbine and (iii) the steam flow rate in kg per hour. Consider pumpwork. **(10 Marks)**

Module-3

5 a. Define stoichimetric air, actual air, excess air and combustion efficiency. **(08 Marks)**

b. Calculate the air-fuel ratio for burning of propane (C_3H_8) with 130 percent theoretical air. **(08 Marks)**

c. Explain Detonation in SI engine. **(04 Marks)**

OR

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

b. In a test on a 3-cylinder, 4-stroke IC engine with 22 cm bore and 26 cm stroke, the following were the observations during a trail period of one hour.
Fuel consumption = 8 kg, Calorific value = 45000 kJ/kg
Total revolutions of the Crankshaft = 12000
Mean effective pressure = 6 bar
Net load on brake = 1.5 kN
Brake drum diameter = 1.8 m, Rope diameter = 3 cm
Mass of cooling water = 550 kg
Inlet temperature of water = 27°C
Exit temperature of water = 55°C
Air consumed = 300 kg, Ambient temperature = 30°C
Exhaust gas temperature = 310°C
Specific heat of gases = 1.1 kJ/kg K
Calculate (i) Indicated and brake power (ii) Mechanical efficiency
(iii) Indicated thermal efficiency
Also draw a heat balance sheet on minute and percent basis. **(12 Marks)**

Module-4

7 a. Explain any two factors affecting the performance of a simple vapour compression system. **(06 Marks)**

b. With a neat sketch, explain steam jet refrigeration. **(06 Marks)**

c. A simple vapour compression plant produces 5 tonnes of refrigeration. The enthalpies of the working fluid at inlet to the compressor, at exit of compressor and at exit from the condenser are 183.19 KJ/kg, 209.41 KJ/kg and 74.59 KJ/kg respectively. Estimate (i) The refrigerant flow rate (ii) COP of the plant (iii) Power required to drive the compressor and (iv) the rate of heat rejection in the condenser. Assume that vapour is dry saturated at the end of compression. **(08 Marks)**

OR

8 a. Explain the following: (i) Adiabatic mixing of air (ii) Heating and Humidification (iii) Cooling and dehumidification. **(12 Marks)**

b. The dry and the wet bulb temperature of atmosphere air at 1 atm (101.325 KPa) pressure are measured with a sling psychrometer and determined to be 25 and 15°C respectively. Determine (i) Specific humidity (ii) Relative humidity (iii) The enthalpy of air (iv) DPT. Use properties of table only. **(08 Marks)**

Module-5

9 a. Derive an expression for workdone with clearance volume. **(08 Marks)**

b. A single acting air compressor has a cylinder bore of 15 cm and a piston stroke of 25 cm. The crank speed is 600 rpm. Air taken from atmosphere (1 bar and 27°C) is delivered at 11 bar. Assuming that both the compression and expansion processes are according to the law $PV^{1.25}$ = constant and the clearance is 5%. Determine (i) Power required to drive the compressor, assuming mechanical efficiency as 80% (ii) The time required to deliver 1 m^3 of air as measured at compressor outlet conditions, (iii) Volumetric efficiency. **(12 Marks)**

OR

10 a. Explain the shapes of nozzle. **(06 Marks)**

b. In a 2-stage air compressor, the work output is found to be 350 KJ/kg of air. It is used to compress 1 kg of free air from 1 bar pressure and 32°C initial temperature. The value of n = 1.3 and R = 0.287 KJ/kgK. Find the intermediate pressure. **(06 Marks)**

c. Obtain an expression for volumetric efficiency of compressor. **(08 Marks)**

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CBCS SCHEME

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Fourth Semester B.E. Degree Examination, Aug./Sept.2020
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. Explain the following properties of fluids, state their units of measurements in S.I.
(i) Weight density (ii) Specific volume
(iii) Dynamic viscosity (iv) Kinematic viscosity **(08 Marks)**

b. Explain the phenomenon of capillarity. Obtain an expression for capillarity rise of a liquid. **(06 Marks)**

c. Find the kinematic viscosity of an oil having density 981 kg/m^3. The shear stress at a point in oil is 0.2452 N/m^2 and velocity gradient at that point is 0.2 per second. **(06 Marks)**

OR

2 a. What do you understand by
(i) total pressure
(ii) centre of pressure
(iii) gauge pressure
(iv) vacuum pressure **(08 Marks)**

b. A circular plate 3m diameter is immersed in water in such a way that its greatest and least depth below the free surface are 4m and 1.5m respectively. Determine the total pressure on one face of the plate and position of the centre of pressure. **(06 Marks)**

c. A position of 15696 kN displacement is floating in water. A weight of 245.25 kN is moved through a distance of 8m across the deck of pontoon, which tilts the pontoon through an angle 4°. Find meta centric height of the pontoon. **(06 Marks)**

Module-2

3 a. Distinguish between:
(i) Steady flow and unsteady flow
(ii) Uniform and non-uniform flow
(iii) Laminar and turbulent flow **(06 Marks)**

b. Derive continuity equation for the 3-dimensional flow in Cartesian coordinates. **(08 Marks)**

c. The stream function for a two dimensional flow is given by $\psi = 2xy$. Calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ. **(06 Marks)**

OR

4 a. What is pitot tube? How will you determine the velocity at any point with the help of pitot tube? **(06 Marks)**

b. A horizontal venturimeter with inlet dia 20 cms and throat dia 10 cms is used to measure the flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 60 lit/s. Find the reading of the oil mercury differential manometer. Take $C_d = 0.98$. **(08 Marks)**

c. A pipe of diameter 400 mm carries water at a velocity of 25 m/s. The pressure at the points A and B are given as 29.43 N/cm^2 and 22.563 N/cm^2 respectively. While the datum head at A and B are 28 m and 30 m. Find the loss of head between A and B. **(06 Marks)**

Module-3

5 a. Derive Hagen Poiseuille equation for laminar flow through a circular pipe. **(10 Marks)**

b. An oil of viscosity 0.2 NS/m^2 and specific gravity 0.85 flows through a circular pipe of diameter 75 mm and length 250 m. The rate of flow of oil though the pipe is 5 lps. Find the pressure drop in a length of 250 m and the shear stress at the pipe wall. **(10 Marks)**

OR

6 a. Derive Darcy-Weigh Bach equation for a fluid flow through a pipe. **(10 Marks)**

b. Determine the rate of flow of water through a pipe of diameter 20 cms and length 50 m when one end of the pipe is connected to a tank and the other end of the pipe is open to the atmosphere. The pipe is horizontal and height of water in the tank is 4m above the centre of the pipe. Consider all minor losses and take coefficient of friction f = 0.009. **(10 Marks)**

Module-4

7 a. Define: (i) Drag (ii) Lift (iii) Stream line body
(iv) Bluff body (v) Displacement thickness **(10 Marks)**

b. A flat plate 1.5 m × 1.5 m moves at 50 km/hr in stationary air of density 1.15 kg/m^3. If the coefficients of drag and lift are 0.15 and 0.75 respectively, determine:
(i) the lift force (ii) the drag force
(iii) the resultant force (iv) power required to keep the plate in motion **(10 Marks)**

OR

8 a. Define the terms dimensional analysis and model analysis. **(04 Marks)**

b. What are the methods of dimensional analysis? Describe the Rayleigh method of the dimensional analysis. **(06 Marks)**

c. Using Bucklingham's π-theorem, show that the velocity through a circular orifice is given $V = \sqrt{29H}\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$ where H is the head causing the flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is the mass density and g is acceleration due to gravity. **(10 Marks)**

Module-5

9 a. Define the following terms:
(i) Internal energy (ii) Enthalpy (iii) Mach number
(iv) Subsonic (v) Supersonic **(10 Marks)**

b. A projectile travels at speed of 1500 km/hr at 20°C temperature and 0.1 MPa air pressure. Calculate the Mach number and Mach angle. Take γ = 1.4 for air and R = 287 J/kgK. **(10 Marks)**

OR

10 a. Explain the necessity of CFD. Mention its applications and limitations. **(10 Marks)**

b. Find the Mach number when an aeroplane is flying at 1100 km/hr through still air having a pressure of 7 N/cm^2 and temperature –5°C. Wind velocity may be taken as zero. Take R = 287.14 J/kgK. Calculate the pressure, temperature and density of air at stagnation point on the nose of the plane. Take γ = 1.4. **(10 Marks)**

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CBCS SCHEME

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17ME45B/17MEB405

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
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. How machine tools are classified? **(08 Marks)**
b. With a neat sketch, explain the specification of lathe. **(08 Marks)**
c. Differentiate between upmilling and down milling. **(04 Marks)**

OR

2 a. Draw a neat sketch of a lathe and briefly explain its parts. **(10 Marks)**
b. Draw a neat sketch of a drilling machine and explain construction. **(10 Marks)**

Module-2

3 a. List out the different types of motions in machine tool. **(08 Marks)**
b. Differentiate between shaper and planer machine tool. **(08 Marks)**
c. Explain briefly about the effect of machining parameters. **(04 Marks)**

OR

4 a. List out the different lathe operations. Explain any two of them. **(08 Marks)**
b. List out the different milling operations. Explain Gang-milling and End milling operations. **(08 Marks)**
c. Explain the working principal of cylindrical grinding machine. **(04 Marks)**

Module-3

5 a. Briefly discuss the characteristics of cutting tool materials. **(08 Marks)**
b. With a neat sketch, explain the geometry of single point cutting tool. **(08 Marks)**
c. Mention the functions of cutting fluids. **(04 Marks)**

OR

6 a. List out the different types of cutting tool materials. Explain H.S.S. and cemented carbide. **(08 Marks)**
b. Briefly explain the nomenclature of drill bit with a neat sketch. **(06 Marks)**
c. List out the different types of cutting fluids. Explain any two of them. **(06 Marks)**

Module-4

7 a. Briefly explain the different types of chips formed during metal cutting process. **(08 Marks)**
b. Draw a merchant's circle diagram, mention its notations and state its assumptions. **(08 Marks)**
c. The following details relates to an orthogonal cutting operation. Feed = 1.25mm/rev, chip thickness = 2mm, rake angle of tool = 10°. Calculate the chip thickness ratio and shear angle. **(04 Marks)**

OR

8 a. Explain orthogonal and oblique cutting in metal cutting process. **(08 Marks)**

b. With a neat sketch, explain mechanics of drilling operation. **(06 Marks)**

c. Index 87 divisions on a work piece using compound indexing. **(06 Marks)**

Module-5

9 a. Define tool wear. Explain the forms of tool wear. **(08 Marks)**

b. Explain briefly about different choices to minimize the cost of tool life and production time. **(06 Marks)**

c. A 50mm bar of steel was turned at 284rpm and tool failure occurred after 10min. The speed was changed to 232rpm and the tool failed in 60min of cutting time. What cutting speed should be used to obtain 30min of tool life? **(06 Marks)**

OR

10 a. Briefly discuss about the effect of cutting parameters on tool life. **(08 Marks)**

b. Explain the Taylor's tool life equation. **(06 Marks)**

c. Briefly explain the tool wear mechanisms. **(06 Marks)**

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CBCS SCHEME

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17ME46B/17MEB406

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
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? **(08 Marks)**

b. Explain the necessary sketch the imperial standard yard and highlight the significance of Airy points. **(06 Marks)**

c. What care should be taken for the Metrological Instruments in the laboratory? **(06 Marks)**

OR

2 a. Three 100mm end bars are measured on a level comparator by first wiring them together and comparing with 300mm bar. There was error of 0.03 mm 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 actual dimensions of all end bars. **(08 Marks)**

b. Explain with an example for optical Instrument for angular measurements. **(08 Marks)**

c. Describe with a neat sketch wringing phenomenon of slip gauge. **(04 Marks)**

Module-2

3 a. Define a fit. Explain the types of the fits. **(06 Marks)**

b. Explain the hole basis system and shaft basis system. **(08 Marks)**

c. Write a short notes on Geometric Dimensional Tolerances (GD and T) **(06 Marks)**

OR

4 a. With a neat sketch, explain Johansson Mikrokator. **(08 Marks)**

b. What are comparators? How do they differ from measuring Instruments? **(06 Marks)**

c. Differentiate measuring instruments, gauges and comparators. **(06 Marks)**

Module-3

5 a. Explain the two wire method of measuring the effective diameter of the screw.thread. **(08 Marks)**

b. Derive an expression for the Chordal thickness is measured by using gear tooth vernier caliper. **(08 Marks)**

c. With a sketch show the terminology of spur gear. **(04 Marks)**

OR

6 a. Illustrate the principles of Interferometry with sketch. **(08 Marks)**

b. Explain the latest Trends in Metrology. **(06 Marks)**

c. State the advantages and applications of co-ordinate measuring machine. **(06 Marks)**

Module-4

7 a. Define Measurement. With block diagram explain the working principle of Generalized measurement system with example. **(08 Marks)**

b. Define an Error. How the errors in measurements classified? Give the reasons for each type of Errors. **(06 Marks)**

c. What are transducers? List out advantages and disadvantages of Mechanical transducer. **(06 Marks)**

OR

8 a. Explain the inherent problems observed in mechanical type intermediate modifying device. **(06 Marks)**

b. With a sketch explain the construction and important parts of a cathode ray oscilloscope. **(08 Marks)**

c. With a block diagram explain the general telemetry system. **(06 Marks)**

Module-5

9 a. Explain the working principles of hydraulic dynometer for torque measurements. **(08 Marks)**

b. Sketch and explain the working of a pirani gauge. **(06 Marks)**

c. Explain with sketches working of Proving ring. **(06 Marks)**

OR

10 a. State the laws of thermocouples. **(04 Marks)**

b. Explain the construction and working of optical pyrometer. **(08 Marks)**

c. Define gauge factor. Explain the Wheatstone bridge arrangement for strain measurements. **(08 Marks)**

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CBCS SCHEME

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15ME42

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
Kinematics of Machines

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define:
i) Kinematic pair
ii) Kinematic chain
iii) Mechanism
iv) Structure. **(08 Marks)**

b. State Grashoff's law. Explain with simple sketches three inversions of Grashoff's chain. **(08 Marks)**

OR

2 a. With a neat sketch, explain Whitworth quick return motion mechanism. **(08 Marks)**

b. Sketch and explain Peaucellier mechanism. Also prove that it can be used to trace an exact straight line. **(08 Marks)**

Module-2

3 In the slider crank mechanism shown in Fig.Q.3. the crank rotates at 10r/s, uniformly in clockwise direction. Determine: i) The acceleration of the connecting rod ii) Acceleration of the slider B iii) Acceleration of a point C on connecting rod. The lengths of various links are OA = AC = 200mm AB = 600mm $\angle AOB = 30^{\circ}$ solve by relative method. **(16 Marks)**

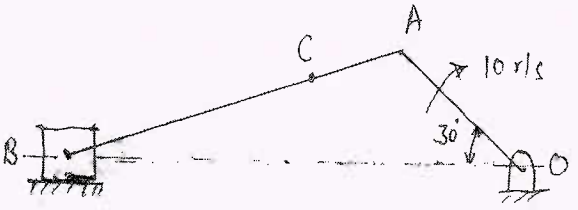

Fig.Q.3

OR

4 a. In a pin jointed four bar mechanism ABCD, the fixed link AD = 600mm, AB = 300mm BC = CD = 360mm and the angle BAD= 60°. The crank AB rotates uniformly at 100rpm. (clockwise) locate all the instantaneous centres and find the angular velocity of the link BC. **(08 Marks)**

b. Draw Klein's construction for single slider crank mechanism and explain how to determine the velocity and acceleration of the slider. **(08 Marks)**

Module-3

5 For the slider crank mechanism, crank rotating uniformly, using complex algebra, derive expressions for the following:
i) Velocity and acceleration of the slider
ii) Angular velocity and angular acceleration of the connecting rod. **(16 Marks)**

OR

6 Design a four link mechanism when motions of the input and the output links are governed by a function $y = x^2$ and x varies from 0 to 2 with no error at x = 0, 1 and 2. Assume angular position of input link θ to vary from 50° to 150° and angular position of output link ϕ vary from 80° to 160°. Assume the length of fixed link as 100mm. **(16 Marks)**

Module-4

7 a. Define: i) Module ii) Circular pitch iii) Backlash. **(06 Marks)**

b. Two spur gears have 24 and 30 teeth of module = 10mm, standard addendum = 1 module and pressure angle = 20°. Determine:

i) Length of path of contact
ii) Length of arc of contact
iii) Contact ratio. **(10 Marks)**

OR

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

b. In the epicyclic gear train shown in Fig.Q.8(b), the internal gear D is fixed and the sun gear A rotates at 120rpm CCW direction. The number of teeth on gear A, B and C are 60, 40 and 25 respectively. Determine the speed and sense of the arm E. **(10 Marks)**

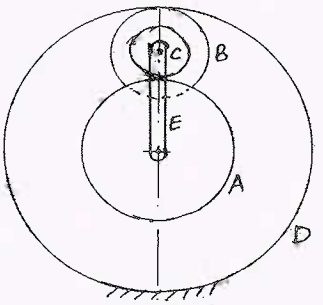

Fig.Q.8(b)

Module-5

9 Draw the profile of the cam to give the following motion to a flat faced reciprocating follower:

i) Follower to raise through 24mm during 150° of the cam rotation with SHM.
ii) Follower to dwell for the next 30° of the cam rotation.
iii) Follower to return to the initial position during 90° of the cam rotation with SHM.
iv) Follower to dwell for the remaining 90° of cam rotation.

Take the minimum radius of the cam as 25mm. **(16 Marks)**

OR

10 The following data relate to a symmetrical circular cam operating a flat faced follower:
Minimum radius of the cam = 40mm
Lift = 24mm, angle of lift = 75°
Nose radius = 8mm
Speed of the cam = 420rpm
Determine the main dimensions of the cam and the acceleration of the follower at the

i) Beginning of the lift
ii) End of contact with circular flank
iii) Beginning of contact with the nose
iv) Apex of the nose. **(16 Marks)**

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CBCS SCHEME

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15ME43

Fourth Semester B.E. Degree Examination, Aug./Sept. 2020
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 thermodynamic data book and steam table is permitted.***

Module-1

1 a. Define :
(i) Compression ratio.
(ii) Mean effective pressure.
(iii) Expansion ratio.
(iv) Cut-off ratio. **(08 Marks)**

b. Derive an equation of Air-standard efficiency of diesel cycle with PV and TS diagrams. **(08 Marks)**

OR

2 a. With a neat sketch, explain the working operation of rocket engine. **(06 Marks)**

b. A simple gas turbine plant operating on the brayton cycle has air entering the compressor at 100 KPa and 27°C. The pressure ratio is 9.0 and maximum cycle temperature is 727°C. What will be the percentage change in efficiency and net work output if the expansion in the turbine is divided into two stages each of pressure ratio 3.0 with intermediate reheating to 727°C. Assume compression and expansion are ideal isentropic. **(10 Marks)**

Module-2

3 a. List out the comparison of Rankine cycle and Carnot cycle. **(06 Marks)**

b. What is reheating? With a schematic diagram and PV and TS diagrams, explain the working of reheat cycle and derive an equation of efficiency of the same. **(10 Marks)**

OR

4 a. In a single heater regenerative cycle the steam enters the turbine at 30 bar, 400°C and the exhaust pressure is 0.10 bar. The feedwater heater is a direct contact type which operates at 5 bar. Find (i) The efficiency (ii) steam rate of the cycle. Neglect pump work done. **(12 Marks)**

b. Draw the schematic diagram of Rankine cycle with PV and TS diagrams. **(04 Marks)**

Module-3

5 a. Calculate the theoretical Air-Fuel Ratio [AFR] for the combustion of C_8H_{18} . **(08 Marks)**

b. Define the following:
(i) Combustion efficiency.
(ii) Enthalpy of formation.
(iii) Adiabatic flame temperature.
(iv) Excess air. **(08 Marks)**

OR

6 a. In a test on a three cylinder four stroke I.C.engine with 22 cm bore and 26 cm stroke the following observation were made during a trial period one hour:
Fuel consumption = 8 kg ; Air consumed = 300 kg; Ambient temperature = 30°; Calorific value = 45,000 kJ/kg ; Net load on brake = 1.5 kN; Brake drum dia = 1.8 m;
Rope diameter = 3 cm; Mass of cooling water = 550 kg; Inlet and outlet temperature of water = 27°C and 55°C rescpectively. Exhaust gas temperature = 310°C; Cp = for exhaust gas = 1.1 $\frac{kJ}{kgK}$. Calculate IP, BP, η_m, η_{IT} and draw heat balance sheet in $\frac{kJ}{min}$ and %. **(12 Marks)**

b. What is detonation and explain the factors affecting detonation. **(04 Marks)**

Module-4

7 a. Sketch and explain the Vapor-Compression refrigeration system. With PV and T-S diagram. **(08 Marks)**

b. Compare vapour compression and vapour absorption refrigeration system. **(08 Marks)**

OR

8 a. Define the following:
(i) DBT.
(ii) Relative humidity.
(iii) Specific humidity.
(iv) Degree of saturation. **(08 Marks)**

b. Moisture air at 35°C has a dew point of 15°C. Calculate the relative humidity, specific humidity and enthalpy. **(08 Marks)**

Module-5

9 a. Derive an equation for minimum work by two stage compressor with perfect inter cooling. **(08 Marks)**

b. Air at 1 bar and 27°C is compressed to 7 bar by a single stage reci-procating air compressor according to the law $PV^{1.3} = C$. The free air delivered is 1 m^3/min. Speed of compressor 300 rpm. Stroke to bore ratio 1.5 : 1, Mechanical efficiency 85% and motor efficiency 90% determine,
(i) Indicated power and isothermal efficiency.
(ii) Cylinder dimensions.
(iii) Power of the motor. **(08 Marks)**

OR

10 a. Define critical pressure ratio for maximum discharge and obtain the expression of critical pressure ratio. **(08 Marks)**

b. Steam approaches a nozzle with a velocity of 250 m/s, 3.5 bar absolute pressure and dryness fraction 0.95. If the back pressure is 2 bar, assuming flow to be isentropic, find the final condition and drop in enthalpy of steam. Also find the exit velocity and the area at exit of the nozzle if the flow rate is 2700 kg/hr. **(08 Marks)**

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CBCS SCHEME

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15ME44

Fourth Semester B.E. Degree Examination, Aug./Sept. 2020
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. Give reasons:
- (i) Viscosity of liquids varies with temperature.
- (ii) Thin objects float on free surface of static fluid.
- (iii) Meta centric height determines stability of floating body.
- (iv) Rise of water in a capillary tube.
- (v) Mercury is used as manometric fluid.
- (vi) Free surface of water in capillary tube is concave. **(06 Marks)**

b. The space between two square flat parallel plates is filled with oil. Each side of the plates is 800 mm. Thickness of the oil film is 20 mm. The upper plate moves at a uniform velocity of 3.2 m/s. When a force of 50 N applied to upper plate. Determine
- (i) Shear stress.
- (ii) Dynamic viscosity of oil in poise.
- (iii) Power absorbed in moving the plate.
- (iv) Kinematic viscosity of oil, if specific gravity of oil is 0.90 **(10 Marks)**

OR

2 a. Derive equation for total pressure and centre of pressure for a plane surface immersed vertically in a static mass of fluid. **(08 Marks)**

b. A wooden block of specific gravity 0.75 floats in a water. If the size of the block is $1m \times 0.5m \times 0.4m$. Find its metacentric height. **(08 Marks)**

Module-2

3 a. Distinguish between:
- (i) Uniform and Non-uniform flows.
- (ii) Compressible and incompressible flows.
- (iii) Rotational and irrotational flows.
- (iv) Laminar and turbulent flows. **(08 Marks)**

b. Velocity potential function for a two dimensional fluid flow is given by $\phi = x(2y-1)$. Check the existence of flow. Determine the velocity of flow at P(2, 3) and the stream function. **(08 Marks)**

OR

4 a. Derive an expression for discharge through rectangular notch. **(08 Marks)**

b. A pipe line is carrying an oil of specific gravity 0.87, the diameter of the pipe changes from 200 mm at section 'A' to 500 mm at section B which is 4 m higher than A. If the pressure at A and B is 100 kPa and 60 kPa respectively and if the discharge is 200 kg/sec. Determine (i) loss head (ii) flow direction. **(08 Marks)**

Module-3

5 a. Prove that the ratio of maximum velocity to average velocity in a viscous flow of fluid through a circular pipe is 2.0. **(08 Marks)**

b. Calculate (i) The pressure gradient along flow, (ii) The average velocity (iii) The discharge for an oil of viscosity 0.02 N-S/m^2 flowing between two stationary parallel plates 1 m wide maintained 10 mm apart. The velocity midway between the plates is 2 m/s. **(08 Marks)**

OR

6 a. Derive Darcy-Weisbach equation for determining loss of head due to friction in a pipe. **(08 Marks)**

b. Identify and explain any four minor losses in pipes. **(08 Marks)**

Module-4

7 a. Explain the methods to control the boundary layer separation. **(08 Marks)**

b. The experiments were conducted in a wind tunnel with a wind speed of 50 km/hr on a flat plate of size 2 m long and 1 m wide. The density of air is 1.15 kg/m^3. The coefficients of lift and drag are 0.75 and 0.15 respectively.

Determine : (i) The lift force (ii) The drag force

(iii) The resultant force (iv) Power exerted by air on the plate **(08 Marks)**

OR

8 a. Explain the difference between stream line body and bluff body. **(06 Marks)**

b. The pressure difference ' ΔP ' for a viscous flow in a pipe depends upon the diameter of the pipe D, length of pipe L, velocity of flow 'V', viscosity of fluid 'μ' and the density of fluid 'ρ'. Using Buckingham's theorem. Show that the relation for pressure difference ' ΔP ' is given by,

$$\Delta P = \rho V^2 f\left[\frac{1}{R_e}, \frac{L}{D}\right]$$ **(10 Marks)**

Module-5

9 a. Show that the velocity of sound wave in compressibe fluid medium is given by, $C = \sqrt{\frac{P}{\rho}}$ for isothermal process. **(10 Marks)**

b. Find the sonic velocity for the following fluids:

(i) Crude oil of Specific gravity 0.8 and bulk modulus is 153036 N/cm^2.

(ii) Mercury having a bulk modulus of 2648700 N/cm^2. **(06 Marks)**

OR

10 a. Show that the stagnation temperature and static temperature related by $\frac{T_0}{T} = 1 + \frac{(\gamma - 1)}{2}.M^2$ where $\gamma = \frac{C_p}{C_v}$, M = Mach number **(08 Marks)**

b. Explain the applications of CFD and philosophy behind it. **(08 Marks)**

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CBCS SCHEME

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15ME46B/MEB406

Fourth Semester B.E. Degree Examination, Aug./Sept.2020
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define Metrology and state any two of its objectives. **(04 Marks)**

b. Discuss any two characteristics of line and end standards. **(04 Marks)**

c. Three 200mm gauges to be calibrated are measured on a level comparator by wringing them together and then comparing them with a 600mm gauge. The 600mm gauge has an actual length 600.0025mm and the three gauges together have a combined length of 600.0035mm. When the three gauges are inter-compared. It is found that gauge A is longer than gauge B by 0.0020mm but shorter than gauge C by 0.001mm. Determine the length of each gauge. **(08 Marks)**

OR

2 a. What is meant by wringing of slip gauges? **(02 Marks)**

b. Explain how conical work pieces are inspected on a Sine centre. **(08 Marks)**

c. What are angle gauges? Select the sizes of angle gauges required to build 57^0 34′ 9″. **(06 Marks)**

Module-2

3 a. What do you mean by Interchangeable manufacture? **(02 Marks)**

b. It is possible to drill a 25mm nominal hole to an accuracy of 25 ± 0.02mm using standard drill and drilling machine available. A shaft is to be machined to obtain a clearance fit in the above hole such that allowance should be 0.01mm and maximum clearance should not be more than 0.08mm. What should be the Tolerance on the shaft? **(06 Marks)**

c. State and explain Taylor's principle of gauge design. **(08 Marks)**

OR

4 a. Name any two functional requirements of a comparator. **(02 Marks)**

b. Sketch and explain dial Indicator. **(06 Marks)**

c. Explain with a sketch, the working of a SOLEX Pneumatic comparator. **(08 Marks)**

Module-3

5 a. What do you mean by Best size wire? **(02 Marks)**

b. Derive an expression for effective diameter of screw thread by Two – wire method. **(08 Marks)**

c. Sketch and explain Gear roll tester for composite error. **(06 Marks)**

OR

6 a. State any two advantages of laser. **(02 Marks)**

b. State any four applications of CMM. **(04 Marks)**

c. Give the constructional details and working principle of CMM. **(10 Marks)**

Module-4

7 a. Distinguish between Accuracy and Precision. **(02 Marks)**

b. Explain with necessary block diagram the elements of generalized measurement system. **(08 Marks)**

c. Explain the classification of errors in measurement. **(06 Marks)**

OR

8 a. State any two inherent problems of mechanical system. **(02 Marks)**

b. Explain briefly the ballast circuit. **(06 Marks)**

c. Sketch and explain Cathode ray oscilloscope. **(08 Marks)**

Module-5

9 a. What is the fundamental difference between direct and indirect method of force measurement? **(02 Marks)**

b. With a neat sketch, explain the working principle of analytical balance. **(07 Marks)**

c. Explain the principle of working of McLeod gauge, with a neat sketch. **(07 Marks)**

OR

10 a. Define the term gauge factor. **(02 Marks)**

b. Explain with a neat sketch, measurement of strain using Wheat Stone Bridge circuit. **(08 Marks)**

c. State and explain three laws of thermocouple. **(06 Marks)**

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15ME32

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Material Science

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following : i) Unit cell ii) Lattice iii) Space lattice iv) Co-ordination number v) Automic packing factor. **(05 Marks)**

b. Differentiate between Edge and Screw dislocation. **(05 Marks)**

c. Explain factors affecting diffusion. **(06 Marks)**

OR

2 a. Explain surface defects with neat sketches. **(05 Marks)**

b. Explain cup and cone fracture, with neat sketch. **(05 Marks)**

c. Explain with neat stress – strain diagram, the mechanical properties of a material in plastic range. **(06 Marks)**

Module-2

3 a. Explain solidification in pure metals. **(05 Marks)**

b. Define Solid Solutions. Explain the types of solid solutions. **(05 Marks)**

c. What is Hume Rothay's rule? Explain all the rules of Hume Rother's. **(06 Marks)**

OR

4 a. Lead (P_b) melts at 323^0C and tin (S_n) melts at 232^0C. Additions of S_n to P_b lowers the melting point Pb and addition of P_b to S_n also lowers the melting point of S_n at 180^0C, Liquid of composition 61.9 % S_n , alpha (α) phase of composition 19.2 % S_n and beta (β) phase of composition 96.2 % S_n are in thermal equilibrium. The solubilities of P_b in S_n and S_n in P_b at room temperature are negligible.

i) Draw the $P_b - S_n$ diagram ii) Identify the reactions occurring at 180^0C

iii) Calculate the amount of phases in an alloy of composition 40% S_n at 1790^0C. **(08 Marks)**

b. Draw the neat sketch of Iron – Carbon diagram. Indicate all phases and explain 3 invariant reactions. **(08 Marks)**

Module-3

5 a. Explain T – T – T diagram for eutectoid steel. **(08 Marks)**

b. With a neat diagram, explain continuous cooling transformation diagram. **(08 Marks)**

OR

6 a. Define Heat treatment. List its objectives. **(05 Marks)**

b. Write the classification of heat treatment. **(05 Marks)**

c. Explain age hardening heat treatment for non – ferrous materials. **(06 Marks)**

Module-4

7 a. What are Ceramics? List and explain processing of ceramics. **(07 Marks)**

b. Explain mechanical properties of ceramics. **(05 Marks)**

c. List advantages and applications of ceramics. **(04 Marks)**

OR

8 a. What are Plastics? List processing of thermoplastics and explain any one method. **(07 Marks)**

b. Explain in brief the selection of engineering materials. **(05 Marks)**

c. Explain NDT method for Residual life assessment. **(04 Marks)**

Module-5

9 a. Define Composite Materials. List their classification based on matrix and reinforced constituents. **(07 Marks)**

b. Differentiate between thermoset and thermoplastic materials. **(05 Marks)**

c. Write a note on Metal Matrix Materials. **(04 Marks)**

OR

10 a. List and explain various fibers used in preparation of composite materials. **(07 Marks)**

b. Explain Powder metallurgy technique of production of composite materials. **(05 Marks)**

c. With neat sketch, explain Squeeze casting. **(04 Marks)**

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15ME33

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Basic Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer FIVE full questions, choosing one full question from each module.***
2. ***Use of thermodynamic data hand book is permitted.***

Module-1

1 a. Distinguish between the following:
(i) Microscopic and macroscopic point of view of thermodynamics.
(ii) Extensive and Intensive properties. **(05 Marks)**

b. Define the zeroth law of thermodynamics. A constant volume gas thermometer containing Helium gives a reading of gas pressure 'P' of 1000 mmHg and 1366 mmHg at icc point and steam point respectively. Assuming a linear relationship of the form, $t = \alpha + \beta P$, express the gas thermometer Celcius temperature 't' in terms of gas pressure 'P'. What is the temperature recorded by the thermometer when it registers a pressure of 1074 mmHg? **(06 Marks)**

c. Explain the thermodynamic definition of work with a suitable diagram. **(05 Marks)**

OR

2 a. Explain thermodynamic equilibrium concept. **(05 Marks)**

b. Deduce the expression for work in case of shaft work and electrical work. **(05 Marks)**

c. The combustion gases of an IC engine expand with in an enclosed piston and cylinder arrangement and follow the path $PV^{1.6} = C$. The pressure at the beginning of the power stroke is 5 MPa and volume 50 cm^3. At the end of the stroke the volume is 1500 cm^3. Calculate (i) The work developed during power stroke (ii) Average power developed by the gas if there are 20 power strokes per second. **(06 Marks)**

Module-2

3 a. Explain the Joule's experiment and describe how it leads to the foundation of first law of thermodynamics. **(05 Marks)**

b. A nozzle is used to convert enthalpy into kinetic energy. Air enters the nozzle at a pressure of 2700 KPa at a velocity of 30 m/s with an enthalpy of 923 KJ/kg and leaves with a pressure of 700 KPa and enthalpy of 660 KJ/kg. (i) If the heat loss is 0.96 KJ and mass flow rate is 0.2 kg/s, find the exit velocity (ii) Find the exit velocity for adiabatic conditions. **(07 Marks)**

c. State both Kelvin Planck and Clausius statements of thermodynamics. **(04 Marks)**

OR

4 a. Explain PMMI and PMMII with suitable diagrams. **(06 Marks)**

b. A reversible heat engine operates between two reservoirs at temperatures of 600°C and 40°C. The engine drives a reversible refrigerator which operates between the reservoir at temperature of 40°C and $-20^{\circ}C$. The heat transfer to the heat engine is 2000 KJ and the network output of the combined engine refrigerator plant is 360 KJ. Evaluate the heat transfer to the refrigerator and net heat transfer to the reservoir at 40°C. **(07 Marks)**

c. Comment on the limitations of the first law of thermodynamics. **(03 Marks)**

Module-3

5 a. What are the factors, that makes a process irreversible? **(05 Marks)**

b. Derive Clausius inequality and comment on its outcome. **(05 Marks)**

c. A heat engine is shown in the Fig. Q5 (c) where 10000 KJ/hr of heat is supplied from source at 1400°C while the working fluid is at 540°C. 8000 KJ/hr of heat is rejected to a sink at temperature 5°C and working fluid is at 60°C. Calculate the following:

(i) Actual efficiency of the engine.

(ii) Fraction of the actual efficiency of the internally reversible efficiency.

(iii) Fraction of actual efficiency of the external reversible efficiency. **(06 Marks)**

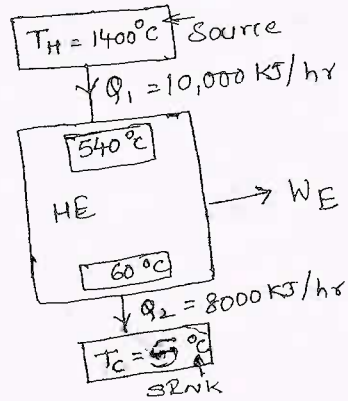

Fig. Q5 (c)

OR

6 a. Prove that entropy is a property. **(05 Marks)**

b. A closed system contains air at pressure 1 bar, temperature 290 K and volume 0.02 m^3. The system undergoes a thermodynamic cycle consisting of the following three processes: (i) Process 1 – 2 : constant volume heat addition till the pressure becomes 4 bar. (ii) Process 2 – 3 : Constant pressure cooling (iii) Process 3 – 1 : Isothermal heating to initial state. Represent the cycle in T-S and P-V plot. Evaluate the change of entropy for each case. Take C_v = 718 J/kg K, R = 287 J/kgK. **(07 Marks)**

c. Write a comment on thermodynamic temperature scale. **(04 Marks)**

Module-4

7 a. Explain the concept of availability and unavailability. **(04 Marks)**

b. Explain the working of throttling calorimeter with a neat diagram. **(05 Marks)**

c. Find the maximum work/kg of air that can be obtained from a piston cylinder arrangement if the air expands from the initial state of $P_1 = 6$ bar, $t_1 = 170^\circ C$ to a final pressure of $P_2 = 1.4$ bar, $t_2 = 60°C$. Neglecting changes in KE and PE and assuming $t_0 = 15^\circ C$, calculate the availability in the initial and final states.
Compare the two results $(C_P)_{air}$ = 1.005 KJ/kgK, R = 287 J/kg K. **(07 Marks)**

OR

8 a. Explain the PT diagram of a pure substance with all necessary points on it. **(05 Marks)**

b. Show that the change in availability is equal to the change in Gibbs function when the temperature and pressure of the system are constant. **(05 Marks)**

c. Steam from a boiler is delivered at 15 bar absolute and dryness fraction of 0.85 into a steam super heater where an additional heat is added at constant pressure. Steam temperature now increases to 573K. Determine amount of heat added and change in internal energy for unit mass of steam. **(06 Marks)**

Module-5

9 a. Explain the Amagat's law of additive volume. **(05 Marks)**

b. State Vander Waal's equation of state and Beattie-Bridgeman equation. **(05 Marks)**

c. The air at DBT 28°C and 1 bar has a specific humidity of 0.016 kg per kg of dry air. Determine

(i) Partial pressure of water vapour.

(ii) Relative humidity.

(iii) Dew point temperature. **(06 Marks)**

OR

10 a. Explain the Dalton's law of partial pressures. **(04 Marks)**

b. Determine the pressure exerted by oxygen in a container of 2 m^3 capacity when it contains 5 kg at 27°C using (i) Ideal gas equation (ii) Vander Waals equation.

Take $a = 139.250 \ \frac{kNm^4}{(kgmole)^2}$; $b = 0.0314 \ \frac{m^3}{kgmole}$. **(07 Marks)**

c. Write short note on compressibility chart and its usefulness. **(05 Marks)**

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15MEB306/15ME36B

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain the objectives of Metrology. **(05 Marks)**

b. With a neat sketch explain international prototype metre. **(06 Marks)**

c. A calibrated metre end bar has an actual length of 10000.0003mm. It is to be used in the calibration of two bars A and B, each having a basic length of 500mm. When compared with the metre bar $L_A + L_B$ was found to be shorter by 0.0002mm. In comparing A with B it was found that A was 0.0004mm longer than B. Find the actual length of A and B. **(05 Marks)**

OR

2 a. Using M112 set of slip gauges, build the dimension 49.3115 mm. **(04 Marks)**

b. Explain with neat sketch how a sine bar can be used to measure an unknown angle. **(06 Marks)**

c. Explain principle of autocollimator. **(06 Marks)**

Module-2

3 a. Differentiate between hole basis system and shaft basis system with sketches. **(04 Marks)**

b. Explain the following:
i) Interchangeability
ii) Selective assembly. **(06 Marks)**

c. State and explain Taylor's principle of gauge design. **(06 Marks)**

OR

4 a. Sketch and explain the working of sigma comparator. **(08 Marks)**

b. Explain with a neat sketch, the working of pneumatic comparator. **(08 Marks)**

Module-3

5 a. Define precisely the following terms with respect to screw thread:
i) Pitch ii) Lead iii) Crest of the thread iv) Root of the thread. **(04 Marks)**

b. What is best size wire? Derive an expression for the same. **(06 Marks)**

c. Draw a neat sketch of a tool makers microscope and explain briefly the construction. **(06 Marks)**

OR

6 a. Sketch and explain Michelson interferometer. **(06 Marks)**

b. Explain the basic concepts of coordinate measuring machines. **(06 Marks)**

c. What are the applications of CMM? **(04 Marks)**

Module-4

7 a. Discuss with block diagram generalized measurement system with examples for each stage elements. **(06 Marks)**

b. Explain with sketches:
   i) Hysterisis
   ii) Sensitivity
   iii) Threshold
   iv) Repeatability. **(06 Marks)**

c. Mention any four advantages of electrical transducer elements. **(04 Marks)**

OR

8 a. What are the inherent problems in mechanical systems? **(04 Marks)**

b. Describe in detail a ballast circuit. **(06 Marks)**

c. With a sketch explain the construction and important parts of a CRO. **(06 Marks)**

Module-5

9 a. With a neat sketch explain the working of McLeod gauge. **(08 Marks)**

b. Explain the working principle of prony brake dynamometer with a neat sketch. **(08 Marks)**

OR

10 a. What are the steps in mounting of strain gauges? **(04 Marks)**

b. What is pyrometer? Explain the working of optical pyrometer. **(08 Marks)**

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

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