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21ME42

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Machining Science & Jigs & Fixtures

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. List the operations carried out on drilling machine and explain any 2 operation with neat sketch. **(08 Marks)**

b. Explain the step by step procedure of taper turning operation carried out and lathe machine. **(06 Marks)**

c. Define machining process and explain the classification of material removal process. **(06 Marks)**

OR

2 a. Explain with neat sketch, the construction of horizontal milling machine (column × knee type). **(08 Marks)**

b. Explain the step by step procedure of machining a rectangular slot of 10 mm wide × 5 mm depth on a rectangular block using shaping machine. **(06 Marks)**

c. With neat sketch, explain the following operation :
(i) Straddle milling
(ii) Reaming
(iii) Plain turning **(06 Marks)**

Module-2

3 a. Sketch and explain the tool geometry of a single point cutting tool and highlight the significance of different angles. **(08 Marks)**

b. Explain the various types of cutting fluids used in metal cutting and state the properties of cutting fluids. **(06 Marks)**

c. List out the differences between orthogonal and oblique cutting. **(06 Marks)**

OR

4 a. Briefly explain the different types of chips produced during metal cutting with neat sketches. **(08 Marks)**

b. Explain the steps involved in cutting force measurement with dynamometers for tuning operation. **(06 Marks)**

c. A Seamless tubing 35 mm outside diameter is turned orthogonally on a lathe. The following data is available. Rake angle = 35°, Cutting speed = 15 m/min, Feed = 0.10 mm/rev, Length of continuous chip in one revolution = 50.72 mm. Cutting force = 200 N, Feed force = 80 N. Calculate the co-efficient of friction, shear plane angle, velocity of chip along tool face and chip thickness. **(06 Marks)**

Module-3

5 a. What is machinability? List and explain the variables that affect the tool life. **(08 Marks)**

b. Explain with neat sketch, the principal of lapping. **(06 Marks)**

c. Explain with neat sketch, the principal of honing. **(06 Marks)**

OR

6 a. Explain with a neat sketch, the various forms of tool wear found in the cutting tools. **(08 Marks)**

b. Write a short notes on the following :
(i) Electroplating
(ii) Powder coating.
(iii) Liquid coating. **(12 Marks)**

Module-4

7 a. With neat labeled sketch, explain the working of Abrasive water jet machining along with its application. **(10 Marks)**

b. Explain the process parameters of USM and list the advantages, limitation of it. **(10 Marks)**

OR

8 a. With neat labeled sketch, explain the working principal of electrical discharge machining. List the various in EDM process and explain any one of them process parameters. **(10 Marks)**

b. Explain with neat sketch the working of ultrasonic assisted electric discharge machining along with its advantages. **(10 Marks)**

Module-5

9 a. With neat sketch, explain template jig and leaf jig. **(10 Marks)**

b. State the factors to be considered for the design of jigs and fixtures. **(05 Marks)**

c. List the difference between jigs and fixtures. **(05 Marks)**

OR

10 a. What is jig and fixture? List and explain the essential features of jigs and fixtures. **(10 Marks)**

b. List the different types of fixtures and with neat sketch explain any one type of fixture in detail. **(10 Marks)**

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CBCS SCHEME

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Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
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 terms :
(i) Absolute pressure
(ii) Gauge pressure
(iii) Differential manometers
(iv) Buoyancy
(v) Meta-centre. **(05 Marks)**

b. The left limb of a mercury U-tube manometer is open to atmosphere and the right limb is connected to a pipe carrying water under pressure. The centre of the pipe is at the level of the free surface of mercury. Find the difference in level of mercury limbs of U-tube, if the absolute pressure of water in the pipe is 14.5 m of water, atmospheric pressure is 760 mm of Hg. **(05 Marks)**

c. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(10 Marks)**

OR

2 a. Define the equation of continuity. Derive the continuity equation for the three dimensional flow in Cartesian co-ordinates. **(10 Marks)**

b. If for a two-dimensional potential flow, the velocity potential is given by : $\phi = 4x(3y-4)$, determine the velocity at the point (2, 3). Determine also the value of stream function ψ at the point (2, 3). **(08 Marks)**

c. State Reynold's transport theorem. **(02 Marks)**

Module-2

3 a. Derive Euler's equation of motion along a stream line for an ideal fluid stating clearly the assumptions. Explain how this is integrated to get Bernoulli's equation along a stream line. **(10 Marks)**

b. A pipe 5 m long is inclined at an angle of 15° with the horizontal. The smaller section of the pipe which is at a lower level is of 80 mm diameter and the larger section of the pipe is of 240 mm diameter. Determine the difference of pressure between the two sections, if the pipe is uniformly tapering and the velocity of water at the smaller section is 1 m/s. **(06 Marks)**

c. A jet of water of diameter 100 mm strikes a curved plate at its centre with a velocity of 15 m/s. The curved plate is moving with a velocity of 7 m/s in the direction of the jet. The jet is deflected through an angle of 150°. Assuming the plate smooth find :
(i) Force exerted on the plate in the direction of the jet.
(ii) Power of the jet. **(04 Marks)**

OR

4 a. Define an orifice-meter. Prove that the discharge through an orifice-meter is given by the relation $Q = C_d \frac{a_0 a_1}{\sqrt{a_1^2 - a_0^2}} \times \sqrt{2gh}$. **(10 Marks)**

b. Water flows over a rectangular notch 1 m wide with a head of 15 cm and afterwards passes through a triangular (V notch) of 90°. Taking C_d for the rectangular and V-notch as 0.62 and 0.59 respectively. Find the head over the triangular notch. **(06 Marks)**

c. With a neat sketch, explain Rota meter. **(04 Marks)**

Module-3

5 a. Prove that the maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow. Also derive Hagen Poiseuille's formula. **(10 Marks)**

b. Determine :

(i) The pressure gradient,

(ii) The shear stress at the two horizontal plates.

(iii) The discharge per metre width for Laminar flow of oil, with a maximum velocity of 2 m/s between two plates which are 150 mm apart. Given $\mu = 2.5$ N-S/m^2. **(06 Marks)**

c. The external and internal diameters of a collar bearing are 200 mm and 150 mm respectively. Between the collar surface and the bearing, an oil film of thickness 0.25 mm and of viscosity 0.09 N-S/m^2 is maintained. Find the torque and the power lost in overcoming the viscous resistance of the oil when the shaft is running at 250 rpm. **(04 Marks)**

OR

6 a. Derive Darcy-Weisbach equation for loss of head due to friction in pipes. **(08 Marks)**

b. A horizontal pipe line 50 m long is connected to a reservoir at one end and discharges freely in to the atmosphere at the other end. For the first 25 m length from the reservoir the pipe has a diameter of 15 cm and it has a square entrance at the reservoir. The remaining 25 m length of pipe has a diameter of 30 cm. The junction of the two pipes is in the form of a sudden expansion. The 15 cm pipe has a gate valve ($K = 0.2$) in fully open condition. If the height of the water surface in the tank is 10 m above the center line of the pipe, estimate the discharge in the pipe by considering the Darcy-Weisbach friction factor $f = 0.02$ for both the pipes. (Include all minor losses in the calculations). **(08 Marks)**

c. Two tanks are connected with the help of two pipes in series. The lengths of the pipes are 1000 m and 800 m where as the diameters are 400 mm and 200 mm respectively. The co-efficient of friction for both the pipes is 0.008. The difference of water level in the two tanks is 15 m. Find the rate of flow of water through the pipes. Considering all losses. **(04 Marks)**

Module-4

7 a. Define the terms : (i) Lift (ii) Drag. **(04 Marks)**

b. Obtain an expression for the lift produced on a rotating cylinder placed in a uniform flow field such that the axis of the cylinder is perpendicular to the direction of flow. **(10 Marks)**

c. A Jet plane which weighs 19620 N has a wing area of 25 m^2. It is flying at a speed of 200 km/hour. When the engine develops 588.6 kW, 70% of this power is used to overcome the drag resistance of the wing. Calculate the co-efficient of lift and co-efficient of drag for the wing. Taken density of air as 1.25 kg/m^3. **(06 Marks)**

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21ME44

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
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) True stress
ii) Poisson's ratio
iii) Stiffness
iv) Volumetric strain. **(04 Marks)**

b. Derive the expression for the total elongation of a tapered circular bar cross-section of diameter 'd_1' and 'd_2' when subjected to an axial load 'P'. **(08 Marks)**

c. A steel bolt of 16mm diameter passes centrally through a copper tube of internal diameter 20mm and external diameter 30mm. The length of the whole assembly is 500mm. After tight fitting of the assembly, the nut is over tightened by quarter $\left(\frac{1}{4}\text{th}\right)$ of a turn. What are the stresses introduced in bolt and tube. If pitch of nut is 2mm. Take E_{steel} = 200GPa and E_{copper} = 120GPa. **(08 Marks)**

OR

2 a. State Hooke's law. Sketch the typical stress-strain curve for mild-steel specimen during tension test. Show the salient points on the graph and briefly explain them. **(10 Marks)**

b. Define Young's modulus and rigidity modulus. Derive relation between Young's modulus (E) and rigidity modulus (G). **(10 Marks)**

Module-2

3 a. Derive the expressions for normal and tangential stress on a plane inclined at 'θ' to the plane of stress in x-direction in a general two dimensional stress system and show that sum of normal stress in any two mutually perpendicular directions is constant. **(12 Marks)**

b. The state of stress in a two dimensionally stressed body is shown in Fig.Q.3(b). Determine graphically (by drawing Mohr's circle), the principal stresses, principal planes, maximum shear stress and its planes. **(08 Marks)**

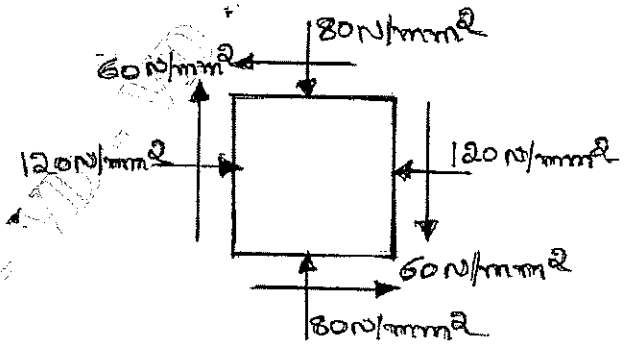

Fig.Q.3(b)

OR

4 The state of stress at a point in a strained material is shown in Fig.Q.4(a). Determine:
i) The direction of the principal planes.
ii) The magnitude of principal stresses.
iii) The magnitude of the maximum shear stress and its direction.
iv) Draw Mohr's circle and verify the results obtained analytically. **(20 Marks)**

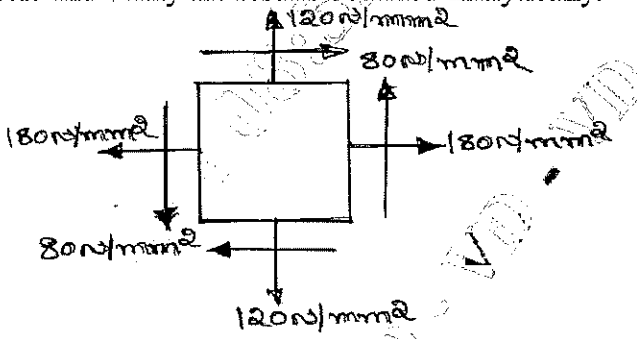

Fig.Q.4

Module-3

5 a. Define a beam. Explain with simple sketches, different types of beams. **(06 Marks)**
b. Draw the shear force and bending moment diagrams for the overhanging beam, carrying uniformly distributed load of 2kN/m over the entire length and a point load of 2kN as shown in Fig.Q.5(b). Locate the point of contra-flexure. **(14 Marks)**

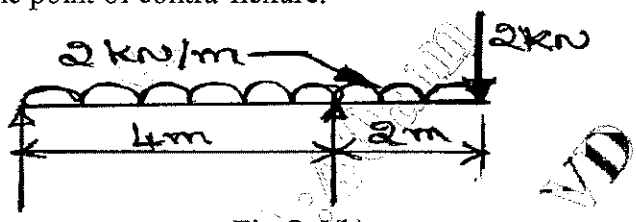

Fig.Q.5(b)

OR

6 Draw shear force and bending moment diagrams for the beam shown in Fig.Q.6. Locate the point of contraflexure. **(20 Marks)**

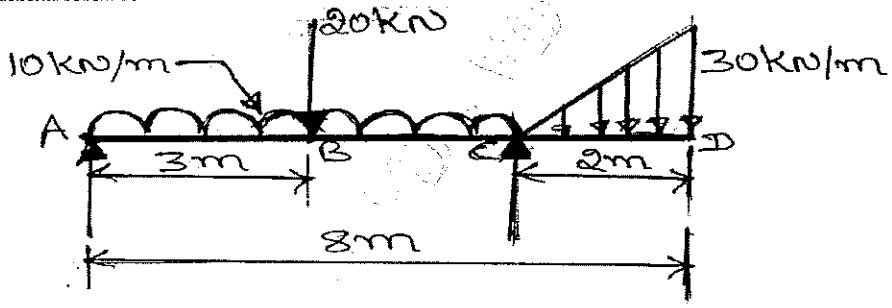

Fig.Q.6

Module-4

7 a. Prove the relation $\frac{M}{I}=\frac{\sigma}{Y}=\frac{E}{R}$ with usual notations. **(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)**

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21ME53

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Finite Element Analysis

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 basic steps involved in finite method for structural analysis. **(10 Marks)**

b. Define plane stress and plane strains with example and write stress strain relations. **(10 Marks)**

OR

2 a. Explain node numbering scheme. **(10 Marks)**

b. What are simplex, complex and multiplex elements? **(05 Marks)**

c. Write a note on Convergence Criteria. **(05 Marks)**

Module-2

3 a. Derive linear interpolation polynomial for 1-D bar element in local coordinates. **(10 Marks)**

b. Derive shape functions for 2D – Constant Strain Triangular (CST) element in local coordinates. **(10 Marks)**

OR

4 The bar shown in Fig.Q4, an axial load P = 200×10^3 N is applied as shown, using elimination approach for handling boundary conditions. Determine (i) nodal displacements (ii) stress in the elements (iii) reactions at the support.

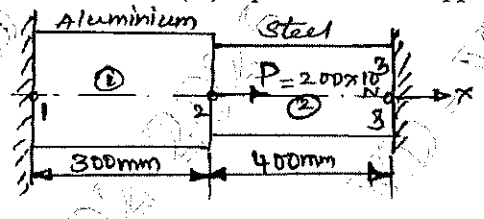


Fig.Q4

$E_1 = 70\times10^9$ N/m^2
$E_2 = 200\times10^9$ N/m^2

$A_1 = 2400$ mm^2
$A_2 = 600$ mm^2

(20 Marks)

Module-3

5 a. Derive Hermite Shape function for beam element. **(10 Marks)**

b. A cantilever beam of span 1 m is subjected to a UDL of 5 KN/m and a point load of 2 KN as shown in Fig.Q5(b). E = 200 GPa, I = 4×10^{-6} m^4.
Find (i) Deflections at the ends (ii) Reactions at the support.

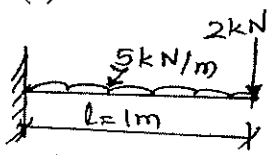


Fig.Q5(b) **(10 Marks)**

OR

6 a. Derive stiffness matrix equation for torsion of shaft. **(10 Marks)**

b. A solid stepped bar of circular cross section as shown in Fig.Q6(b), is subjected to a torque of 1 KN-m at its free end a torque of 3 KN-m at its change in cross-section. Determine the angle of twist in the bar. Take $E = 2 \times 10^5$ MPa, $G = 7 \times 10^4$ MPa.

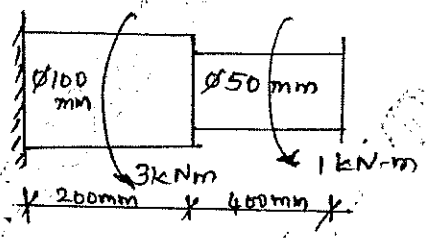


Fig.Q6(b) **(10 Marks)**

Module-4

7 a. Define element convection matrix for a one-dimensional uniform fin. **(08 Marks)**

b. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convective heat transfer coefficient as shown in Fig.Q7(b). The ambient temperature is – 5°C.

$K_1 = 6$ W/m °C
$K_2 = 20$ W/m °C

$T_\infty = -5$°C
$T_1 = 20$°C
$h = 1000$ W/m °C

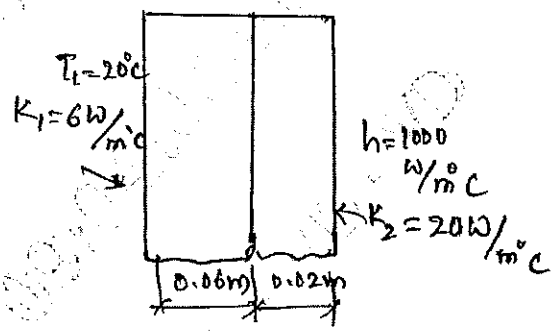


Fig.Q7(b) **(12 Marks)**

OR

8 a. Derive stiffness matrix for flow through porous medium. **(06 Marks)**

b. For smooth pipe of variable c/s shown in Fig.Q8(b). Determine potential at junctions, velocities in each section of pipe and volumetric flow rate. Potential at left end $P_1 = 10$ m^2/s right end $P_4 = 1$ m^2/sec, fluid flow through pipe $K_x = 1$.

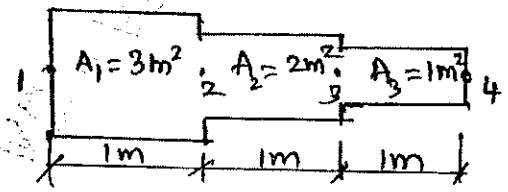
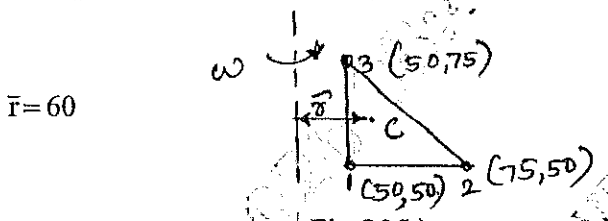


Fig.Q8(b) **(14 Marks)**

Module-5

9 a. Derive stiffness matrix of axisymmetric bodies with triangular elements. **(10 Marks)**

b. For the element of an axisymmetric body rotating with constant angular velocity $\omega = 1000$ rev/min as shown in Fig.Q9(b). Determine the body force vector including weight of material with specific density is 7850 kg/m^3.



$\bar{r} = 60$

Fig.Q9(b) **(10 Marks)**

OR

10 a. Derive consistent mass matrix of
(i) Bar element (2 - noded)
(ii) Truss element **(10 Marks)**

b. For the stepped bar shown in Fig.Q10(b), determine the eigen values. Take $A_1 = 400$ mm^2 ; $A_2 = 200$ mm^2. Specific weight density = 7850 kg/mm^3. E = 200 GPa.

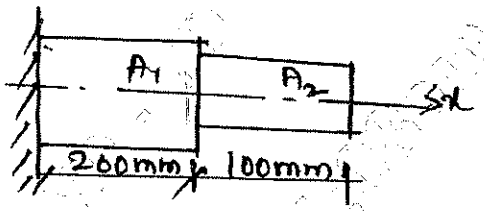


Fig.Q10(b) **(10 Marks)**

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21ME54

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Modern Mobility and Automotive 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 History of Automobile. **(06 Marks)**

b. List the components of automotive engine. Mention their functions and material used for manufacturing. **(08 Marks)**

c. With a neat sketch, explain working of thermosyphon cooling system. **(06 Marks)**

OR

2 a. Classify the automobiles with respect to usage power source and capacity. **(06 Marks)**

b. Explain dry sump lubrication system with neat sketch. **(08 Marks)**

c. What is engine management system? Explain. **(06 Marks)**

Module-2

3 a. Explain centrifugal clutch with neat sketch. **(06 Marks)**

b. With sketch explain three speed synchromesh transmission. **(08 Marks)**

c. Draw the schematic diagram showing the layout of an air suspension system and describe the same. **(06 Marks)**

OR

4 a. Explain fluid flywheel with neat sketch. **(07 Marks)**

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

c. Explain telescopic shock absorber with a neat sketch. **(05 Marks)**

Module-3

5 a. With necessary sketch, explain the steering linkages used for independent suspension. **(07 Marks)**

b. Draw the layout of a hydraulic braking system and show the arrangement of various components. **(07 Marks)**

c. Explain working of airbags. **(06 Marks)**

OR

6 a. Explain the working of power steering. **(07 Marks)**

b. Explain Girling mechanical brake with neat sketch. **(07 Marks)**

c. Explain the concept of collapsible steering. **(06 Marks)**

Module-4

7 a. Explain automotive gas pollutants and their effects on environment. **(10 Marks)**

b. What are hydrogen fuel cell vehicles? How they differ from electric vehicles? Also mention their advantages and disadvantages. **(10 Marks)**

OR

8 a. Describe in detail fuels used in IC engines. **(10 Marks)**

b. Explain layouts of hybrid electric vehicles with necessary sketches. **(10 Marks)**

Module-5

9 a. What are the basic components of an electric vehicles? Explain functions of the components. **(10 Marks)**

b. Write short note on following:

i) Lithium batteries

ii) Metal air batteries. **(10 Marks)**

OR

10 a. Explain drivetrain alternatives based on power sources for the electric vehicles. **(10 Marks)**

b. Explain construction and working of any two types of electric vehicle motors. **(10 Marks)**

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21ME642

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Mechatronics System Design

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 mechanical system relevant to mechatronics systems. **(10 Marks)**
b. Explain the application areas of mechatronics. **(10 Marks)**

OR

2 a. Explain integrated design issues in mechatronics system. **(10 Marks)**
b. Explain LVDT for position measurement. **(10 Marks)**

Module-2

3 a. Explain the conversion of mechanical illustrations to block diagram models. **(10 Marks)**
b. Explain the direct method of block diagram modeling for the transfer function,

$$T(s)=\frac{Y(s)}{R(s)}=\frac{3}{5s^2+8s+13}$$ **(10 Marks)**

OR

4 a. Explain the analog approach of Block diagram modeling. **(10 Marks)**
b. Apply analog method and develop a block diagram model of transformer system. **(10 Marks)**

Module-3

5 a. Explain the parity and Error-coding checks. **(10 Marks)**
b. Explain the fault-detection techniques with microprocessor. **(10 Marks)**

OR

6 a. Explain the transient state and steady state response of a signal. **(10 Marks)**
b. Explain second order system with natural response. **(10 Marks)**

Module-4

7 a. Explain different measures of system performance. **(10 Marks)**
b. Explain the working of inverting and non-inverting amplifier. **(10 Marks)**

OR

8 a. Explain the elements of data-acquisition system with diagram. **(10 Marks)**
b. Explain amplification, filtering, multiplexing. **(10 Marks)**

Module-5

9 a. Explain position control of a permanent magnet DC gear motor. **(10 Marks)**
b. Explain auto control system for green house temperature. **(10 Marks)**

OR

10 a. With a block diagram, explain engine management system. **(10 Marks)**
b. Explain transducer calliberation system for automatic applications. **(10 Marks)**

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21ME652

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Renewable Energy Power Plants

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. With a neat sketch explain the working of Nuclear Power Plant. List its advantages and disadvantages. **(10 Marks)**

b. Write a brief note on Indian Energy Scenario. **(10 Marks)**

OR

2 a. With a neat sketch explain Pyranometer. List out its advantages and disadvantages. **(10 Marks)**

b. What is the need of renewable energy sources? Explain. **(10 Marks)**

Module-2

3 a. Define following terms with respect to solar geometry :
i. Declination angle
ii. Zenith angle
iii. Hour angle
iv. Surface azimuth angle
v. Solar altitude angle. **(10 Marks)**

b. With a schematic sketch explain the working principle of solar pond. List out its applications. **(10 Marks)**

OR

4 a. Explain the working principle of photovoltaic cell using suitable sketch. **(10 Marks)**

b. What is flat plate collector? Explain its working principle with sketches. **(10 Marks)**

Module-3

5 a. List out different types of wind mills. Explain horizontal axis wind mill. **(10 Marks)**

b. Mention and discuss the problems associated with wind energy. **(10 Marks)**

OR

6 a. With a neat sketch explain the construction and working of floating drum biogas plant. **(10 Marks)**

b. Explain the factors which effect the production of biogas. **(10 Marks)**

Module-4

7 a. With a schematic representation of general layout of Hydel power plant, explain its working principle. **(10 Marks)**

b. How Hydel power plants are classified? Explain. **(10 Marks)**

OR

8 a. Explain the limitations of tidal energy. **(10 Marks)**

b. How energy is produced from waves? Explain. **(05 Marks)**

c. List out the advantages and disadvantages of wave energy. **(05 Marks)**

Module-5

9 a. With a sketch explain the working principle of closed cycle OTEC plant. **(10 Marks)**

b. With a sketch explain the working of HOT DRY ROCK geothermal energy systems. **(10 Marks)**

OR

10 a. What are the problems associated with OTEC? Explain. **(05 Marks)**

b. List out the advantages and disadvantages of geothermal power plants. **(05 Marks)**

c. With neat sketches explain following types of geothermal energy plants.
i. Flash steam
ii. Binary cycle power plant. **(10 Marks)**

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21ME63

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Machine Design

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain briefly the six steps involved in the design procedure. **(06 Marks)**

b. State of stress at a point in loaded member is an shown in Fig.Q1(b). Determine principal stresses and its direction, Max. shear stress and its direction.

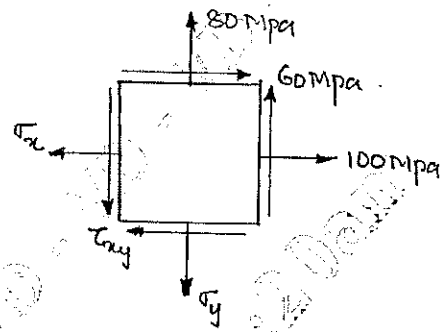

Fig.Q1(b) **(08 Marks)**

c. A shaft stepped down from a diameter of 50 mm to 25 mm with a fillet radius of 5 mm is subjected to torsional moment of 100×10^3 N-mm. Find Max. Shear stress induced in the shaft taking stress concentration into account. **(06 Marks)**

OR

2 a. Derive an expression for stress induced in rod due to axial impact loading with usual notations. **(10 Marks)**

b. A Cantilever beam made of cold drawn carbon steel (σ_u = 550 MPa, σ_y = 470 MPa, σ_{-1} = 275 MPa) of circular cross section is subjected to load. Which varies from –F to 3F. Determine the Max. load that this member can withstand for an indefinite life, using a factor of safety 2.

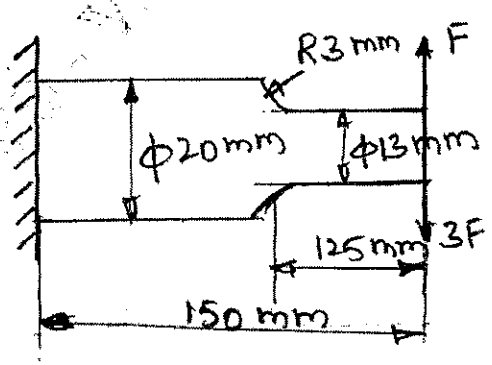

Fig.Q2(b) **(10 Marks)**

Module-2

3 A shaft is supported by two bearings placed 1 m apart. A 500 mm diameter pulley is mounted at a distance of 200 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having Max. tension of 3000 N. The pulley weights 1000 N. Another pulley 300 mm diameter is placed 300 mm to the left of right hand bearing is driven with the help of electric motor and the belt which is placed horizontally to the right when viewed from left bearing. This pulley weighs 500 N. The angle of contact for both pulley is 180° and $\mu = 0.24$. Determine suitable diameter for solid shaft, assuming torque on one pulley is equal to torque on another pulley. Take C15 steel ($\sigma_y = 235.4$ MPa, $\sigma_u = 425$ MPa) as the shaft material and use ASME code for design of shaft. Assume minor shock condition. **(20 Marks)**

OR

4 a. Design a rigid flange coupling to transmit 50 KW at 500 rpm. Take C-40 material for shaft, keys and bolts having allowable stresses $\sigma_{yd} = 131.44$ MPa and $\tau_{yd} = 65.72$ MPa. Take cast iron ($\sigma_{yd} = 24.9$ MPa and $\tau_{yd} = 12.45$ MPa) for flange. **(10 Marks)**

b. A railway car of weight 25 KN moving at 15 km/hr has to brought to rest by 4 buffer spring. The Max. compression of each spring is 300 mm. Find the no. of coils required if each spring has a mean diameter of 160 mm, wire diameter of 20 mm and G = 84 GPa. **(10 Marks)**

Module-3

5 a. Explain Caulking and Fullering with neat sketches. **(08 Marks)**

b. Design a longitudinal butt joint for a boiler of diameter 1×10^3 mm subjected to a steam pressure of 2 MPa. Select a double riveted double cover plates with equal width, chain riveting with required efficiency of 75%. Take allowable stresses has

i. Allowable tensile stress = 80 MPa
ii. Allowable shear stress = 60 MPa
iii. Allowable crusting stress = 120 MPa. **(12 Marks)**

OR

6 a. A bracket supporting a load 'P' is welded to a plate by a four fillet weld of size 6 mm. What is the Max. load 'P' that may be carried by the joint, if the stress in the joint is 96 MPa.

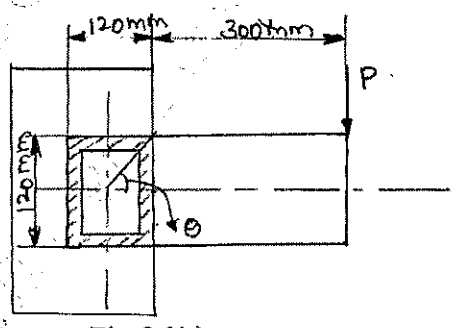

Fig.Q6(a) **(10 Marks)**

b. An M10 steel bolt of 125 mm long is subjected to an impact load. The kinetic energy absorbed by the bolt is 2.5 J. Determine :

i. Stress in the shank of the bolt if there is no threaded portion between the nut and the bolt head
ii. Stress in the shank if the area of the shank is reduced to that of the root area of the thread or the entire length of the bolt is threaded. **(10 Marks)**

Module-4

7 Design a pair of spur gear 20° involute to transmit 30 KW of power at 600 rpm of pinion, no. of teeth on pinion is 15, transmission ration is 5. Material of pinion is cast steel untreated with allowable normal stress of 138 MPa and material of the gear is high grade cast iron with allowable normal stress of 103 Mpa. **(20 Marks)**

OR

8 Design a pair of bevel gears to connect 2 shaft of 60°, pinion rotates at 720 rpm and transmits 15 KW power, the gear rotates exactly at 240 rpm. The no. of teeth on pinion is 24 and teeth profile is 14½° involute, material of pinion is cast steel untreated with allowable normal stress of 138 MPa and gear is cast steel heat treated with allowable normal stress of 220 MPa. **(20 Marks)**

Module-5

9 a. Design a multi-plate clutch to transmit 25 KW at 300 rpm. The plates have friction surfaces of steel and phosphorous bronze run on oil. Design the clutch for 25% overload with operating pressure of 0.5173 MPa. **(10 Marks)**

b. A single block brake which has a torque capacity of 15 N-m is as shown in Fig.Q9(b). Take $\mu = 0.3$, Max. pressure in the brake lining is 1 MPa, width of block is equal to length, determine

i. Actuating force
ii. Dimension of the block
iii. Resultant hinge pin reactions.

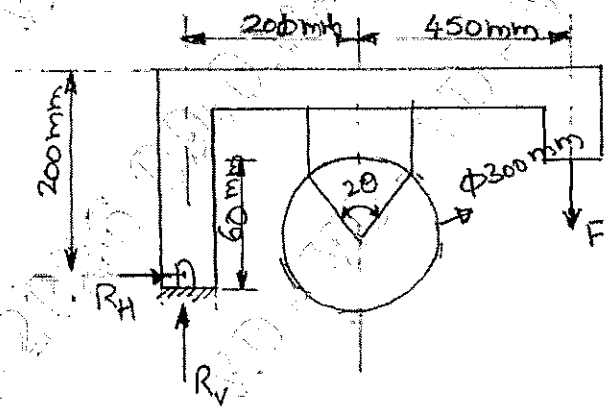

Fig.Q9(b) **(10 Marks)**

OR

10 a. Derive an expression for Petroff's Eq. with usual notations. **(10 Marks)**

b. A 75 mm long full journal bearing of diameter 75 mm supports a load of 10 kN. The speed of the journal is 1200 rpm. The absolute viscosity of the oil is 10×10^{-3} Pas and diametral clearance ratio is 0.001. determine the coefficient of friction using :

i. Petroff's Eq.
ii. Mckee's equation
iii. Raimondi and Boyd curve **(10 Marks)**

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ME 6th Sem.

CBCS SCHEME

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21ME642

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Mechatronics System Design

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 mechanical system relevant to mechatronics systems. **(10 Marks)**
b. Explain the application areas of mechatronics. **(10 Marks)**

OR

2 a. Explain integrated design issues in mechatronics system. **(10 Marks)**
b. Explain LVDT for position measurement. **(10 Marks)**

Module-2

3 a. Explain the conversion of mechanical illustrations to block diagram models. **(10 Marks)**
b. Explain the direct method of block diagram modeling for the transfer function,

$$T(s) = \frac{Y(s)}{R(s)} = \frac{3}{5s^2 + 8s + 13}$$ **(10 Marks)**

OR

4 a. Explain the analog approach of Block diagram modeling. **(10 Marks)**
b. Apply analog method and develop a block diagram model of transformer system. **(10 Marks)**

Module-3

5 a. Explain the parity and Error-coding checks. **(10 Marks)**
b. Explain the fault-detection techniques with microprocessor. **(10 Marks)**

OR

6 a. Explain the transient state and steady state response of a signal. **(10 Marks)**
b. Explain second order system with natural response. **(10 Marks)**

Module-4

7 a. Explain different measures of system performance. **(10 Marks)**
b. Explain the working of inverting and non-inverting amplifier. **(10 Marks)**

OR

8 a. Explain the elements of data-acquisition system with diagram. **(10 Marks)**
b. Explain amplification, filtering, multiplexing. **(10 Marks)**

Module-5

9 a. Explain position control of a permanent magnet DC gear motor. **(10 Marks)**
b. Explain auto control system for green house temperature. **(10 Marks)**

OR

10 a. With a block diagram, explain engine management system. **(10 Marks)**
b. Explain transducer calliberation system for automatic applications. **(10 Marks)**

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21ME71

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Automation and Robotics

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 basic elements of automated system with block diagram. **(10 Marks)**

b. With block diagram, explain the difference between open-loop system and closed-loop control system. **(10 Marks)**

OR

2 a. Explain the Error Detection and Recovery in an automated system. **(10 Marks)**

b. Explain the five levels of automation in control in manufacturing with block diagram. **(10 Marks)**

Module-2

3 a. Explain the fundamentals of Automated production line. **(10 Marks)**

b. Explain the Application of Automated production line. **(10 Marks)**

OR

4 a. Explain the fundamental of Automated Assembly System. **(10 Marks)**

b. Explain the Quantitative analysis of Assembly system. **(10 Marks)**

Module-3

5 a. Explain the five sensors in Robotics. **(10 Marks)**

b. Explain the robot accuracy and Repeatability. **(10 Marks)**

OR

6 a. With neat block diagram, explain the five common body and arm robot configuration. **(10 Marks)**

b. With neat sketch, explain the five types of joints commonly used in industrial robot. **(10 Marks)**

Module-4

7 a. Explain the fundamental difference between AC and DC type motors with diagram. **(10 Marks)**

b. Write the comparison between Hydraulic Pneumatic and Electric actuating system. **(10 Marks)**

OR

8 a. With example, explain Homogeneous transformation of robot for rotation and translation. **(10 Marks)**

b. Briefly explain forward and inverse kinematic of a robot. **(10 Marks)**

Module-5

9 a. List the levels of Robot Programming and explain Offline Robot Programming. **(10 Marks)**

b. Write the comparison between Powered Lead through and Manual Lead through programming. **(10 Marks)**

OR

10 a. Explain the World Coordinate System with neat diagram. **(10 Marks)**

b. Write a note on Robot Programming Language. **(10 Marks)**

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