

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY-GURUJADA VIZINAGARAM**  
**III B. Tech II Semester Supplementary Examinations, November-2025**  
**DESIGN OF MACHINE MEMBERS-II**  
**(MECHANICAL ENGINEERING)**

Time: 3 hours

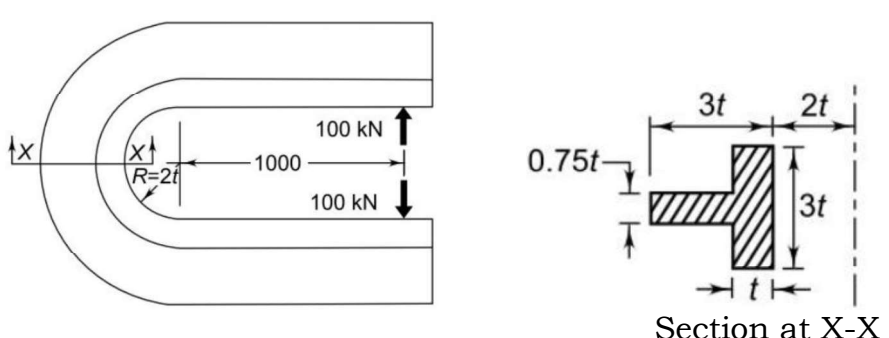
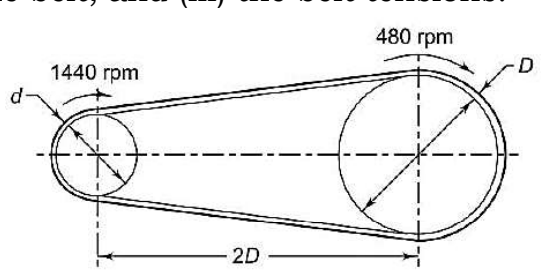
Max. Marks: 70

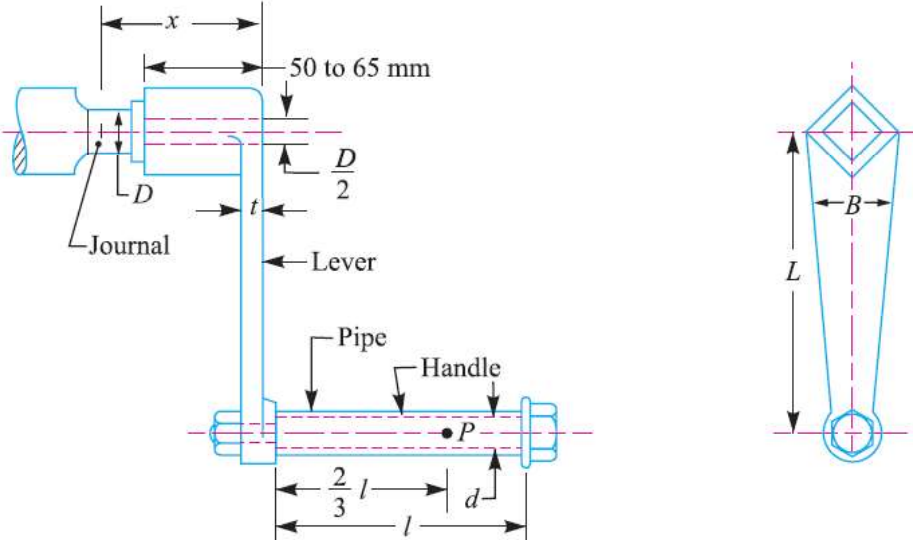
Answer any **FIVE** Questions **ONE** Question from **Each unit**

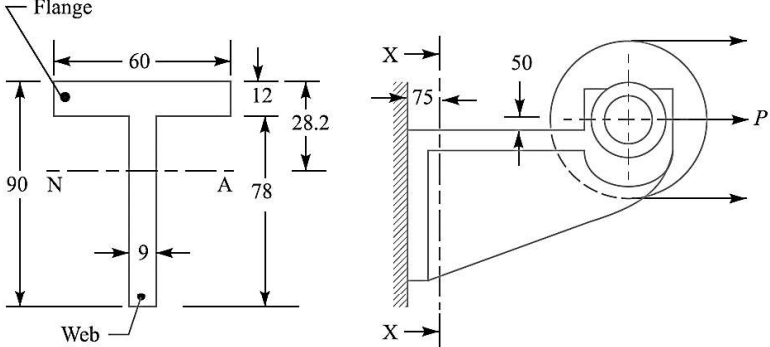
All Questions Carry Equal Marks

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| <b>UNIT-I</b>  |    |   |      |
|----------------|----|---|------|
| 1.             | a) | A taper roller bearing has a dynamic load capacity of 26 kN. The desired life for 90% of the bearings is 8000 h and the speed is 300 rpm. Calculate the equivalent radial load that the bearing can carry.  | [7M] |
|                | b) | Explain the design procedure of Ball and Roller Bearing with suitable diagram.  | [7M] |
| (OR)           |    |   |      |
| 2.             | a) | Design a journal bearing for a centrifugal pump from the following data:<br>Load on the journal = 20 000 N; Speed of the journal = 900 r.p.m.; Type of oil is SAE 10, for which the absolute viscosity at 55 °C = 0.017 kg / m-s; Ambient temperature of oil = 15.5°C; Maximum bearing pressure for the pump = 1.5 N / mm <sup>2</sup> .<br>Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/m <sup>2</sup> /°C. | [7M] |
|                | b) | What is $L_{50}$ life? Briefly discuss the criterion for static load carrying capacity of ball bearing.   | [7M] |
| <b>UNIT-II</b> |    |   |      |
| 3.             | a) | What are the functions of piston? Elaborate the design requirements of piston.  | [7M] |
|                | b) | Determine the dimensions of cross-section of the connecting rod for a diesel engine with the following data:<br>Cylinder bore = 100 mm<br>Length of connecting rod = 350 mm<br>Maximum gas pressure = 4 MPa<br>Factor of safety = 6   | [7M] |
| (OR)           |    |   |      |
| 4.             | a) | What is the difference between centre and overhung crankshafts? Explain.  | [7M] |
|                | b) | The following data is given for the piston of a four-stroke diesel engine:<br>Cylinder bore = 100 mm<br>Maximum gas pressure = 5 MPa<br>Bearing pressure at small end of connecting rod = 25 MPa<br>Length of piston pin in bush of small end = 0.45 D<br>Mean diameter of piston boss = 1.4 × outer diameter of piston pin   | [7M] |

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|    |    | <p>Allowable bending stress for piston pin = <math>140 \text{ N/mm}^2</math><br/>           Calculate:<br/>           (i) outer diameter of piston pin;<br/>           (ii) inner diameter of piston pin and<br/>           (iii) mean diameter of piston boss</p>  |      |
|    |    | <b>UNIT-III</b>   |      |
| 5. | a) | What is a curved beam? Give practical examples of machine components made of curved beams.  | [7M] |
|    | b) | <p>The C-frame of a 100 kN capacity press is shown in Fig. 1. The material of the frame is grey cast iron FG 200 and the factor of safety is 3. Determine the dimensions of the frame.</p>  <p style="text-align: center;"><b>Fig. 1</b></p>  | [7M] |
|    |    | (OR)  |      |
| 6. | a) | What is power screw? Discuss the advantages, disadvantages and applications of power screws.  | [7M] |
|    | b) | <p>A double-threaded power screw, used for lifting a load, has a nominal diameter of 30 mm and a pitch of 6 mm. The coefficient of friction at the screw threads is 0.1. Neglecting collar friction, calculate:<br/>           (i) efficiency of the screw with square threads; and<br/>           (ii) efficiency with Acme threads (<math>2\theta = 29^\circ</math>).</p>   | [7M] |
|    |    | <b>UNIT-IV</b>  |      |
| 7. | a) | Write down the basic procedure for selection of flat belt.  | [7M] |
|    | b) | <p>The layout of a leather belt drive transmitting 10 kW of power is shown in Fig. 2. The centre distance between the pulleys is twice the diameter of the bigger pulley. The belt should operate at a velocity of 20 m/s approximately and the stresses in the belt should not exceed <math>2.25 \text{ N/mm}^2</math>. The density of leather is <math>0.95 \text{ g/cc}</math> and the coefficient of friction is 0.35. The thickness of the belt is 5 mm. Calculate: (i) the diameter of pulleys; (ii) the length and width of the belt; and (iii) the belt tensions.</p>  <p style="text-align: center;"><b>Fig. 2</b></p> | [7M] |
|    |    | (OR)  |      |
| 8. | a) | Design a chain drive to actuate a compressor from 15 kW electric motor running at 1000 r.p.m., the compressor speed   | [7M] |

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|     |    | being 320 r.p.m. The minimum centre distance is 500 mm. The compressor operates 16 hours per day. The chain tension may be adjusted by shifting the motor on slides.   |      |
|     | b) | A bronze spur pinion rotating at 600 r.p.m. drives a cast iron spur gear at a transmission ratio of 4:1. The allowable static stresses for the bronze pinion and cast iron gear are 84 MPa and 105 MPa respectively. The pinion has 16 standard 20° full depth involute teeth of module 8 mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the standpoint of strength.   | [7M] |
|     |    | <b>UNIT-V</b>  |      |
| 9.  | a) | <p>A right angled bell-crank lever is to be designed to raise a load of 5 kN at the short arm end. The lengths of short and long arms are 100 and 450 mm respectively. The lever and the pins are made of steel 30C8 (<math>S_{yt} = 400 \text{ N/mm}^2</math>) and the factor of safety is 5. The permissible bearing pressure on the pin is 10 N/mm<sup>2</sup>. The lever has a rectangular cross-section and the ratio of width to thickness is 3:1. The length to diameter ratio of the fulcrum pin is 1.25:1. Calculate:</p> <p>(i) The diameter and the length of the fulcrum pin.<br/> (ii) The shear stress in the pin.<br/> (iii) The dimensions of the boss of the lever at the fulcrum.</p> <p>Assume that the arm of the bending moment on the lever extends up to the axis of the fulcrum.</p> | [7M] |
|     | b) | <p>A cranked lever, as shown in Fig. 3, has the following dimensions:</p> <p>Length of the handle = 300 mm<br/> Length of the lever arm = 400 mm<br/> Overhang of the journal = 100 mm</p> <p>If the lever is operated by a single person exerting a maximum force of 400 N at a distance of 1/3rd length of the handle from its free end, Find: 1. Diameter of the handle and 2. Cross-section of the lever arm.</p> <p>The permissible bending stress for the lever material may be taken as 50 MPa and shear stress for shaft material as 40 MPa.</p>  <p style="text-align: center;"><b>Fig. 3</b></p>   | [7M] |
|     |    | (OR)   |      |
| 10. | a) | A horizontal pull $P = 5 \text{ kN}$ is exerted by the belting on one of the   | [7M] |

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|    |  | <p>cast iron wall brackets which carry a factory shafting. At a point 75 mm from the wall, the bracket has a T-section as shown in Fig. 4. Calculate the maximum stresses in the flange and web of the bracket due to the pull.</p>  <p style="text-align: center;"><b>Fig. 4</b></p>   |      |
| b) |  | <p>A workshop crane is lifting a load of 25 kN through a wire rope and a hook. The weight of the hook etc. is 15 kN. The rope drum diameter may be taken as 30 times the diameter of the rope. The load is to be lifted with an acceleration of 1 m/s<sup>2</sup>. Calculate the diameter of the wire rope. Take a factor of safety of 6 and Young's modulus for the wire rope 80 kN/mm<sup>2</sup>. The ultimate stress may be taken as 1800 MPa. The cross-sectional area of the wire rope may be taken as 0.38 times the square of the wire rope diameter.</p> | [7M] |

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Code No: R2032032

**R20**

SET-2

**III B. Tech II Semester Regular/Supplementary Examinations, April -2025**  
**DESIGN OF MACHINE MEMBERS-II**  
(MECHANICAL ENGINEERING)

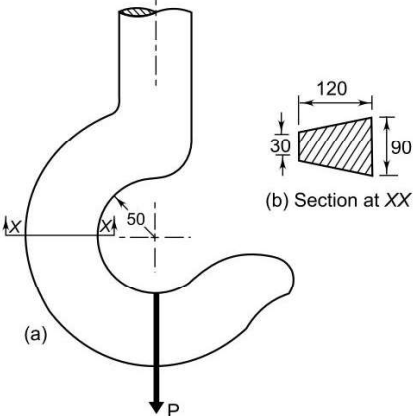
Time: 3 hours

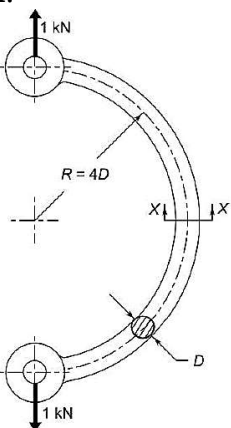
Max. Marks: 70

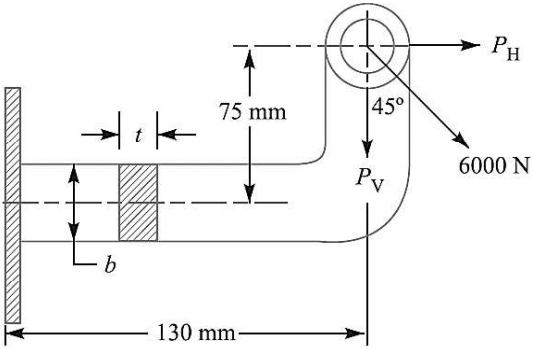
Answer any **FIVE** Questions **ONE** Question from **Each unit**  
All Questions Carry Equal Marks

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|    |    | <b>UNIT-I</b>  |      |
|----|----|--|------|
| 1. | a) | What are journal bearings? Explain the procedure followed in designing a journal bearing.  | [7M] |
|    | b) | <p>A journal bearing is to be designed for a centrifugal pump for the following data:</p> <p>Load on the journal = 12 kN; Diameter of the journal = 75 mm; Speed = 1440 r.p.m; Atmospheric temperature of the oil = 16°C; Operating temperature of the oil = 60°C; Absolute viscosity of oil</p> | [7M] |

|    |    |  |      |
|----|----|--|------|
|    |    | at $60^{\circ}\text{C} = 0.023 \text{ kg/m-s}$ .<br>Give a systematic design of the bearing.   |      |
|    |    | (OR)   |      |
| 2. | a) | What are the various terms used in journal bearings analysis and design? Give their definitions in brief.  | [7M] |
|    | b) | A rolling contact bearing is subjected to the following work cycle:<br>(a) Radial load of 6000 N at 150 r.p.m. for 25% of the time;<br>(b) Radial load of 7500 N at 600 r.p.m. for 20% of the time; and<br>(c) Radial load of 2000 N at 300 r.p.m. for 55% of the time.<br>The inner ring rotates and loads are steady. Select a bearing for an expected average life of 2500 hours.   | [7M] |
|    |    | <b>UNIT-II</b>   |      |
| 3. | a) | What is the function of a connecting rod of an internal combustion engine? Explain the various stresses induced in the connecting rod.   | [7M] |
|    | b) | Calculate the diameter of a piston rod for a cylinder of 1.5 m diameter in which the greatest difference of steam pressure on the two sides of the piston may be assumed to be $0.2 \text{ N/mm}^2$ . The rod is made of mild steel and is secured to the piston by a tapered rod and nut and to the crosshead by a cotter. Assume modulus of elasticity as $200 \text{ kN/mm}^2$ and factor of safety as 8. The length of rod may be assumed as 3 metres. | [7M] |
|    |    | (OR)   |      |
| 4. | a) | With a neat sketch, explain the design procedure adopted for designing a crankshaft.   | [7M] |
|    | b) | The cylinder of a four-stroke diesel engine has the following specifications:<br>Brake power = 3 kW<br>Speed = 800 rpm<br>Indicated mean effective pressure = 0.3 MPa<br>Mechanical efficiency = 80%<br>Determine the bore and length of the cylinder liner.   | [7M] |
|    |    | <b>UNIT-III</b>  |      |
| 5. | a) | What is power screw? Write down the important terminology of power screw.  | [7M] |
|    | b) | A crane hook having an approximate trapezoidal cross-section is shown in Fig. 1. It is made of plain carbon steel 45C8 ( $S_{yt} = 380 \text{ N/mm}^2$ ) and the factor of safety is 3.5. Determine the load carrying capacity of the hook.  | [7M] |
|    |    |  <p style="text-align: center;"><b>Fig. 1</b></p>  |      |
|    |    | (OR)   |      |

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| 6.             | a) | Derive the expression to calculate the torque required for lifting load in power screw.  | [7M] |
|                | b) | <p>A curved link of the mechanism made from a round steel bar is shown in Fig. 2. The material of the link is plain carbon steel 30C8 (<math>S_{yt} = 400 \text{ N/mm}^2</math>) and the factor of safety is 4. Determine the dimensions of the link.</p>  <p style="text-align: center;"><b>Fig. 2</b></p>   | [7M] |
| <b>UNIT-IV</b> |    |  |      |
| 7.             | a) | Derive the condition for maximum power transmission in belt drive.   | [7M] |
|                | b) | <p>The following particulars of a single reduction spur gear are given:<br/> Gear ratio = 10:1; Distance between centres = 660 mm approximately; Pinion transmits 500 kW at 1800 r.p.m.; Involute teeth of standard proportions (addendum = m) with pressure angle of <math>22.5^\circ</math>; Permissible normal pressure between teeth = 175 N per mm of width. Find:</p> <ol style="list-style-type: none"> <li>1. The nearest standard module if no interference is to occur;</li> <li>2. The number of teeth on each wheel;</li> <li>3. The necessary width of the pinion; and</li> </ol> | [7M] |
| (OR)           |    |  |      |
| 8.             | a) | A pulley used to transmit power by means of ropes has a diameter of 3.6 metres and has 15 grooves of $45^\circ$ angle. The angle of contact is $170^\circ$ and the coefficient of friction between the ropes and the groove sides is 0.28. The maximum possible tension in the ropes is 1000 N and the mass of the rope is 1.5 kg per metre length. Determine the speed of the pulley in r.p.m. and the power transmitted if the condition of maximum power prevail.   | [7M] |
|                | b) | <p>A pair of helical gears are to transmit 15 kW. The teeth are <math>20^\circ</math> stub in diametral plane and have a helix angle of <math>45^\circ</math>. The pinion runs at 10 000 r.p.m. and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 MPa; determine a suitable module and face width from static strength considerations and check the gears for wear, given <math>\sigma_{es} = 618 \text{ MPa}</math>.</p>  | [7M] |
| <b>UNIT-V</b>  |    |  |      |

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| 9.  | a) | A lever-loaded safety valve is mounted on the boiler to blow off at a pressure of 1.5 MPa gauge. The effective diameter of the opening of the valve is 50 mm. The distance between the fulcrum and the dead weights on the lever is 1000 mm. The distance between the fulcrum and the pin connecting the valve spindle to the lever is 100 mm. The lever and the pin are made of plain carbon steel 30C8 ( $S_{yt}=400 \text{ N/mm}^2$ ) and the factor of safety is 5. The permissible bearing pressure at the pins in the lever is 25 N/mm <sup>2</sup> . The lever has a rectangular cross-section and the ratio of width to thickness is 3:1. Design a suitable lever for the safety valve. | [7M] |
|     | b) | A foot lever is 1 m from the centre of shaft to the point of application of 800 N load. Find: <ol style="list-style-type: none"> <li>1. Diameter of the shaft,</li> <li>2. Dimensions of the key, and</li> <li>3. Dimensions of rectangular arm of the foot lever at 60 mm from the centre of shaft assuming width of the arm as 3 times thickness.</li> </ol> The allowable tensile stress may be taken as 73 MPa and allowable shear stress as 70 MPa.  | [7M] |
|     |    | (OR)  |      |
| 10. | a) | A mild steel bracket as shown in Fig. 3, is subjected to a pull of 6000 N acting at 45° to its horizontal axis. The bracket has a rectangular section whose depth is twice the thickness. Find the cross-sectional dimensions of the bracket, if the permissible stress in the material of the bracket is limited to 60 MPa.  | [7M] |
|     |    |  <p style="text-align: center;"><b>Fig. 3</b></p>   |      |
|     | b) | Select a wire rope for a vertical mine hoist to lift a load of 55 kN from a depth 300 metres. A rope speed of 500 metres / min is to be attained in 10 seconds.   | [7M] |

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