

Hall Ticket Number:

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Code No. : 16544 N/O

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (Mech. Engg.) VI-Semester Main &amp; Backlog Examinations, May/June-2023

Machine Design

Time: 3 hours

Max. Marks: 60

Note: Answer all questions from Part-A and any FIVE from Part-B

Part-A (10 × 2 = 20 Marks)

| Q. No. | Stem of the question   | M | L | CO | PO |
|--------|--|---|---|----|----|
| 1.     | Determine the position of neutral axes of a curved beam with circular cross section of radius 60 mm. Position of the centroidal axis is axis of loading is 100 mm.   | 2 | 3 | 1  | 2  |
| 2.     | Determine the eccentricity between the centroidal and neutral axes of a curved beam with trapezoidal cross section. Depth of the cross section is 450 mm and inner width 350 mm. Outer width is 250 mm. Position of the inner surface from axis of loading is 500 mm.  | 2 | 3 | 1  | 2  |
| 3.     | Calculate the initial preload required to close the gap between 12 graduated leaves and 3 full length leaves semi elliptical leaf spring, when it is subjected to a central load of 50 KN.   | 2 | 2 | 2  | 2  |
| 4.     | Define spring index and spring constant.   | 2 | 1 | 2  | 1  |
| 5.     | Diameters of the two 90° bevel gears in mesh are 250 mm and 150 mm. Determine pitch cone angles for pinion and gear. If speed of pinion is 360 rpm, what is the speed of gear?   | 2 | 2 | 3  | 2  |
| 6.     | Determine the form factor for a helical pinion of 20 teeth, if the helix angle of the helical gear is 35°.   | 2 | 1 | 3  | 2  |
| 7.     | What is bearing characteristic number for a sliding contact bearings? What is its value if the absolute viscosity of the oil used is 0.06 kg/m-s, radial clearance is 0.15 mm, bearing pressure is 1.5 MPa and journal speed is 420 rpm?                               | 2 | 2 | 4  | 2  |
| 8.     | State the classification of bearings.  | 2 | 1 | 4  | 1  |
| 9.     | Mention the types of cranks shaft and show simple sketches of it.  | 2 | 1 | 5  | 1  |
| 10.    | Determine the thickness of the piston head, if the cylinder boar is 200 mm, allowable bending stress in piston material is 37 MPa and maximum gas pressure is 5 MPa. Write the formula used to calculate. Speed of the engine is 2400 rpm and stroke length is 120 mm. | 2 | 3 | 5  | 2  |

Contd... 2

| <b>Part-B (5 × 8 = 40 Marks).</b> |  |   |   |   |   |
|-----------------------------------|--|---|---|---|---|
| 11. a)                            | For a rectangular cross-section 80mm x 40mm of C clamp shown in figure, find the maximum tensile and compressive stress if P 20 kN.  | 6 | 3 | 1 | 2 |
|                                   |  |   |   |   |   |
| b)                                | Why trapezoidal section is use in crane hook.  | 2 | 1 | 1 | 2 |
| 12. a)                            | A loaded narrow gauge car of weight 16 KN when moving at 1.2 m/s is brought to rest by a bumper consisting of two parallel helical compression springs. Spring index is 6. The springs are compressed by 200 mm while absorbing the kinetic energy of the moving car. Permissible shear stress in the spring is 400 MPa. Determine the maximum load on each spring and wire diameter. Taking shear modulus as 0.84 GPa determine the number of active coils in the spring.                   | 6 | 3 | 2 | 3 |
| b)                                | State the classification springs and mention their applications.   | 2 | 3 | 2 | 3 |
| 13. a)                            | Power is to be transmitted from a motor shaft rotating at 1240 rpm to another shaft rotating at 420 rpm using a pair of 20° pressure angle involute teeth spur gears is 14 KW. Starting torque is 25 % more than the running torque. Number of teeth on pinion are 25 and both the wheels are made of heat treated steel with an allowable static stress of 240 MPa. Design the gear wheels using Lewis equation and check for wear strength.  | 6 | 2 | 3 | 2 |
| b)                                | Mention the failures of gear teeth.  | 2 | 1 | 3 | 2 |
| 14. a)                            | Define the terms Rating Life and Dynamic Load rating. A rolling contact bearing is used to take radial load $F_r$ and axial load $F_a$ . Write the expression for equivalent dynamic load, defining the terms used.  | 3 | 3 | 4 | 1 |
| b)                                | Select a suitable deep groove ball bearing to resist 8 KN radial load and 5 KN thrust load when rotating at 1500 rpm. Assume that inner race rotates and load is steady. Life expected is 500 Hours. Service is continuous. What is the required rated life of the bearing? $X=0.56$ , $Y=1.5$   | 5 | 3 | 4 | 3 |
| 15.                               | Bore of a single acting four stroke single cylinder engine is 400 mm and its stroke length is 600 mm. Mean effective pressure is 0.5 MPa, maximum combustion pressure is 2.5 MPa and engine speed is 2000 rpm. Ratio of connecting rod length to crank radius is 5. Mass of the reciprocating parts is 1.5 kg, allowable compressive strength of the material is 320 MPa, design the connecting rod for the above specified engines. Check the whipping stress. Assume suitable data if any. | 8 | 2 | 5 | 3 |

|        |  |   |   |   |   |
|--------|--|---|---|---|---|
| 16. a) | Design crane hook to lift the load of 250kN.   | 4 | 1 | 1 | 1 |
| b)     | Safety valve blow off at a pressure of 12 bar exerting an axial load of 3400N on helical compression spring that holds the valve in position. If the spring index is 5, determine the diameter of the wire and coil. Take allowable stress of the material of the wire is 420 MPa  | 4 | 3 | 2 | 2 |
| 17.    | Answer any <i>two</i> of the following:  |   |   |   |   |
| a)     | Determine the form factor for a helical gear of helix angle $20^\circ$ with $20^\circ$ pressure angle to transmit 50 KW at 5400 rpm. Pinion has 20 teeth and velocity ratio is 3. Design stress for pinion and gear are 233 MPa and 207 MPa respectively. Calculate the formative number of teeth on each wheel. Determine which wheel is weak.  | 4 | 2 | 3 | 2 |
| b)     | Design a journal bearing for centrifugal pump. Diameter of the journal is 100mm, length of the journal is 150mm, pressure is 20MPa and speed is 4000 RPM. Bearing operating with SAE 10 lubricant with viscosity of 0.1 kg/m-sec at temperature of $75^\circ\text{C}$ , Ambient temperature is $35^\circ\text{C}$ . Difference between exit and entry of the cooling water is $12^\circ\text{C}$ find the mass of the water per unit time for cooling for a well-ventilated bearing. | 4 | 2 | 4 | 3 |
| c)     | State the design consideration of piston.  | 4 | 1 | 5 | 1 |

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

|      |                               |     |
|------|-------------------------------|-----|
| i)   | Blooms Taxonomy Level – 1     | 25% |
| ii)  | Blooms Taxonomy Level – 2     | 35% |
| iii) | Blooms Taxonomy Level – 3 & 4 | 40% |

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