Exam Date & Time: 08-Jan-2024 (02:30 PM - 05:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

VII SEMESTER B. TECH MAKEUP EXAMINATIONS, JAN 2024

Design of Mechanical Systems [MME 4042]

Marks: 50

Duration: 180 mins.

PART A

Answer all the questions.

Instructions to Candidates: Answer ALL the questions. Missing data may be appropriately assumed. Assumptions made must be clearly mentioned. Use of design data handbook (hard copy only) is allowed.

- An IC Engine has a valve diameter of 80 mm. The lift of the valve is 30 mm. The weight of the valve is 5 N. The peak pressure when the exhaust valve opens is 0.4 MPa. The spring is set in initial compression by 20 mm. The acceleration of the valve is 25 m/s². The stiffness of the spring required is 10 N/mm. The rocker arm is made of cast steel with an I-section for which the ultimate tensile strength is 400 MPa. The diameter of the fulcrum pin is 30 mm. The length of the arm is 180 mm. Design the rocker arm with suitable justifications.
- The tangential force acting on the overhung crankshaft is 5000 N. The thickness and width of the web are 25 mm and 50 mm, respectively. The stroke length is 210 mm. Determine the stresses in the web of the overhung crankshaft at the maximum torque position due to the tangential force with suitable justifications.
- 3) A left side flange of protected flange coupling transmits a maximum torque of 1790625 Nmm. Permissible tensile strength for steel & cast iron may be taken as 120 MPa & 100 MPa respectively. The diameter of the shaft is 63 mm. Using a neat sketch perform the (5) design check for flange, hub and bolts.
- 4) In a single plate clutch, the maximum load taken by each toggle lever is 1900 N. The allowable stress for spring material is 360 MPa. Design the spring making suitable assumptions.
- 5) Explain any three principles of designing cast components with the help of neat sketches.

(5)

(5)

PART B

Answer all the questions.

ANSWER ANY ONE OF THE TWO QUESTIONS

6) Design the connecting rod for a four stroke petrol engine having the specifications: (25)

Indicated power at 1600 rpm = 25 kW

Stroke length = 220 mm

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Connecting rod length = 440 mm

Compression ratio = 8:1

Weight of reciprocating parts = 20 N

Mean effective pressure = 1.45 MPa

Maximum explosion pressure = 2.45 MPa.

Weight density of material of connecting rod is $80,000 \text{ N/m}^3$.

The Permissible tensile strength of connecting rod material is 315 MPa. The material for bolt is Mild Steel with ultimate tensile strength of 500 MPa and FOS = 6. Draw the **front view** of assembly showing big and small ends in section.

OR

[OR] Design a screw jack to lift a load of 5000 kg through a height of 150 mm. The screw rod
7) is made of steel having yield strength of 300 MPa, in tension & compression and yield shear strength of 180 MPa. The nut is made of phosphor bronze having an allowable bearing pressure of 15 MPa. The cup and body are made of cast iron having an ultimate (25) strength of 500 MPa in compression & 250 MPa in tension. Draw the front view of the screw jack.

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