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15MT51

Fifth Semester B.E. Degree Examination, Aug./Sept.2020
Design of Machine Elements

Time: 3 hrs. Max. Marks: 80

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. What is stress concentration? Give two examples. Show how the stress concentration can be minimized in these cases. **(04 Marks)**

b. Explain briefly the six steps involve in the design procedure. **(04 Marks)**

c. Determine the maximum stress in the following cases taking stress concentration into account.

(i) A rectangular plate of 50 mm × 80 mm with a hole of 10 mm dia in the centre is loaded in axial tension of 10 kN. Thickness of plate = 10 mm.

(ii) A circular shaft of 45 mm dia stepped down to 30 mm dia having a fillet radius of 6 mm subjected to a twisting moment of 150 N-m. **(08 Marks)**

OR

2 a. Explain the following theories failure:
(i) Maximum shear stress theory
(ii) Maximum normal stress theory **(08 Marks)**

b. Determine the dia of the rod according to:
(i) Maximum normal stress theory
(ii) Maximum shear stress theory taking axial pull of 20 kN, with a shear force of 10 kN. **(08 Marks)**

Module-2

3 Design a cotter joint for the following specification:
(i) Axial thrust 100 kN
(ii) Shear stress 60 MPa
(iii) Crushing stress 120 MPa **(16 Marks)**

OR

4 Design flange coupling for the following specification: Power transmitted, 25 KW Speed = 200 rpm. Assume maximum torque is 25% greater than mean torque. Design following parts: (i) Shaft based on torsional strength (ii) Keys (iii) Hub (iv) Bolt **(16 Marks)**

Module-3

5 A steel shaft transmitting 20 HP at 200 rpm is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located 100 mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of the left hand bearing and receives power in a vertical direction from below. Using an allowable shear stress of 54 MPa in shear, determine the dia of shaft. **(16 Marks)**

OR

6 A shaft is supported by two bearings placed 1100 mm apart. A pulley of dia 620 mm is keyed at 400 mm to the right from the left hand bearing and this drives a pulley directly below it with a maximum tension of 2.75 kN. Another pulley of dia 400 mm is placed 200 mm to the left of right hand bearing and is driven with a motor placed horizontally to the right. The angle of contact of the pulley is 180° and the coefficient of friction between the belt and the pulleys is 0.3. Find the dia of the shaft. **(16 Marks)**

Module-4

7 Design spur gear for following specification:
(i) Power transmitted 15 KW at 1500 rpm
(ii) Velocity ratio 3. **(16 Marks)**

OR

8 Design helical gear for following specification:
(i) Power transmitted 30 KW at 1800 rpm
(ii) Velocity ratio 2 **(16 Marks)**

Module-5

9 Design the main bearing of a steam turbine that runs at 1800 rpm. The load on the bearing is estimated to be 2500 N. **(16 Marks)**

OR

10 a. Derive an expression for the shear stress induced in a Helical compression spring with usual notation. **(08 Marks)**

b. Design a helical compression spring to support an axial load of 3000 N. The deflection under load is limited to 60 mm. The spring index is '6'. The spring is made of chrome vanadium steel and FOS-2. **(08 Marks)**

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