CBCS SCHEME

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17MA54

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Elements of Machine Design

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain the following theories of failure:
(i) Maximum normal stress theory
(ii) Maximum shear stress theory
(iii) Distortion energy theory **(09 Marks)**

b. Design a circular shaft transmitting power of 10 KW at 1440 rpm. The yield stress is 324 MPa. Assume FoS = 2.5. **(06 Marks)**

c. Define the following terms:
(i) Factor of safety
(ii) Stress concentration factors
(iii) Codes
(iv) Standards
(v) Fatigue stress concentration factor **(05 Marks)**

OR

2 a. Derive an expression for stress induced in a rod due to the axial impact of a weight 'w' dropped from a height 'h' on to a collar attached at the free end of the rod. What is the stress due to suddenly applied load? **(10 Marks)**

b. Determine the load that can be a bar of rectangular cross-section shown in Fig.Q2(b). Limiting the maximum stress to 130 MPa and taking stress concentration in to account.

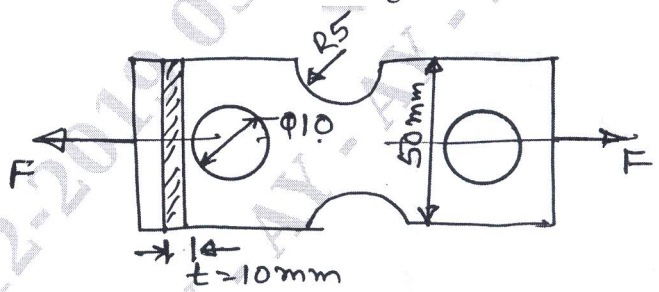

Fig.Q2(b) **(10 Marks)**

Module-2

3 A horizontal commercial shafting is supported by two bearings 1.5 m apart. A keyed gear 20° involute and 175 mm in diameter, is located 400 mm to the left of the right bearing and is driven by a gear directly behind it. A 600 mm diameter pulley is keyed to the shaft 600 mm to the right of the left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of the belt is 3:1 with a slack side on top. The drive transmits 45 KW at 330 rpm take $C_m = C_f = 1.5$. Calculate the diameter and angle of twist. Use design stress 40 MPa and G = 80 GPa. **(20 Marks)**

OR

4 a. Derive Soderberg's equation

$$\frac{1}{n} = \frac{\sigma_m}{\sigma_y} + \frac{K_{ft}\sigma_a}{ABC\sigma_{en}}$$ **(08 Marks)**

b. The piston rod of a steam engine is subjected to a completely reversed load of 40 kN.The material have an endurance limit of 280 MPa and an yield strength of 310 MPa. Assuming a FOS of 2. Determine the diameter of the bar. **(12 Marks)**

Module-3

5 Design spur gear for the following specification:
a. Power transmitted = 20 kN
b. Speed of the pinion = 1440 rpm **(20 Marks)**

OR

6 Design pair of straight bevel gears are to transmit 15 KW at 1500 rpm input speed. The diameter of the pinion is 100 mm and velocity ratio 3. The tooth form 20° full depth. **(20 Marks)**

Module-4

7 Design a CI flange coupling to transmit 18 KW at 1440 rpm. The allowable stresses for shaft, keys, bolts are 75 MPa in shear and 150 MPa in crushing. The allowable shear stress for C.I flange is 5 MPa. Draw the assembly sketch. **(20 Marks)**

OR

8 a. Design a Cotter joint for the following specification – Axial thrust 100 kN. Allowable stresses are:
(i) Tensile stress 100 MPa
(ii) Shear stress 60 MPa
(iii) Crushing stress 120 MPa. **(14 Marks)**

b. A rectangular sunk key 14 mm wide × 10 mm thick × 75 mm long is required to transmit 1200 N-m torque from a 50 mm diameter solid shaft. Determine whether the length is sufficient or not if the permissible shear stress and crushing stress are limited to 56 MPa and 168 MPa respectively. **(06 Marks)**

Module-5

9 a. Derive Petroff's equation for coefficient of friction for hydrodynamic bearing. **(08 Marks)**
b. Explain the significance of bearing characteristic number in the design of sliding bearing. **(06 Marks)**
c. Discuss the mechanism of fluid film lubrication. **(06 Marks)**

OR

10 a. Design a journal bearing for a centrifugal pump from the following data:
(i) Load on the journal = 10 kN
(ii) Speed of the journal = 900 rpm
(iii) Ambient temperature = 15°C **(14 Marks)**
b. Explain selection of bearings from manufacturer catalogue. **(06 Marks)**

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