CBCS SCHEME

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15MA54

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Elements of Machine Design

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Use of hand book is permitted.*
3. *Assume missing data suitably.*

Module-1

1 a. Define code and standards. **(04 Marks)**

b. Explain the following theories of failure:
i) Maximum Shear Stress theory ii) Distortion energy theory **(06 Marks)**

c. Find the value of the maximum stress induced on the fillet if the stress concentration factor for the filleted flat box shown in Fig.Q1(c) having a $\frac{D}{d}$ ratio of 1.2. Also determine the factor of safety if the flat box is made of steel having yield stress of 640 MPa. Thickness of the box is 25 mm.

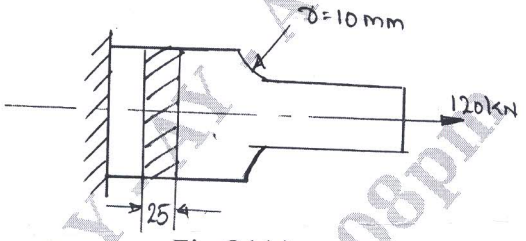

Fig.Q1(c) **(06 Marks)**

OR

2 a. A steel rod of 1.5 m long. It has to resist longitudinally an impact 2.5 kN falling under gravity at a velocity of 0.99 m/s. Maximum stress is limited to 150 MPa. Design the diameter of rod. **(06 Marks)**

b. Design a protected type cast iron flange coupling for a steel shaft transmitting 30 KW @ 200 rpm. The allowable shear stress in the shaft and key material is 40 MPa. The maximum torque transmitted to be 20% greater than the full load torque. The allowable shear stress in the bolt is 60 MPa and flange is 40 MPa. **(10 Marks)**

Module-2

3 A round rod of diameter 1.2 d is reduced to a diameter 'd' with a fillet radius of 0.1 d. This stepped rod is to sustain a twisting moment that fluctuates between 2.5 kN-m to 1.5 kN-m together with a bending moment that fluctuates between 1 kN-m to –1 kN-m. The rod is made of C40 steel (σ_y = 328.6 MPa, σ_u = 620 MPa). Determine diameter of rod. Take FoS 2. **(16 Marks)**

OR

4 A horizontal piece of commercial shafting is supported by two bearings 1.5 m apart. A keyed gear 20° involute and 175 mm in diameter is located at 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 belt is 3:1, with slack side on top. The drive transmits 45 KW @ 330 rpm. Take $K_b = K_t = 1.5$. Find the necessary diameter of the shaft. Take τ_{all} = 40 MPa, G = 80 GPa. **(16 Marks)**

Module-3

5 A pair of carefully cut spur gear with 20° FDI is used to transmit 12 KW @ 1200 rpm of pinion. The gear has to rotate at 300 rpm. The material used for both pinion and gear is medium carbon steel whose allowable bending stress may be taken as 230 MPa. Design the gear against dynamic load. Suggest suitable hardness. Take 24 teeth on pinion, E =210 GPa. **(16 Marks)**

OR

6 Design a pair of bevel gears to connect two shafts at 60°. The gears are alloy steel of case hardened and precision cut with form cutters. The gear ratio is 5:1. The power transmitted is 30 KW @ 900 rpm of the pinion. The teeths are 20°FDI. The pinion has 24 teeth. Check the gears for dynamic and wear consideration. **(16 Marks)**

Module-4

7 a. Design a socket and spigot type cotter joint to sustain an axial load of 100 kN. The material selected for joint has the following design stresses. σ_t = 100 MPa, σ_c = 150 MPa and τ = 6 MPa. **(08 Marks)**

b. Design a Knuckle joint to connect two mild steel rods subjected to an axial pull of 100 kN. The allowable stress for rod and pin are 100 MPa, 130 MPa and 60 MPa in tension, crushing and shear respectively. The bending of the pin is prevented by selection of proper fit. **(08 Marks)**

OR

8 A bush type flexible coupling has 4 pins of size M16 made of steel having allowable shear stress of 60 MPa. The outside diameter and length of rubber bush on the pin are 38 mm and 45 mm respectively. The pins are located on the pitch circle of diameter 200 mm. the allowable bearing pressure in rubber bush is 1 MPa. If the coupling rotates at 900 rpm. Calculate the power that can be transmitted. Check whether the size of the pin is acceptable for the power transmitted. **(16 Marks)**

Module-5

9 a. List and explain the properties of lubricant. **(06 Marks)**

b. SAE 20 oil is used to lubricate a hydrodynamic journal bearing of diameter 75 mm and length 75 mm, oil enters @ 40°C. The journal rotates @ 1200 rpm. The ψ = 0.001. Assume operating temperature 53°C, find:

i) Magnitude and location of h_{min}
ii) Power loss
iii) Oil flow through bearing
iv) Side leakage **(10 Marks)**

OR

10 a. Explain the principle of hydrodynamic lubrication. **(08 Marks)**

b. Derive Petroff's equation for lightly loaded bearing. **(08 Marks)**

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