CBCS SCHEME

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15MT51

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
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 design data hand book is permitted.

Module-1

1 a. Define the following:
i) Principle stresses
ii) Factor of safety
iii) Stress concentration. **(06 Marks)**

b. A point in a structural member is subjected to a plane stress as shown in the Fig.Q.1(b). Determine:
i) Normal and tangential stress
ii) Principle stresses and their directions
iii) Max shear stress and its direction. **(10 Marks)**

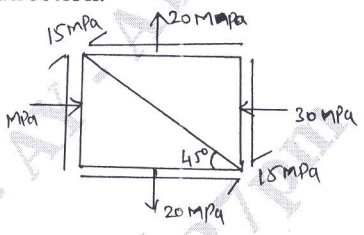

Fig.Q.1(b)

OR

2 a. Explain the methods of reducing stress concentration. **(04 Marks)**

b. A bolt is subjected to a load of 18kN axial and a shear load of 12kN. The material has yield stress of 328.6MPa. Determine the diameter of the bolt according to the following theory:
i) Rankine's theory
ii) Shear energy theory
iii) Shear stress theory. Take FOS = 2.5 **(12 Marks)**

Module-2

3 a. Design a cotter joint to resist a load of 40kN which acts along the axis of the rod connected by the cotter. The material of the rod and cotter is same and has the following properties T = 160MPa, σ_t = 200MPa, σ_c = 420MPa. Take FOS = 4. **(08 Marks)**

b. Design a Knuckle joint for connecting 2 rods subjected to an axial force of 12kN. The permissible stress are 40N/mm^2 in tension, 80N/mm^2 in compression and 32N/mm^2 in shear. **(08 Marks)**

OR

4 a. Design a protected type cast iron flang coupling for a steel shaft transmitting 30kW at 200rpm. The allowable shear stress in the shaft and key material is 40MPa. The max torque transmitted to be 20% greater than full load torque. The allowable shear stress in the bolt is 60MPa and in the flange is 40MPa. **(08 Marks)**

b. The Jaws of a machine vice weigh 5000N and are slided by a two start acme thread 50mm diameter and 8mm pitch at a speed of 800mm/min. The ends of the screw carried a thrust washer of mean diameter 56mm. The co efficient of thread a friction is 0.14. Determine the power of the motor required in kW and the efficiency of the drive. **(08 Marks)**

Module-3

5 A shaft is supported between two bearings placed 1m apart. A 600mm diameter pulley is mounted at a distance of 300mm to the right of left hand bearing and this drives a pulley directly below with the help of belt with max tension of 2.25kW. Another pulley 400mm diameter is placed 200mm to the left of right hand bearing and is driven with the help of electric motor and belt which is placed horizontally to the right. The angle of contact for both the pulley is 180° and coefficient of friction is 0.24. Determine the suitable diameter for the solid shaft allowing a working stress of 63MPa in tension and 42MPa in shear. **(16 Marks)**

OR

6 A solid shaft supported between bearing 500mm apart carry a pulley of mass 80kg and diameter 300mm located at 200mm to the right of left bearing. It runs at 500rpm in counter clock wise direction and receives 20kW power by a horizontal belt. Another pulley of 400mm diameter and mass 100kg mounted on a shaft 150mm to the left of right hand bearing and drives a pulley located below it. The coefficient of friction between belt and pulley is 0.28 and angle of lap is 170°. Recommend a suitable diameter for the shaft if allowable stresses are 100MPa in tension and 65MPa in shear. The loads are considered to be suddenly applied with minor shock. **(16 Marks)**

Module-4

7 Two spur gears are to be used intermitantly with medium shock for a rock crusher drive. The gears are to be designed for the following requirements. Power to be transmitted 20kW, speed of pinion 1000rpm, velocity ratio 3.5:1, tooth profile 20° stup, static stress for pinion material 100MPa and for gear = 70MPa. Determine the necessary module and phase width. Take number of teeth on pinion as 18. **(16 Marks)**

OR

8 Design a steel helical gear from the following data power transmitted = 30kW, speed of pinion = 1500rpm, helix angle = 20°. Pressure angle in the diametral plane α is 20° FDI, velocity ratio = 4, number of teeth on pinion = 24, static stress of cost steel $(\sigma_d)_p = (\sigma_d)_g = 50.71$MPa, $(BHN)_{Gear} = 350$. **(16 Marks)**

Module-5

9 a. Explain the types of Bearings. **(04 Marks)**

b. Design a full hydrodynamic journal bearing with the following specification for machine tool application:
Journal diameter = 75mm
Radial load = 10kN
Minimum oil film thickness = 22.5 microns
Inlet temperature = 40°C
Bearing material = babbitt
Determine the length of the bearing and select a suitable oil for this application. **(12 Marks)**

OR

10 a. Explain the types of spring. **(06 Marks)**

b. Design a helical compression spring to sustain compression load of 1000N with an associated deflection of 22mm and cross section of the wire is assumed to be circular and elastic limit in shear is 800N/mm^2. Take FOS = 2.5, spring index is 6 and G = 80900N/mm^2. **(10 Marks)**

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