CBCS SCHEME

USN | | | | | | | | | | 15MA54

Fifth Semester B.E. Degree Examination, July/August 2021
Elements of Machine Design

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer any FIVE full questions.*
2. *Use of Design Data Hand Book is permitted.*
3. *Missing data may be assumed.*

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.

1 a. Enumerate the significance of standards and codes in machine design. **(04 Marks)**

b. A circular rod of diameter 60 mm and length 200 mm is fixed at one end. The free end is subjected to a transverse load of 6 KN and a torque of 400 N-m. Determine the stresses at the critical points. **(08 Marks)**

c. Discuss the importance of factor of safety and factors to be considered in selection of it. **(04 Marks)**

2 a. A round rod of 50 mm diameter is to sustain an axial tensile load of 20 KN and a twisting moment of 1.5 kNm. The rod is made of C40 steel. Determine the factor of safety from the following theories of failure:
(i) Maximum Principal stress theory.
(ii) Maximum Shear stress theory **(08 Marks)**

b. A filleted plate with a circular hole subjected to a tensile force of 5 KN is shown in Fig. Q2 (b). The ultimate strength of the plate material is 200 MPa. Determine the thickness of the plate. Take Factor of safety as 2.5 **(08 Marks)**

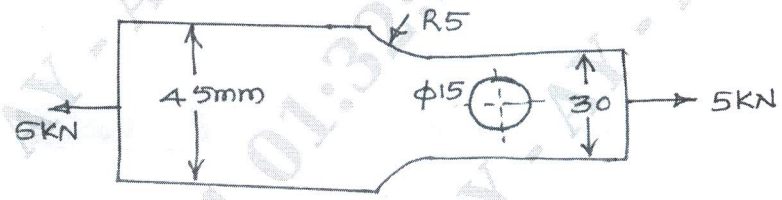

Fig. Q2 (b)

3 a. Discuss the effects of surface, size and load factor on fatigue strength. **(06 Marks)**

b. A medium carbon steel rod drawn at 650°C is subjected to a reversed axial load of 200 KN. Determine the required diameter of the rod using Factor of safety 2. The endurance limit and the ultimate tensile strength of the material of the rod are 250 MPa and 550 MPa respectively. Assume no column action. **(10 Marks)**

4 A section of steel shaft of 2 m long supported between bearings running at 1000 rpm carries a 20° involute spur gear of pitch diameter 200 mm at its mid point. The gear delivers 20 KW power to its mating gear located directly above the shaft. If the shaft material selected has an allowable shear stress of 40 MPa, determine the diameter of shaft. **(16 Marks)**

5 A pair of carefully cut spur gears with 20° full depth involute profile is used to transmit 12 kW at 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 gears. Take 24 teeth on pinion. Modulus of elasticity may be taken as 210 GPa. **(16 Marks)**

6 Design a pair of bevel gear to transmit 10 KW. Pinion rotates at 600 rpm and gear rotates at 300 rpm. $\theta = 90°$. Assume teeth on pinion as 20. $\alpha = 20°$ FDI. Select Cast steel for both gears $\sigma_d = 138.3$ MPa. **(16 Marks)**

7 Design and draw a cotter join to support a load varying from 30 KN in compression to 30 KN in tension. The material used is carbon steel for which the following allowable stresses may be used.
Tensile stress = Compressive stress = 50 MPa
Shear stress = 35 MPa
Crushing stress = 90 MPa **(16 Marks)**

8 a. Define key and mention its applications. Also discuss the types of keys. **(06 Marks)**
b. The shaft and the flange of a marine engine are to be designed for flange coupling in which the flange is forged on the end of the shaft. The following particulars are to be considered in the design:
Power of the engine = 3 MW Speed of the engine = 100 rpm
Permissible shear stress in bolts and shaft = 60 MPa Number of bolts used = 8
Pitch circle diameter of bolts = 1.6 × diameter of shaft
Find : (i) Diameter of shaft (ii) Diameter of bolts (iii) Thickness of flange
(iv) Diameter of flange. **(10 Marks)**

9 a. Discuss bearing characteristic number and bearing modulus for journal bearings. **(08 Marks)**
b. The load on the journal bearing is 150 KN due to turbine shaft of 300 mm diameter running at 1800 rpm. Determine (i) Length of the bearing if the allowable bearing pressure is 1.6 N/mm^2 and (ii) Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60°C and viscosity of the oil at 60°C is 0.02 kg/m-s and the bearing clearance is 0.25 mm. **(08 Marks)**

10 a. Discuss the following terms with reference to ball bearings (i) Life (ii) Rating life (iii) Minimum life. **(06 Marks)**
b. A shaft running at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 KN for 10 percent of time, 2 KN for 20 percent of time, 1 KN for 30 percent of time and no load for remaining time of cycle. If the total life expected for the bearing is 20×10^6 revolutions at 95 percent reliability, calculate dynamic load rating of the ball bearing. **(10 Marks)**

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