CBCS SCHEME

USN | | | | | | | | | |

15ME64

Sixth Semester B.E. Degree Examination, Jan./Feb. 2023
Design of Machine Elements – II

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. A crank hook is made of trapezoidal cross section with 120 mm as inner side, 60 mm outer side and depth of 90 mm. The inner radius of curvature is 120 mm. Determine the safe load that can be raised by the hook limiting the tensile stress to 90 MPa. The load line is 15 mm away from the center of curvature. **(08 Marks)**

b. Determine the dimensions of curved beam shown in Fig.Q1(b) in which the maximum fiber stress are numerically equal in pure bending. Given that $b_i + b_o = 120$ mm.

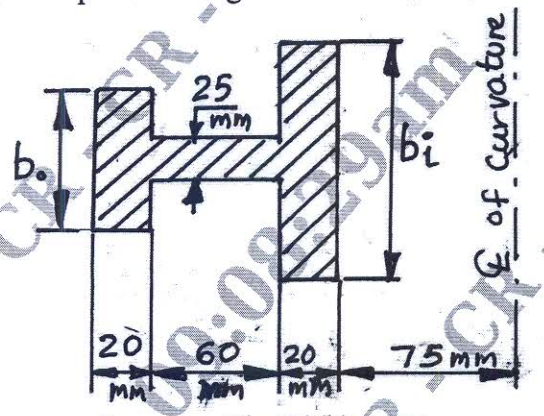

Fig.Q1(b) **(08 Marks)**

OR

2 a. A 150 mm outside diameter, 100 mm inside diameter and 120 mm long sleeve is filled on to a solid shaft of diameter 100 mm. The modulus of elasticity of both the materials is 210 GPa. Poisson's ratio is 0.28. The contact pressure is not to exceed 60 MPa. Determine:
(i) Tangential stresses at inside and outside diameters of both cylinders.
(ii) The radial stresses at inside and outside diameters of both.
(iii) Sketch the stress distribution. **(08 Marks)**

b. A thick cylinder of internal diameter 300 mm carries fluid under pressure of 9 MPa. The allowable tensile stress is 90 MPa at inside of the cylinder. Find the required wall thickness of the cylinder and sketch the stresses distribution across wall. **(08 Marks)**

Module-2

3 a. A flat belt is required to transmit 9 KW at 1200 rpm from a 120 mm effective diameter pulley to another pulley of diameter 360 mm. The center distance is 1.5 meter. Belt thickness is 12 mm. Allowable stress for belt material is 2.1 MPa. Belt weighs 10 kN/m^3. Coefficient of friction is 0.27. Find the width and length of belt. **(08 Marks)**

b. Select a V-belt to transmit 12 kW at 2400 rpm from a 120 mm diameter pulley to a compressor to run at 300 rpm. The center distance is approximately 1.2 meters. **(08 Marks)**

OR

4 a. A railway can weighing 20 kN and moving at a velocity of 15 kmph is stopped by a bumper consisting of 4 helical compression springs in which the maximum compression allowed is 300 mm. Find the number of active coils required if the spring is made of 20 mm dia wire and mean coil diameter of 160 mm. Also find the shear stress induced in the coils. Take G = 80 GPa. **(08 Marks)**

b. A truck spring has 3 full length and 9 graduated leaves. The span is 1.1 meters, width of central band is 150 mm. The central load on spring = 9 kN. The allowable stress is 500 MPa if all the leaves were stressed to same valve. Deflection under load is 72 mm. Design the spring. Take E = 206 GPa. **(08 Marks)**

Module-3

5 Design a pair of steel spur gears (σ_0 = 450 MPa) to transmit 18 kW at 3000 rpm of 20 teeth pinion. The velocity ratio required is 6:1. The teeth are 20° full depth involute. Check for dynamic and wear loads. **(16 Marks)**

OR

6 a. Derive Lewis equation for tangential tooth load for a spur gear with usual notations. **(06 Marks)**

b. A pair of right angle bevel gears is required to transmit 40 kW at 720 rpm of 20 teeth pinion made of cast steel (σ_0 = 220 MPa) to a C30 steel gear (σ_0 = 138 MPa) at a velocity ratio of 4. The teeth are 20° full depth involute form. Find the module, face width and pitch diameter of the gears. **(10 Marks)**

Module-4

7 Design a single start worm and worm gear drive to transmit 18 KW at 1440 rpm to a phosphor bronze worm wheel (σ_0 = 103.5 MPa) to rotate at 40 rpm. The teeth are 20° full depth involute. **(16 Marks)**

OR

8 a. Design a single plate clutch to transmit 30 KW at 1200 rpm. The external diameter of plates is 1.5 times the internal diameter, coefficient of friction is 0.3. Allowable pressure on friction lining is 0.24 MPa. **(08 Marks)**

b. Design a simple band brake operating on a drum diameter of 600 mm absorbing 15 KW at 720 rpm. The angle of contact is 210°. Coefficient of friction is 0.3. Length of lever = 1 m, one end of band is attached to the fulcrum, while the other end is attached to the brake lever at a distance of 400 mm from fulcrum. Find the operating force and size of band taking allowable stress as 50 MPa. Also design brake lever of rectangular cross section having depth as twice the width and allowable bending stress as 80 MPa. **(08 Marks)**

Module-5

9 a. Derive Petroff equation for coefficient of friction for lightly loaded bearing with usual notations. **(06 Marks)**

b. A 75 mm long, 75 mm diameter full journal bearing supports a load of 12 kN at 1800 rpm. Assume diametral clearance as 0.001, oil viscosity = 0.01 PaS. Determine:
(i) Sommerfeld's number (ii) Coefficient of friction (iii) Heat generated **(10 Marks)**

OR

10 a. Define: (i) Basic static capacity (C_o) (ii) Basic dynamic capacity (C)
(iii) Life of bearing (L) for a ball bearing **(06 Marks)**

b. Select a deep groove ball bearing for a shaft 50 mm diameter rotating at 1200 rpm. The radial load on bearing is 3000 N and axial load is 2000 N. The bearing operates for 8 hours/day for 5½ years. **(10 Marks)**

* * * * *