Code: 9A14503 **R09**

B.Tech III Year I Semester (R09) Supplementary Examinations June 2017

PRINCIPLES OF MACHINE DESIGN

(Mechatronics)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

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1 (a) Select a suitable material for the following with reason:
(i) Steam turbine blade. (ii) Machine tool bed. (iii) Journal bearing bush. (iv) Carburetor body.
(b) What do you mean by “Preferred numbers”? Explain with a suitable example.
(c) Write short notes on “Factor of safety”.

2 A steel cantilever beam, of circular cross section, is 200 mm long. It is of diameter ‘2d’ for the first 50 mm and of diameter ‘d’ for the remaining length (from fixed end). It is subjected to an axial loading, which varies from 200 N (compression) to 600 N (tension) and also a transverse loading at its free end, which varies from 100 N (up) to 150 N (down). Determine the diameters of the beam for a factor of safety 2. Assume the following data:
Yield strength of the material = 330 MPa
Endurance limit in reversed loading = 300 MPa
Load factor = 0.7 in reversed axial loading
= 1 in reversed bending.
Size factor = 0.85
Surface timing factor = 0.90
Stress concentration factor = 1.44 for bending
= 1.64 for axial loading
Notch sensitivity index = 0.90.

3 (a) Two plates of 10 mm thickness are joined by means of a single riveted, double strap butt joint. Determine: (i) The rivet diameter. (ii) Rivet pitch. (iii) Strap thickness. (iv) Efficiency of the joint. Take the working stresses of 80 MPa in tension and 60 MPa in shear.
(b) A circular rod of diameter 60 mm is connected to a rigid plate by a fillet weld around circumference of the shaft. Determine the size of the weld, if the torque on the shaft is 3 kN-m. The allowable shear stress in the weld is 60 MPa.

4 (a) Define equivalent bending moment and equivalent twisting moment with respect to design of shafts.
(b) A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of a bending moment 10 kN-m and a torsional moment of 30 kN-m. Determine the diameter of the shaft using (i) maximum shear stress theory and (ii) maximum strain energy theory. Assume factor of safety as 2 and Poisson ratio as 0.3.

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5 (a) Explain the functions and applications of mechanical springs.

(b) A load of 2 kN is dropped axially on a close coiled helical spring, from a height of 250 mm. The spring has 20 effective turns, and is made of 25 mm diameter wire. The spring index is 8. Find the maximum shear stress induced in the spring and the amount of compression produced. Take modulus of rigidity for the spring wire material as 84 kN/mm^2.

6 (a) Derive the relation for the ratio of driving tensions of a V-belt.

(b) Find the width of the belt necessary to transmit 10 kW to a pulley 300 mm diameter, if the pulley rotates at 1600 rpm and the coefficient of friction between the belt and pulley is 0.22. Assume the angle of contact as 210° and the maximum tension in the belt is not to exceed 8 N/mm width.

7 A pair of helical gears with 30° helix angle is used to transmit power of 15 kW at 10,000 rpm of the pinion. The velocity ratio is 4. Both the gears are made of hardened steel of static strength 100 N/mm^2. Number of teeth on pinion is 24. The face width may be taken as 14 times the module. The teeth are of 20° involute full depth system and the tooth form factor may be taken as $0.154 - 0.912/Z_E$, where Z_E represents the equivalent number of teeth. Design the gears from the standpoint of strength and check the gears for wear load.

8 (a) Layout the design procedure for journal bearing, when the bearing load, the diameter and speed of the shaft are known.

(b) A ball bearing is subjected to the following work cycle.

Element no:	Redial load (N)	Speed (rpm)	Element time (1%)
1	6000	150	25
2	7500	600	20
3	2000	300	55

The inner ring rotates and loads are steady. Select a bearing for an expected average life of 2500 hours.

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