

Roll No.

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BT-6 / M-17
MACHINE DESIGN-II
Paper-ME-310-E Opt. II

Time allowed : 4 hours]

[Maximum marks : 100

Note : Attempt five questions in all, selecting at least one question from each unit. All questions carry equal marks. Use of machine design data book is allowed.

Unit-I

1. (a) Why the tangential component of gear tooth force is called useful component ? 5
- (b) A pair of spur gears consist of a 24 teeth pinion, rotating at 1000 rpm and transmitting power to a 48 teeth gear. The module is 6 mm, while the face width is 60 mm. Both gears are made of steel with an ultimate tensile strength of 450 MPa. They are heat treated to a surface hardness of 250 BHN. Assume that velocity factor accounts for the dynamic load. Calculate
- (i) Beam strength
 - (ii) Wear strength
 - (iii) The rated power that the gears can transmit, if service factor and the factor of safety are 1.5 and 2 respectively. 15

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(2)

2. A pair of helical gears consist of 24 teeth pinion meshing with 72 teeth gear. Normal pressure angle is 20 deg. and the helix angle is 24 deg. The pinion rotates at 720 rpm. Normal module of gear is 5 mm and face width is 50 mm. Both pinion and gear are made of steel with $S_{ut} = 600$ MPa. Gears are heat treated to a surface hardness of 360 BHN.

What power can be transmitted by the gears if the service factor is 1.4 and factor of safety is 2 ? Assume that velocity factor accounts for the dynamic load. 20

Unit-II

3. It is required to drive a V-belt drive to connect a 20 kW, 1440 rpm motor to a compressor running at 480 rpm for 15 hours per day. Space is available for a distance of approximately 1.2m. Determine :
- (i) the specifications of the belt
 - (ii) diameters of motor and compressor pulley
 - (iii) the correct centre distance
 - (iv) the no. of belts 20
4. An automotive single plate clutch consists of two pairs of contacting surfaces. The outer diameter of the friction disc is 270 mm. The coefficient of friction is 0.3 and the maximum intensity of pressure is 0.3 MPa. The clutch is transmitting a torque of 531 N-m. Assuming uniform wear theory, calculate :
- (i) the inner diameter of the friction disc
 - (ii) spring force required to keep the clutch engaged. 20

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(3)

Unit-III

5. (a) The following data is given for a full hydrodynamic bearing :
- Journal speed = 1260 rpm; journal diameter = 60 mm ;
bearing length = 60 mm ; radial clearance = 0.04 mm;
radial load = 6kN; minimum oil thickness = 0.008 mm.
Specify the viscosity of the lubricating oil you will recommend for bearing. 15
- (b) If the designation of a bearing is 6308, give its complete specifications from the SKF catalogue and determine its life at 20,000 N dynamic load. If the bearing rotates at 720 rpm, what was its life in hours ? 5
6. It is required to design a helical compression spring subjected to a maximum force of 7.5 kN. The mean coil diameter should be 150 mm from space consideration. The spring rate is 75 N/mm. The spring is made of oil hardened and tempered steel wire with ultimate tensile strength of 1250 MPa. The permissible shear stress for the spring wire is 30% of the ultimate tensile strength ($G = 81370$ MPa). Calculate :
- (i) wire diameter and
(ii) no. of active coils. 20

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(4)

Unit-IV

7. Design a piston for a four-stroke diesel engine developing 15 kW power at 700 rpm. Other data is as follows : 20
- Crank radius = 110 mm; indicated mean effective pressure = 0.7 MPa; Maximum gas pressure = 5.1 MPa; mechanical efficiency = 75%; heat dispersion through top = 5% of heat produced; fuel consumption = 0.16 kg per BP per hr; higher calorific value of fuel = 44000 kJ/kg; difference of temperature at the centre and the edge of piston head = 205 deg.; allowable stress for piston material = 35 MPa; allowable stress for piston ring material = 80 MPa; allowable pressure on piston barrel = 0.42 MPa; Allowable bearing pressure for gudgeon pin = 20 MPa; Allowable pressure between piston and ring = 0.045 MPa; Allowable tension in piston pin = 90 MPa. 20
8. A rimmed flywheel made of grey cast iron (mass density = 7100 kg/m³) is used on a punching press running at mean speed of 200 rpm. The punching operation consists of one-quarter revolution during which the flywheel is required to supply 3000 N-m of energy. The coefficient of speed fluctuations is limited to 0.2. The rim which contributes 90% of the required moment of inertia, has a mean radius of 0.5m due to space limitations. The cross-section of the rim is square. Determine its dimensions. 20

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