Code : 021821

B.Tech 8th Semester Exam., 2019

MECHANICAL SYSTEM DESIGN

Time : 3 hours   Full Marks : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are **NINE** questions in this paper.

(iii) Attempt **FIVE** questions in all.

(iv) Question No. **1** is compulsory.

(v) Standard Design Data book is allowed. Assume any missing data suitably.

1. Write in short on any *seven* of the following :

   (a) Three main portions of crankshaft

   (b) Difference between the functioning of flywheel and that of governor

   (c) Virtual number of teeth in helical gear

   (d) Interference and undercutting

   (e) Overcome the axial thrust in helical gears

   (f) Classification of chains

   (g) Objectives of lubrication in sliding contact bearing

   (h) Buckling of connecting rod

   (i) Parts of trunk type piston

2. It is required to design a chain drive to connect 5 kW, 1400 r.p.m. electric motor to a drilling machine. The speed reduction is 3 : 1. The centre distance should be approximately 500 mm.

   (a) Select a proper roller chain for the drive.

   (b) Determine the number of chain links.

   (c) Specify the correct centre distance between the axes of sprockets.

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3. Design a journal bearing for a centrifugal pump from the following data :

   Load on the journal = 20000 N;
   Speed of the journal = 900 r.p.m.;
   Type of oil is SAE 10, for which the absolute viscosity at 55 °C = 0·017 kg/m-s;
   Ambient temperature of oil = 15·5 °C;
   Maximum bearing pressure
                       for the pump = 1·5 N/mm^2

Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10 °C. Heat dissipation coefficient = 1232 W/m²/°C.   14

4. A pair of spur gears with 20° full-depth involute teeth consists of a 20-teeth pinion meshing with a 41-teeth gear. The module is 3 mm while the face width is 40 mm. The material for pinion as well as gear is steel with an ultimate tensile strength of 600 N/mm². The gears are heat treated to a surface hardness of 400 BHN. The pinion rotates at 1450 r.p.m. and the service factor for the application is 1·75. Assume that velocity factor accounts for the dynamic load and the factor of safety is 1·5. Determine the rated power that the gears can transmit. Lewis form factor is 0·32 for 20 teeth.   14

5. The turning moment diagram for a petrol engine is drawn to the following scales :

   Turning moment, 1 mm = 5 N-m;
   Crank angle 1 mm = 1°.

The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line, taken in order are 295 mm², 685 mm², 40 mm², 340 mm², 960 mm²,

270 mm². Determine the mass of 300 mm diameter flywheel rim when the coefficient of fluctuation of speed is 0·3% and the engine runs at 1800 r.p.m. Also determine the cross-section of the rim when the width of the rim is twice of thickness. Assume density of rim material as 7250 kg/m³.   14

6. Determine the dimensions of cross-section of the connecting rod for a diesel engine with the following data :

   Cylinder bore = 100 mm;
   Length of connecting rod = 350 mm;
   Maximum gas pressure = 4 MPa;
   Factor of safety = 6.

Determine the dimensions of small and big end bearings of the connecting rod for a diesel engine with the following data :   14

   {Length,l /diameter,d} ratio for piston pin bearing = 2;
   {Length,l /diameter,d} ratio for crank pin bearing = 1·3;
   Allowable bearing pressure for piston pin bearing = 12 MPa;
   Allowable bearing pressure for crank pin bearing = 7·5 MPa.

7. A four-stroke diesel engine has the following specifications :

Brake power = 5 kW;

Speed = 1200 r.p.m.

Indicated mean effective

pressure = 0·35 N/mm^2;

Mechanical efficiency = 80%.

Determine—

(a) bore and length of the cylinder;

(b) thickness of the cylinder head;

(c) size of studs for the cylinder head. 14

8. Design the crank pin and, left-hand and right-hand crank webs of centre crankshaft for a single-cylinder vertical engine using the following data :

Cylinder bore = 125 mm;

(L/r) ratio = 4·5;

Maximum gas pressure = 2·5 MPa;

Length of stroke = 150 mm;

Weight of flywheel cum belt pulley = 1 kN;

Total belt pull = 2 kN;

Width of hub for flywheel cum

belt pulley = 200 mm.

The torque on the crankshaft is maximum when the crank turns through 25° from the top dead centre and at this position the gas

(Turn Over)

pressure inside the cylinder is 2 MPa. The belts are in the horizontal direction. Assume suitable data and state the assumptions you make. 14

9. The hydraulic press, having a working pressure of water as 16 N/mm^2 and exerting a force of 80 kN is required to press materials up to a maximum size of 800 mm × 800 mm and 800 mm high, the stroke length is 80 mm. Design and draw the following parts of the press : 14

(a) Design of ram

(b) Cylinder

(c) Pillars

(d) Gland

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