ME-802 MACHINE DESIGN JUN 2014

Note : (i) Attempt any five questions. At least one question from each unit. All questions carry equal marks. (ii) Assume suitable data, if required

(ii) Use of design data book is permitted.

Unit-I

1 Power of 60 kW at 750 r.p.m. is to be transmitted from an electric motor to compressor shaft at 300 r.p.m. by V-belts. The approximate large pulley diameter is 1500 mm. The approximate centre distance is 1650 mm, and overload factor is to be taken as 1.5. Give a complete design of the belt drive. A belt with cross-sectional area of 350 mm2 and density 1000 kg/m3 and having an allowable tensile strength 2 MPa is available for use. The coefficient of friction between the belt and the pulley may be taken as 0.28. The driven pulley is overhung to the extent of 300 mm from the nearest bearing and is mounted on a shaft having a permissible shear stress of 40 MPa with the help of a key. The shaft, the pulley and the key are also to be designed. 20

Or

2 Design a chain drive to actuate a compressor from 15 kW electric motor running at 1000 r.p.m., the compressor speed being 350 r.p.m. The minimum centre distance is 500 mm. The compressor operates^ hours per 4ay. The chain tension njgy be adjusted by shifting the motor on slides. ^

Unit-II

3 A pair of parallel helical gears consists of 24 teeth pinion rotating at 5000 rpm and supplying 2.5 kW power to a gear. The speed reduction is 4 : 1. The normal pressure angle and helix angle are 20° and 23° respectively. Both gears are made of hardened steel (Sut = 750 N/mm2). The service factor and the factor of safety are 1.5 and 2 respectively. The gears are finished to meet the accuracy of Grade-4.

(H In the initial stages of gear design, assume that the velocity factor accounts for the dynamic load and that the face width is ten times the normal module. Assuming the pitch line velocity to be 10 m/s, estimate the normal module.

(ii) Select the first preference value of the normal module and calculate the main dimensions of the gears.

(iii) Determine the dynamic load using Buckingham's equation and find out the effective load for the above dimensions. What is the correct factor of safety for bending ?

(vi) Specify surface hardness for the gears, assuming a factor of safety of 2 for wear consideration. 20

Or

4. A pair of straight bevel gears, mounted on shafts that are intersecting at right angles, consists of a 24 teeth pinion meshing with a 32 teeth gear. The pinion shaft is connected to an electric motor developing 12.5 kW rated power at 1440 rpm. The starting torque of the motor is 150% of the rated torque. The pressure angle is 20°. Both gears are made of case hardened steel (Sul = 750 N/mm2). The teeth on gears are generated and 'finished by grinding and lapping processes to meet the requirements of Class - 3 Grade. The factor of safely in preliminary stages of gear design 2. (!) In the initial stages of gear design, assume that velocity factor accounts for the dynamic load and that the pitch line velocity is 7.5 m/s. Estimate the module based on beam strength. Select the first preference value of module and calculate the main dimensions of the gears.

(II) Determine the dynamic load using Buckingham's equation and find out the effective load for above dimensions. What is the correct fhotor of safety for bending ?

(Iv) Specify the jurface hardness for thenars assuming a facto^of Hllfbty of 2 for wear consideration.

Unit-III

5. Design a. connecting rod for an I.C. engine running at 1800 r.p.m. and developing a maximum pressure of 3.15 N/mm2. The diameter of the plHtOll Is 100 mm; mass of the

reciprocating parts per cylinder 2.25 kg; length Of connecting rod 380 mm; stroke of piston 190 mm and Compression ratio 6:1. Take a factor of safety of 6 for the design. Take length to diameter ratio for big end bearing as 1.3 and small end bearing OS 2 Olid the corresponding bearing pressures as 10 N/mm2 and 15 N/ mm8. The density of material of the rod may be taken as 8000 kg/m3 and the allowable stress in the bolts as 60 N/mm2 and in cap as 80 N/mm2. The rod Is to be of 1-section for which you can choose your own proportions. Draw a neat dimensioned sketch showing provision for lubrication. Use Ranklno formula for which the numerator constant may be taken as 320 N/mm2 and the denominator constant 1/7500. 20

Or

6. (a) Design a plain carbon steel centre crankshaft for a single acting four stroke single cylinder engine for the following data

Bore . = 400 mm

Stroke = 600 mm ,

Engine speed = 200 r.p.m.

Mean effective pressure = 0.5 N/mm2

Maximum combustion pressure = 2.5 N/mm2

Weight of flywheel used as a pulley = 50 kN

Total belt pull = 6.5 kN

When the crank has turned through 35° from the top dead centre, the pressure on the piston is 1 N/mm2 and the torque on the crank is maximum. The ratio of the connecting rod length to the crank radius is 5. Assume any other data required for the design. 20

Unit-IV

7. (a) How does the working of a clamp coupling differ from that of a muff coupling ? Explain.

(b) Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. The material properties are as follows -

(i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.

(ii) The allowable shear stress for cast iron is 15 MPa.

(iii) The allowable bearing pressure for rubber bush is 0.8 N/mm2.

(iv) The material of the pin is same as that of shaft and key.

Draw neat sketch of the coupling. 14

Or

8. (a) Explain the various types of ends used for pressure vessel giving practical applications of each. 6

(b) The hydraulic press, having a working pressure of water as 16 N/mm2 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,

(i) Design of ram (ii) Cylinder (iii) Pillars (iv) Gland.

Unit-V

9.(a) Define the following terms with suitable examples - 12

(I) Pro-assigned parameters

(II) IIdlMVlor.constraints

(III) Nltle Constraints

(IV) Composite constraint surface (v) Free points (vi) Bound molnt (v) A OW-gO load Is to prepared from five types of articles. The weight wis volume V| and the value c(of different articles are given ahead - 8

Or

10. (a) explain the I Man matrix with positive definite and negative definite and negative definite

(b) Explain the semi definite and saddle point conditions with example.