Total number of printed pages – 8 **B. Tech**

CPME 6306

Sixth Semester Examination – 2008

MACHINE DESIGN – II

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) State the factors on which the endurance strength of machine components depends.

   (b) Distinguish between repeated stress and fluctuating stress cycle.

   (c) Explain two methods of reducing stress concentration.

   (d) Explain why friction clutches are designed on the basis of uniform wear condition.

   (e) What are the important factors in brake design ?

   (f) Define specific dynamic capacity of a rolling element bearing.

   (g) What are the different methods of cooling of a journal bearing ?

   (h) Explain the different causes of gear tooth failure.

   (i) Discuss the design criteria for crank pin.

   (j) Discuss the design criteria for big end bearing cap of a connecting rod.

2. A long straight tube, 80 mm internal diameter and 3mm thick, is subjected to an internal fluid

pressure of 6.0 MPa. In addition, the tube is also subjected to a twisting moment of 80 N-m. Treating it as a thin cylinder and assuming the yield stress for tube material as 290 MPa find out the factor of safety required from the following two theories of failure : 10

(i) Maximum principal stress theory

(ii) Distortion energy theory.

3. A steel rod of circular cross-section is subjected to a variable bending moment that varies from 750 Nm to 1500 Nm and an axial load that varies from 5 KN to 14 KN. The maximum bending moment occurs at the same instant when the axial load is also maximum. Determine the required diameter of the rod for a factor safety of 2.5. Neglect any stress concentration. Assume the following data :

Ultimate strength = 550 MPa;

Yield strength = 470Mpa;

Size factor = 0.85

Surface finish factor = 0.89

Correction factors = 1.0 for reversed bending

= 0.7 for axial load

The endurance limit may be taken as half of ultimate strength. 10

4. Design a suitable forged steel connecting rod of **I** cross section along with bolts for the big end cap bearing for a petrol engine with following specifications : 10

Piston diameter = 100mm

Weight of the reciprocating parts per cylinder = 20 N

Length of the connecting rod center to center = 280 mm

Maximum explosion pressure = 3.3 MPa

Rated speed of the engine = 1750 rpm

Bearing pressure for big end = 7 MPa

Crushing stress for forged steel = 325 MPa

Factor of safety for the buckling load = 4.0

Length to diameter ratio for big end bearing = 1.30

Permissible direct stress for bolt material = 100 MPa.

5. An Otto engine develops an indicated power of 70 KW at 180 rpm with 80 explosions per minute. The change of speed from commencement to the end of power stroke must not exceed 0.5% of mean on either side. Design a suitable rim section of the fly wheel, having width four times

the depth, so that the hoop stress does not exceed 3.9 MPa. Assume that the fly wheel stores 15/14 times the energy stored by the rim and that the work done during power stroke is 1.4 times the work done during the cycle. Take the density of the material as 7200 Kg/m^3. 10

6. Two parallel shafts with centers 60cm apart are to be connected by a pair of 20° involute stub tooth spur gears to provide a velocity ratio of 4 with driver rotating at 200 rpm. Design the pair of gears to transmit 20 KW if the safe static stress for cast iron pinion is 100 MPa and that for steel gear is 180 Mpa.

Take Lewis form factor Y = 0.175-(0.841/T)

And Barth's velocity factor $K_v = 3/(3+V)$

Where T is the number teeth and V is the velocity in m/sec. 10

7. A single plate friction clutch with both sides effective is used in an automobile to transmit 40 KW at 1200 rpm. The outer diameter of the plate should not exceed 180 mm because of space limitation. The service factor may be taken as 1.5 and the maximum intensity of pressure is not to exceed 0.84 MPa. Assume that the coefficient of friction between the friction lining of the disc and steel is limited to 0.25. Design the clutch plate with friction lining and the splined shaft. Draw a neat sketch showing the effective area of friction lining. 10

8. Design a hydrodynamic journal bearing for a steam turbine shaft of 20 cm diameter, running at 1800 rpm and carrying a load of 100 KN on each bearing. Assume ambient temperature to be 25 ^{0}C and viscosity of the lubricant used in the bearing may be taken as 0.021 PaS at mean bearing temperature of 65 ^{0}C.

Check the heat dissipation capacity of the bearing and state if any artificial cooling is required and the amount of oil to be circulated. 10

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