Registration No. :

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B. Tech

PCME 4306

Sixth Semester (Special / Back) Examination – 2013
DESIGN OF MACHINE COMPONENTS

BRANCH : MECH

QUESTION CODE : E 299

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any four from the rest. Draw neat sketches wherever necessary. Assume any missing data suitably. Use of Prescribed Design Data Book is permitted inside the examination hall. The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) What is stress concentration factor ? What are the methods of reducing stress concentration ?

   (b) What are the factors that affect the endurance limit of machine components ?

   (c) What is the difference between Gerber curve and Soderberg line ?

   (d) What is the difference between S ~ N Curves for ferrous and non-ferrous mechanical components ?

   (e) What is the functional difference between a brake and a clutch ?

   (f) Define virtual number of teeth for a bevel gear.

P.T.O.

(g) Define basic static load capacity, basic dynamic load capacity and life of a bearing.

(h) Why is a hollow piston pin preferred to a solid one ?

(i) Which type of the cross-section do you prefer for the main body of the connecting rod and why ?

(j) Enumerate the design considerations for crank pin.

2. (a) Determine the value of minimum ultimate strength according to Goodman's relation and yeild strength according to Soderberg's relation for a machine component which is subjected to a flexural stress, fluctuates between +250 MN/m^2 and -100 MN/m^2. Yeild strength = 0.55 ultimate strength, endurance strength = 0.5 ultimate strength and factor of safty = 2.5.   6.5

(b) Design the cylinder wall whose inner diameter is 250 mm. The cylindrical tank is meant for storing liquefied gas. The gas pressure is limited to 18 MPa. The tank is made of plain carbon steel 10C4 having ultimate tensile strength $320N/mm^2$ and poissons ratio 0.2.5.   6

3. Design a clutch for the speed gear box of a lathe machine to transmit 15 kW at 1000 rpm. The outer diameter of the clutch is limited to 125mm. For the above purpose select axial friction clutch with woven asbestos friction lining having co-efficient of friction as 0.25. The maximum operating temperature is limited to 200°. Consider overload as 25%. Maximum pressure at inner radius is 0.35 N/mm^2.   12.5

4. Design a journal bearing for transmitting power 25 MW, 350 rpm steam turbine which is supported by two bearings for the following data. Consider the bearing to be an average industrial bearing.

The bearing is 360° Hydrodynamic bearing, Journal diameter = Bearing length, The steam turbine shaft is made of alloy steel 40Ni2Cr1Mo28 having yield strength

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of about 1250 N/mm², Ambient temperature is 26°C, temperature of the oil film is 60°C, heat transfer coefficient is 15 W/(m²K), Bearing cap is made of gray CI of FG250 with tensile strength 250 N/mm², bolt material is 45C8 having allowable strength 80N/mm².

12.5

5. Design a pair of helical gears to transmit 15 kW power at a speed reduction ratio of 4 : 1. The input shaft rotates at 1500 rpm. Take helix and normal pressure angles equal to 25° and 20° respectively. Both pinion and gear are made of steel having following data :

Name of the part	Permissible stress	BHN
Pinion	55 MPa	340
Gear	45 MPa	320

The number of teeth on the pinion may be taken as 30. Assume other suitable data. Young's modulus for shaft, gear and pinion is 0.2×10^6 N/mm². The gears are required to be designed against bending failure of the teeth under dynamic condition.

12.5

6. Design a connecting rod for a petrol engine from the following data :

Diameter of piston is 110 mm, mass of the reciprocating part is 1.75 kg, length of the connecting rod is 320 mm, stroke is 150 mm, speed is 1500 rpm with possible over-speed 2500 rpm, compression ratio is 4 : 1 and maximum explosion pressure is 2.5 MPa. Material for the connecting rod is 37Mn2 with yield strength 445 N/mm². Allowable bearing pressure is 12 N/mm². Material for the bolt is 35Ni1Cr60 having tensile strength 650 N/mm². Assume other suitable data.

12.5

7. (a) What are the design requirements of piston ?   6

    (b) Describe the working principle of Internal expanding shoe brake.   6.5

8. (a) Discuss the suitability of CI as the gear material. 3.5

(b) Define the following terms : 6

    (i) Flywheel effect

    (ii) Coefficient of fluctuation of speed and

    (iii) Coefficient of fluctuation of energy.

(c) Why the tangential component of gear tooth force is called 'useful' component ? 3

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