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Total number of printed pages – 4

B. Tech
PCME 4306

Sixth Semester Examination – 2013

DESIGN OF MACHINE COMPONENTS

BRANCH : MECHANICAL

QUESTION CODE : A172

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 are the common drawbacks of the maximum shear stress theory compared to the maximum distortion energy theory ?
 - (b) What is the difference between Gerber curve and Soderberg lines ?
 - (c) What is the difference between S~N Curves for ferrous and non-ferrous components ?
 - (d) Explain by drawing the sketch the different terms used in case of a journal bearing clearance ratio and eccentricity.
 - (e) Why in case of thin cylinder subjected to internal pressure, the tangential stress is the criteria for determine the thickness of the cylinder wall ?
 - (f) What is the functional difference between a brake and a clutch ?
 - (g) Define basic static load capacity, basic dynamic load capacity of a bearing.

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- (h) What do you mean by virtual or formative bevel gear ?
- (i) What are the basic functions of piston rings ?
- (j) What types of crank shafts are commonly used ?
2. (a) A machine component is subjected to a flexural stress which fluctuates between $+300 \text{ MN/m}^2$ and -200 MN/m^2 . Determine the value of minimum ultimate strength according to Goodman's relation and yeild strength according to Soderberg's relation. Yeild strength = 0.5 ultimate strength, endurance strength = 0.55 ultimate strength and factor of safty = 2.5. 6
- (b) Design a closed cylindrical pressure vessel with dish end closures which is required to contain air at a pressure of 4.5 MPa. The shell is 450 mm inside diameter. The joint is double welded butt joint having joint efficiency 75%. The vessel is made of plain carbon steel having allowable strength 100 N/mm^2 . The shape factor is 1.07. 6.5
3. (a) Describe the working principle of centrifugal clutch. 2.5
- (b) Design a suitable clutch for the speed gear-box of a lathe machine to transmit 15 kW at 1200 rpm. Due to space limitation, the outer diameter is limited to 140 mm. Select axial friction clutch with woven asbestos friction lining having co-efficient of friction as 0.2. The maximum operating temperature is limited to 250° . Take overload as 25%. Maximum pressure at inner radius is 0.35 N/mm^2 . Allowable bearing pressure is within the range of 0.3 to 0.7 N/mm^2 . The ratio of inner diameter to outer diameter is 0.6. 10
4. (a) What do you mean by self-energizing and self-locking brake ? 2.5
- (b) A shaft rotating at 1500 rpm is supported by two single-row deep-groove ball bearings. The forces acting on ball bearing are 6500 N radial load and 3800 N axial thrust. The shaft diameter is 40 mm and expected life of the bearings is 500 hour. Select suitable bearings. 10

5. Design a pair of helical gears to transmit 20 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 23° and 20° respectively. Both pinion and gear are made of steel having following data. The number of teeth on the pinion may be taken as 30.

Name of the part	Permissible stress	BHN
Pinion	50 MPa	350
Gear	45 MPa	310

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. The wear and lubrication factor is 1.25 and velocity factor is 0.46. Face width is 15 times normal module. Profile error is 0.015. Assume other suitable data. 12.5

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

Diameter of piston is 100 mm, weight of the reciprocating part is 1.75 kg, length of the connecting rod is 315 mm, stroke is 140 mm, speed is 2500 rpm, compression ratio is 4:1 and maximum explosion pressure is 2.5 MPa. Material for the connecting rod is 37 Mn² with yield strength 450 N/mm². Allowable bearing pressure is 12 N/mm². Material for the bolt is 35Ni1Cr60 having allowable tensile strength 120 N/mm². Gasket factor is 0.2. Assume other suitable data. 12.5

7. (a) Describe the steps, which you will be considering for design for crank pin ? 2.5

(b) Design a flywheel for a single-cylinder, four-stroke vertical cylinder diesel engine developing 5 kW at 1200 rpm. Assume coefficient of speed fluctuation as 0.01 and coefficient of fluctuation of energy as 2.35. The flywheel is made of grey cast-iron having limiting speed 25 m/sec. The mass of the rim is 90% of the total mass and remaining 10% is contributed by web and hub. The width to thickness ration of the rim cross-section is 1.5. Density of the rim material is 7100 kg/m³ and the width to thickness ratio of rim is 1.5. The flywheel is fixed to an overhang shaft. The length of the overhang is 250 mm. Assume allowable shear stress for the crankshaft and key as

50 MPa and for cast-iron in tension as 20 MPa. The combined shock and fatigue factors for tension and bending may be taken as 1.2 and 1.5 respectively. 10

8. (a) Explain briefly about the following terms : 5
- (i) Stress concentration factor
 - (ii) Endurance limit
- (b) What is meant by whipping of a connecting rod and what is its effect ? 2.5
- (c) Define the following terms : 5
- (i) Coefficient of fluctuation of speed and
 - (ii) Coefficient of fluctuation of energy.