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Total number of printed pages – 3

B. Tech
PCME 4306

Sixth Semester Back Examination – 2015

DESIGN OF MACHINE COMPONENTS

BRANCH : MECH

QUESTION CODE : M 182

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 : 2x10
- (a) State the assumptions made in deriving a bending formula.
 - (b) Explain the concept of stress concentration.
 - (c) What is pressure vessel ?
 - (d) Explain bearing characteristic number and bearing modulus.
 - (e) Classify the bevel gear.
 - (f) Why a positive clutch is used ?
 - (g) What is the condition of self-locking of brake ? When a brake becomes self-locking ?
 - (h) Name different types of anti-friction bearing.
 - (i) Define virtual number of teeth on a helical gear.
 - (j) What is the function of a crank shaft ?
2. (a) Design a suitable diameter for a circular shaft required to transmit 90kW at 180 rpm. The shear stress in the shaft is not to exceed 70N/mm^2 and the maximum torque exceeds the mean by 40%. Also find the angle of twist in a length of 2 meters. Assume modulus of rigidity is 900GN/m^2 . 5

P.T.O.

- (b) Determine the thickness of the flat end cover plates for a 1N/mm^2 boiler that has a diameter of 600 mm. The limiting tensile stress in the boiler shell is 40N/mm^2 . 5
3. A hot rolled steel shaft is subjected to a torsional moment that varies from 330Nm clockwise to 110Nm counter clockwise and an applied bending moment at a critical section varies from 440 Nm to -220 Nm . The shaft is of uniform cross-section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m^2 and yield strength of 410 MN/m^2 . Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.88 and a surface finish factor of 0.62. 10
4. (a) A soft cone clutch has a cone pitch angle is 10° , mean diameter of 300 mm and a face width of 100 mm. if the coefficient of friction is 0.2 and has an average pressure of 0.07N/mm^2 for speed of 500 rpm. Find 5
- (a) the force required to engage the clutch and
- (b) the power that can be transmitted. Assume uniform wear.
- (b) Describe with the help of a neat sketch the principle of operation of an internal expanding shoe brake. Describe the expression for the braking torque. 5
5. A pair of straight teeth spur gears, is to transmit 20kW when the pinion rotates at 300 rpm. The velocity ratio is 1 : 3. The allowable static stresses for the pinion and gear materials are 120 and 100N/mm^2 respectively. The pinion has 15 teeth and its face width is 14 times the module. Determine : 10
- (a) module
- (b) face width
- (c) pitch circle diameters of both pinion and gear from the stand point of strength only, taking into consideration the effect of the dynamic loading.

The tooth form factor y can be taken as $y = 0.154 - \frac{0.912}{\text{No. of teeth}}$

And the velocity factor C as $C_v = \frac{3}{3 + v}$, where v is expressed in $\frac{\text{m}}{\text{s}}$.

6. (a) What are rolling contact bearings ? Discuss its advantages and disadvantages over sliding contact bearing. 5
- (b) The load on journal bearing is 150kN due to turbine shaft of 300 mm diameter running at 1800 rpm. Determine
- (i) length of bearing if the allowable bearing pressure is 1.6N/mm^2 and
- (ii) amount of heat to be removed by lubricant per minute if the bearing temperature is 60°C and viscosity of the oil at 60°C is 0.02kg/m-s and the bearing diameter is 0.25mm . 5
7. Design a cast iron flywheel having six arms for a four stroke engine developing 120kW at 180rpm. The mean diameter of the flywheel may be taken as 3 meters. The fluctuation of speed is $\pm 2.5\%$ of mean speed. The work done during the working stroke is 1.3 times the average work done during the whole cycle. Assume allowable shear stress for the shaft and key as 40N/mm^2 and tensile stress for cast iron as 20N/mm^2 . The following properties for the rim and elliptical arms may be taken :
- (a) width of rim is 2 times thickness of rim and
- (b) Major axis is 2 times minor axis. 10
8. Write short notes on any **two** : 5×2
- (a) Thick cylindrical shell
- (b) Block and band brake
- (c) Connecting rod
- (d) Maximum Normal stress theory.

