Registration No. :

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B. Tech

PCME 4306 (New)

## Sixth Semester (Back) Examination – 2013

### DESIGN OF MACHINE COMPONENTS

BRANCH : MECH

QUESTION CODE : B242

Full Marks – 70

Time : 3 Hours

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

1.  Answer the following questions :                                    2 ×10

    (a)  Draw S~N Curves for ferrous components and show the salient points of the curve.

    (b)  What do you mean by stress concentration factor ?

    (c)  State the maximum shear stress theory and maximum distortion energy theory.

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

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

    (f)  What is internal expanding shoe brake ? Where this type of brake is used ?

    (g)  Why ball and roller bearings are called antifriction bearings ?

    (h)  What factors should be considered in designing friction clutch ?

    (i)  What are the basic functions of piston rings ?

    (j)  What are the advantages of helical gears over spur gears ?

2.  The figure below shows a shaft with load varying from 0 kN to 14 kN. Determine the dimensions of the shaft if it made of steel having ultimate strength = 800 N/mm$^2$ and Yeild strength = 600 N/mm$^2$. The shaft is machine

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finished. Consider factor of safty = 2, surface finish factor = 0.85, size factor = 0.8 , reliability factor = 1.0, temperature factor =1.0 , notch sensitivity factor = 0.67. All dimensions are in mm.    12.5
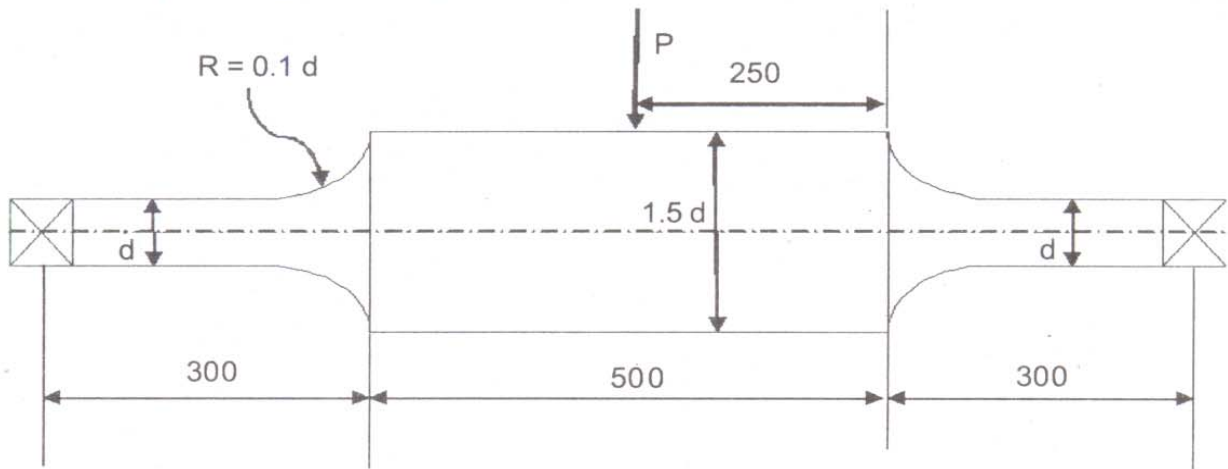


3. A closed pressure vessel consists of a cylindrical shell enclosed by hemispherical ends. The pressure vessel is required to contain air at a pressure of 4 MPa. The shell is 450 mm inside diameter. The vessel joint is a double welded butt joint with joint effiency 85%. The vessel is made of plain carbon steel having allowable strength 100 N/mm$^2$. The shape factor is 1.07. Design the oressure vessel.   12.5

4. Design a suitable clutch for the speed gear box of a machine to transmit 12 kW at 1000 rpm. Due to space limitation, the outer diameter is limited to 120 mm. Select axial friction clutch with woven asbestos friction lining having co-efficient of friction as 0.15. The maximum operating temperature is limited to 200$^0$. 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.    12.5

5. (a) What do you mean by self-energizing and self-locking brake ?    3.5

   (b) What do you mean by basic static load capacity, basic dynamic load capacity and life of bearing ?    3

   (c) Explain by drawing the sketch the different terms used in case of journal bearings such as journal, clearance, eccentricity, attitude angle.    3

   (d) Describe the type of stress produced in (i) flywheel rim and (ii) flywheel arms.    3

6. A motor shaft has to transmit power 7.5 kW at speed 1450 rpm to a low speed shaft rotating at 500 rpm. A 20$^0$ pressure angle involute tooth gear-pinion is used. The pinion has 25 teeth. Both gear and pinion are made of cast iron having

allowable strength of 55 N/mm² and BHN is 340. Elastic modulus of both gear and pinion is $0.1 \times 10^6$ N/mm². Take shaft material as C30 having shear strength = 250 N/mm². The value of service factor is 1.5 and velocity factor is 0.35. The profile error is 0.032. Assume other suitable data. Design completely the pair of spur gears.

12.5

7. Design a piston with piston pin and rings for four stroke diesel engine developing power at 2200 rpm. Other related data are given below :

Piston diameter : 100 mm ; Length of the stroke : 120 mm ; mean effective pressure : 0.7 N/mm² ; bsfc : 0.26 kg/kWh ; L/r ratio : 4 ; Heat conducted through the piston crown is equal to 10% of the heat generated during combustion ; highest calorific value of the fuel is 42 MJ/kg ; mechanical efficiency : 80%. Piston is made of Aluminium alloy having allowable tensile strength is 55 N/mm². Thermal conductivity is 1600 J/s m² °C/mm and the temperature difference between center and the edge of the piston head is 111°C. Piston pin is made of alloy steel 37Mn2 having allowable tensile strength of 120 N/mm². Bearing pressure at the pin 20 N/mm². Piston ring material : Crome plated CI having allowable strength 85 N/mm², Radial pressure on the ring is 0.025 N/mm². Assume other suitable data.

12.5

8. (a) Why in case of thin cylinder subjected to internal pressure, the tangential stress is the criteria for determine the thickness of the cylinder wall ?    3

   (b) Explain with neat sketch the working principle of centrifugal clutch.    3.5

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

   (d) Describe the steps, which you will be considering for design for crank pin ?    3

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