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TME-603

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4095Roll No. **B. Tech.****(SEM. VI) EXAMINATION, 2007-08****MACHINE DESIGN - II***Time : 3 Hours]**[Total Marks : 100*

- Note :
- (i) *Attempt all questions.*
 - (ii) *Assume any missing data suitably.*
 - (iii) *Use of design data book is permitted.*

1 Attempt any **two** of the following : **10×2=20**

- (a) A pair of 20° stub teeth spur gears is to transmit 20 kW. The pinion rotates at 500 rpm and the velocity ratio is 1 : 4. The allowable static stresses for gear and pinion materials 100 MPa and 120 MPa respectively. The pinion has 20 teeth and the face width is 10 times the module. Design the gear for static strength.
- (b) A pair of helical gears is used to transmit 20 kW at 5000 rpm of the pinion. The teeth are 20° stub in diametral plane and the helix angle is 35°. The pinion has a pitch circle diameter of 80 mm and gear ratio is 4 : 1. Both gear and pinion are made of cast steel with an allowable static strength of 100 MPa. Suggest a suitable module and face width for the gear pair and check the strength of the design in wear. Take modulus of elasticity for cast steel as 2×10^5 MPa and

$$\sigma_{es} = 620 \text{ N/mm}^2.$$

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- (1) Write a short note on lubrication of gears.
- (2) Advantages and disadvantages of helical gear over spur gear.

2 Attempt any **two** of the following : **10×2=20**

- (a) A 20° full depth straight teeth bevel gear rotates at 500 rpm and transmits 12 kW power to other gear rotating at 200 rpm. The outer module is 3.5 mm and the number of teeth on pinion is 30. Ratio between the cone distance and face width is 3. Check the safety of design for steady loading if allowable static stress in bending is 100 MPa.
- (b) A worm gear has 30 teeth of $14\frac{1}{2}^\circ$ and the coefficient of friction for worm gear is 0.05. The worm is triple threaded with a module of 6 mm and pitch circle diameter of 50 mm. Calculate the following :
 - (i) Lead angle of worm
 - (ii) Velocity ratio
 - (iii) Center distance
 - (iv) Efficiency of gearing.
- (c) Answer the following in brief :
 - (i) Formative number of teeth for a bevel gear
 - (ii) Importance of center distance in the design of worm and worm gear.

3 Attempt any **two** parts of the following : **10×2=40**

- (a) A full journal bearing of 50 mm diameter and 100 mm length has a bearing pressure of 1.4 N/mm². The speed of the journal is 900 rpm and the ratio of journal diameter to the diametral clearance is 1000. The lubricating oil used has absolute



viscosity at operating temperature of 75°C is 0.011 kg/m-s . The room temperature is 35°C . Determine the amount of artificial cooling required and the mass of lubricating oil required if the difference between the outlet and inlet temperature of the oil is 10°C . Take specific heat of oil is $1850 \text{ J/kg}^{\circ}\text{C}$.

- (b) A bearing is required for a 35 mm shaft. It is to operate for 8 hours per day, 5 days per week for 5 years and is to carry a stationary radial load of 2250 N at 1500 rpm . The inner race rotates. There is possibility of light shock. Suggest a suitable bearing.
- (c) Answer the following in brief :
- (i) Effect of clearance on the bearing performance.
 - (ii) Important considerations for selection of bearing.

4 Attempt any **two** of the following : **$10 \times 2 = 20$**

- (a) Determine the cross section of I section connecting rod for a single cylinder IC engine. Following data are provided for the engine :

- (1) Piston diameter = 100 mm
- (2) mass of reciprocating parts = 2.25 kg
- (3) length of connecting rod = 300 mm
- (4) stroke length = 125 mm
- (5) speed = 1500 rpm
- (6) maximum explosion pressure = 3.5 N/mm^2
- (7) factor of safety = 7
- (8) density of rod material = 8000 kg/m^3
- (9) yield stress in compression = 330 MPa

Assume width of section as $4t$ and depth as $5t$, where t is the web thickness of I section.



(b) A cast iron piston for single acting four stroke engine for the following applications :

- (1) Cylinder bore = 100 mm
- (2) Stroke = 120 mm
- (3) maximum gas pressure = 5 N/mm^2
- (4) break mean effective pressure = 0.65 N/mm^2
- (5) fuel consumption = 0.227 kg/k W/h
- (6) Speed = 2200 rpm

Find the suitable thickness of the piston head. Thermal conductivity for cast iron is $460 \text{ J/s m}^2 \text{ }^\circ\text{C/m}$ and allowable temperature difference is 222°C .

(c) Explain the following in brief :

- (1) Why I section is chosen for high speed IC engines ?
- (2) Lubrication of small end bearing and crank pin bearing of connecting rod.
- (3) Two most usual causes of failure of crank shafts.

5 Answer any **four** of the following in brief : 5×4=20

- (1) Forces acting on the bevel gear tooth
- (2) Different types of piston rings.
- (3) Stresses induced in a connecting rod.
- (4) Materials used for sliding contact bearings.
- (5) Variation of coefficient of friction with bearing modulus.
- (6) Types of roller bearing.
- (7) Material and manufacturing of crankshaft.

