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मठ - 032

Machine Design - II (1090)

P. Pages : 3

Time : Four Hours

Max. Marks : 100

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Attempt **any two** bits from each question.
5. Assume suitable data if necessary.
6. Use of non programmable calculator is allowed.
7. Use of PSG design data book is allowed.

1. a) A 4-shoe centrifugal clutch is used to transmit 40 kw at 1440 rpm. The engagement is at 80% of the full speed. Inner diameter of the drum is 320 mm & the C.G. of each shoe is radially at a distance of 130 mm from axis. Coefficient of friction between friction lining & drum is 0.22. Design the clutch when normal pressure between friction lining & drum is 0.1 MPa If the arc of contact for each friction lining is 60° . 10
b) A bicycle & a rider traveling at 20 km/hour on a level road have a total mass of 80 kgm. A brake is applied to the wheel which is 780 mm in diameter. Coefficient of friction between brake pad & wheel is 0.1. Consider the pad as rectangular with $b = 3t$. Determine size of disk brake pad if $p_{\max} = 1\text{N/mm}^2$. The bicycle is to stop at a distance of 50 m. Neglect KE of rotating parts. 10
c) Explain :
i) What is the significance of PV value in brake design. 3
ii) Cone clutch. 7
2. a) It is required to select a V-belt drive from 5 kw normal torque motor, which runs at 1440 rpm to a light duty compressor running at 970 rpm. The compressor runs for 24 hours per day. Space is available for a centre distance of about 500 mm Assume that the pitch diameter of the driving pulley is 150 mm. 10

- b) It is required to design a chain drive to connect 5 kw, 1440 rpm electric motor to a drilling machine. The speed reduction is 3:1. The centre distance should be approximately 500 mm.
- select a proper roller chain for the drive
 - Determine the number of chain links.
 - Specify the correct centre distance between the axes of sprockets.

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- c) Explain the followings :

- Basic types of product forms.
- Design consideration in controls.

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3. a) The following data is given for a spur gear made of plain carbon steel & manufactured by shaping :

Module = 8 mm

Centre distance = 380 mm

Permissible bending stress = 60 N/mm²

Pinion speed = 1500 rpm

Gear speed = 400 rpm

Face width = 10 m

Tooth system = 20° full depth involute

Application factor = 1.5

Factor of safety = 2.0

Assuming that the velocity factor accounts for the dynamic load, calculate the rated power that the gear pair can transmit, suggest the surface hardness. 10

- b) A helical pinion having 21 teeth is to be made from plain carbon steel 55C8 having $S_{ut} = 720 \text{ N/mm}^2$. It is to mesh with gear made of plain carbon steel 40C8 having $S_{ut} = 580 \text{ N/mm}^2$. The gear pair is required to transmit 10 kw power from an electric motor running at 1000 rpm to a machine running at 300 rpm. The starting torque of the motor is 150% of the rated torque. The factor of safety required is 2. The face width can be taken as 10 times the normal module & the tooth system is 20° full depth involute. The helix angle is 25°. The gear & pinion are to be hardened to 350 BHN & 360 BHN respectively. Design the gear pair by dynamic factor & Buckingham's equation if deformation factor is 114 N/mm.

$$\text{Use } Y = 0.484 - \frac{2.87}{\text{No. of teeth}}; C_v = \frac{5.6}{5.6 + \sqrt{v}}$$

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- c) Explain :

- Gear tooth failure.

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- Herringbone Gear.

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4. a) A right angled drive a straight bevel gears consists of a 24 teeth pinion meshing with a 32 teeth gear. The pinion shaft is connected to 10 kw, 1000 rpm electric motor. The starting torque of the motor is 125% of the rated torque. The load distribution factor is 1.2. The gear is to be made of grey C.I. FG 350, while pinion is to be made of case hardened steel 40C8 ($S_{ut} = 580 \text{ MPa}$) for a 20° full depth involute profile, design the gears by using the dynamic factor if the factor of safety is 1.5, against bending failure. If the gears are to have a factor of safety of 2 against pitting failure, design the surface hardness required. 10
- b) A two start worm drives a 60 teeth phosphor bronze gear. The axial module is 6 mm, having normal pressure angle as 20° . The diametral factor is 10. Find the factor of safety in bending, wear & heat dissipation if the worm is to transmit 7 kw at 1800 rpm.
Assume $\mu = 0.05$, $6_b = 110 \text{ N/mm}^2$, $K = 0.83 \text{ N/mm}^2$, $Y = 0.392$. 10
- c) Explain the following :
- i) Efficiency of worm drive. 5
- ii) Force analysis of Bevel gear. 5
5. a) A ball bearing carries a radial load of 400 N at 1760 rpm for 40% time, 600 N at 800 rpm for 30% time & 200 N at 1000 rpm for the remaining period of the cycle. If the expected life of the bearing is 10000 hours at 90% reliability. Find the dynamic load rating of the bearing. Assume inner race rotating & non rotating radial load condition. Also calculate the life of selected bearing at 95% reliability. 10
- b) A steel tube with inner & outer diameter of 20 mm & 40 mm respectively. It is jacketed by an outer steel tube having an outer diameter 60 mm. The tubes are assembled by shrinking process in such a way that maximum principal stress induced in any tube is limited to 100 N/mm^2 . Calculate the shrinkage pressure & original dimensions of the tubes ($E = 207 \text{ kN/mm}^2$). 10
- c) Explain the following :
- i) Auto frettage. 5
- ii) Selection of bearing from manufacturer's catalogue. 5
