

III B.Tech II Semester Supplementary Examinations, April/May 2005
MACHINE DESIGN

(Common to Mechanical Engineering and Production Engineering)

Time: 3 hours**Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

1. (a) A 100 mm long and 60 mm diameter journal bearing supports a load of 2500 N at 600 rpm. If the room temperature is 20°C , what should be the viscosity of oil to limit the bearing surface temperature to 60°C ? Diametral clearance = 0.06 mm. Energy dissipation coefficient based on the projected area of the bearing = $210\text{W}/\text{m}^2\text{ }^{\circ}\text{C}$.
(b) A 250×250 mm bearing carries a load of 108 kN. The bearing rotates at 1500 rpm. The clearance ratio is 670. For full journal bearing the power lost in friction is 14.36 kW. Find the viscosity of the oil.
2. (a) What are the commonly used non-metallic bearing materials?
(b) The radial load on a roller bearing varies as follows. A load of 50 kN is acting 20% of time at 500 rpm and a load of 40 kN is acting 50% of time at 600 rpm. In the remaining time, the load is varying from 40 kN to 10 kN linearly at 700 rpm. Select a roller bearing from NU22 series for a life of at least 4000 hours. The operating temperature is 175°C .
3. (a) Give the design criteria for selection of diameter of connecting rod ends.
(b) Sketch the inertial loading pattern on connecting rod and state when it will Occur.
4. A crank shaft of the center crank type is to be designed for a diesel engine developing 7.5 KW on break at 1200 rpm .The crank shaft is forged type and has to carry 2 fly wheels of 500N each on either side of the main bearing. The plane of rotation of each wheel is 100mm from the centerline of adjacent bearing. The maximum load on the connecting rod is 35 KN. The length of the stroke of piston is 160mm and the length of the connecting rod is 320mm.The maximum torque is experienced in crankshaft when the crank turns 30° from I.D.C position. The maximum permissible stress in crank pin, web and shaft should not exceed 60 N/sq.mm. The safe limit for the bearing stress, the crank pin and main bearing is 800 N/sq.mm design the crank shaft
5. (a) Derive an expression for deflection of a helical torsion spring.
(b) Design a spring for a balance to measure 0 to 1000 N over a scale of length 80 mm. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is $85\text{ kN}/\text{mm}^2$. Also calculate the maximum shear stress induced
6. (a) Prove that the centrifugal tension must be 1/3rd of the max. tension for max. power transmission

- (b) Design a cross belt drive having 1.5 m center distance between the two pulleys. The diameter of bigger and smaller pulleys are 'D' and 'd' respectively. The smaller pulley rotates at 1000 r.p.m. and the bigger pulley at 500 r.p.m. The flat belt is 6 mm thick and transmits 7.5 kW power at belt speed of 13 m/s approximately. The coefficient of belt friction is 0.3 and the density of belt material is 950 kg/m^3 . The permissible tensile stress for the belt material is 1.75 MPa.
7. (a) Explain on what factor does the surface strength of gears depend.
- (b) A spur gear drive with following specifications $m = 4 \text{ mm}$; $b = 44 \text{ mm}$; $Z_p = 20$; $Z_g = 70$; $N_p = 870 \text{ rpm}$; $N_g = 250 \text{ rpm}$, is used to transmit 15 KW. Check for wear strength and suggest the required surface hardness of pinion.
8. Design a CI piston for single acting 4-stroke engine for the following specification
- Cylinder bore = 100 mm
Stroke = 120 mm
Maximum gas pressure = 5 N/sq.mm
Break mean effective pressure = 0.65 N/sq.mm
Fuel consumption = 0.23 Kg/Kw/hr
Speed = 2200 rpm
