

NAME.....

ROLL NO.....

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY-2008**

**III B.TECH SUPPLEMENTARY EXAMINATIONS  
PRINCIPAL OF MACHINE DESIGN  
(MECHATRONICS)**

AUG/SEP 2008

TIME-3 HOUR  
MARK-80

**ANSWER ANY FIVE QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS.**

1. Compare the weights of equal lengths of hollow shaft and solid shaft to transmit a given torque for the same maximum shear stress. The material for both the shafts is same and inside diameter is  $\frac{2}{3}$  of outside diameter in case of hollow shaft.
2. Determine the diameter of hollow shaft having inside diameter 0.5 times the out side diameter. The permissible shear stress is limited to 200 MPa. The shaft carries a 900 mm diameter cast iron pulley. This pulley is driven by another pulley mounted on the shaft placed below it. The belt ends are parallel and vertical. The ratio of tensions in the belt is 3. The pulley on the hollow shaft weighs 800 N and overhangs the nearest bearing by 250 mm. The pulley is to transmit 35 kW at 400 rpm.
3. (a) What is the importance of the dimensionless groups in the design of journal bearings.  
(b) A full-length bearing operates with the following data  
Length of bearing = 150 mm  
Dia of bearing = 100mm  
Radial load on bearing = 25kN  
Speed of journal = 250 rpm  
Radial clearance = 0.045 mm  
It is desired to limit minimum oil film thickness to 0.025mm. Determine a suitable value for the viscosity of the lubricant and the power loss due to friction.
4. Design and make a neat dimensional sketch of a muff coupling which is used to connect two steel shafts transmitting 40kW at 350 rpm. The material for the shaft and key is plain carbon steel for which allowable shear and crushing stress may be taken as 40N/mm<sup>2</sup> respectively. The material for the cast iron for which the allowable shear stress may be assumed as 15N/mm<sup>2</sup>. Take standard proportions.
5. A carbon steel rod of circular cross-section having  $s_u = 600\text{MN/m}^2$ ,  $s_y = 450\text{MN/m}^2$ ,  $s' e = 300\text{MN/m}^2$  is subjected to a bending moment which varies between 300 to 500 Nm and axial load which varies between 5 to 10 kN. Assuming that the bending moment and axial load are in phase determine the diameter of the rod to have a factor of safety of 2.
6. Determine the dimensions of an I-Section connecting rod for a petrol engine from the following data:  
Diameter of the piston = 110 mm;  
Mass of the reciprocating parts = 2 kg;  
Length of the connecting rod from center to center = 325 mm;  
Stroke length = 150 mm;  
R.P.M = 1500 with possible over speed of 2500;  
Compression ratio = 4:1;  
Maximum explosion pressure = 2.5 N/mm<sup>2</sup>.
7. A 50 kW, 1200 rpm, high torque squirrel-cage motor is used to drive a punch press. The speed of the punch press flywheel is 300 rpm. If the center distance is 2.5 m, select a suitable leather belt.
8. Design a pair of spur gears to drive a lobe-blower from a 120 kW motor running at 2880 rpm. With a reduction ratio of 1.6. The pitch diameter of the pinion is not to be more than 80 mm. Drive is an enclosed one with proper lubrication. Life to be indefinite. Light shock loads are likely.

Name Material (Steel) Design compressive Design bending stress (N/mm<sup>2</sup>) stress (N/mm<sup>2</sup>)  
Pinion CI 35 600 550 Gear CI 25 600 400