B. Tech.
(SEM. VI) EXAMINATION, 2006-07
MACHINE DESIGN

Time : 2 Hours] [Total Marks : 50

Notes :  (1) Attempt all questions.
         (2) Assume any missing data suitably.
         (3) Use of design data book is permitted.

1. Attempt any two parts of the following : 6×2=12
   (a) Answer in brief :
       1. Heat treatment of steel
       2. Difference between toughness and hardness of a material
       3. Differentiate between cast iron, wrought iron and mild steel.
   (b) Suggest suitable materials for the following machine elements stating the special property which makes it suitable for use :
       1. Worm and worm gear
       2. Nut of a heavy duty screw jack
       3. Automobile cylinder block
       4. Keys (used for fastening)
(c) Answer in brief:

1. Surface roughness and its measurement

2. What are fits and tolerances? How are they designated?

2. Attempt any **one** part of the following:  \(12 \times 1 = 12\)

   a. A shaft is to be used for transmitting 5 kW power from an electric motor to a lathe headstock through a belt and pulley drive. The mean diameter of the pulley is 400 mm and it weighs 200 N. The pulley is located at 250 mm from the centre of the bearing and is overhanging on side. The angle of lap is 180° and the coefficient of friction between the belt and the pulley is 0.25. The pulley rotates at 200 rpm. The allowable stress for the shaft material is 45 MPa. Assume the shock and fatigue factor for bending and torsion as 1.5 and 2.0 respectively.

   b. Design a cast iron rigid flange coupling for a mild steel shaft transmitting 80 kW at 500 RPM. The allowable shear stress of the shaft material is 50 MPa. The allowable shear stress for cast iron and bolt materials are 14 MPa and 35 MPa respectively.
3. Attempt any one part of the following: $12 \times 1 = 12$

(a) A 20° stub involute teeth spur gear drive is required to transmit 25 kW at 240 rpm of pinion. The gear ratio is 1:2. The centre distance between the gears may be taken as 600 mm. The static stress for gear and pinion may be taken as 80 MPa and face width is 10 times the module. Find module, face width and number teeth on gears. Check the design for wear load if the load stress factor is 1.4.

(b) A belt 100 mm wide and 10 mm thick is transmitting power at a peripheral velocity of 1000 m/min. The net driving tension is 1.8 times the tension on the slack side. If the safe permissible stress on the belt section is 1.6 N/mm², calculate the maximum power that can be transmitted at this speed. Assume density of the leather as 100 kg/m³. Also calculate the absolute maximum power that can be transmitted by this belt and the speed at which it can be transmitted.

4. Attempt any one part of the following: $14 \times 1 = 14$

(a) A steam boiler is to be designed for a working pressure of 2.0 N/mm². The inside diameter of the boiler is 1.5 m. Design a triple riveted double strap longitudinal butt joint for the boiler with unequal cover plates. The allowable stresses...
for the boiler material are 120 MPa in crushing, 75 MPa in tension and 50 MPa in shear. Draw the joint to a suitable scale.

(b) Design a knuckle joint to transmit an axial load of 125 kN. The material of joint parts and pin may be taken as same with allowable stresses in tension, shear and crushing as 80 MPa, 40 MPa and 100 MPa respectively. Draw a neat sketch of the joint showing all the major dimensions.