Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, JULY 2017

SUBJECT: DESIGN OF MACHINE ELEMENTS [MTE 2202]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided might be suitably assumed
- Use of design data hand book is permitted

1. Design a spur gear drive to transmit 20 kW of power at 1200 RPM of pinion. The gear ratio is 3:1. The pinion is to have 18 no of teeth. The pressure angle is 20˚. Both pinion and gear are made of cast steel 0.2 %C, untreated. The gears are subjected to medium shock with 8 to 10 hours per day of service. Also calculate dynamic load and check for wear load. **(10)**

2. A belt pulley is mounted on a shaft midway between 2 supported bearings that are 1m apart. The shaft receives 20 kW power at 500 RPM through a motor. The angle of wrap of belt on the pulley is 180˚ and the belt tensions act vertically downward. The ratio of belt tensions is 2.5. The shaft is made of steel (Yield strength is 300 N/mm^2) and FOS is 3. Determine the shaft diameter on the basis of maximum shear stress. **(10)**

3A. A power screw having double start square threads of 25 mm nominal diameter, 21mm core diameter is acted upon by an axial thrust of 10 kN. The outer diameter of collar is 50 mm and inner diameter of collar is 20 mm. The coefficient of friction at the screw is 0.2. The screw rotates at 12 RPM. Calculate the stresses in the screw, torque required to raise load and power required to drive it. Take μ_c= 0.15. **(04)**

3B. A hot rolled steel bar is subjected to a tensile force which varies from 30KN to 10 KN. The material of the bar has an ultimate strength of 600 N/mm^2 ad **(06)**

yield strength of 400 N/mm^2. Estimate the bar diameter for continuous operation. Use Soderberg design equation.

4A. A rectangular plate 70 mm wide with a semicircular groove of 12 mm radius is subjected to **(04)**

i. A tensile load of 10 KN

ii. A bending moment of 15 N-m

Determine the thickness in each case separately taking allowable stress as 120 MPa.

4B. An electric motor weighing 10 kN is lifted by means of an eyebolt as shown in Fig 4B. The eyebolt is screwed into the frame of the motor. The eyebolt is made of plain carbon steel (Yield strength is 400 N/mm^2) and FOS is 6. Determine the bolt size. **(03)**

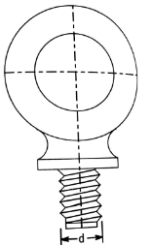

Fig 4B

4C. Select a single row deep groove ball bearing for a shaft that is 75 mm in diameter and rotates at 125 RPM. The bearing is subjected to a radial load of 21 kN and there is no thrust load. The expected life of bearing is 10000 hrs. **(03)**

5A. A cantilever beam of circular section made of C40 steel and subjected to a completely reversed load of 5 KN is shown in Fig 5A below. The material is cold drawn, notch sensitivity is 0.9 and factor of safety is 2. Calculate the diameter of the shaft. **(05)**

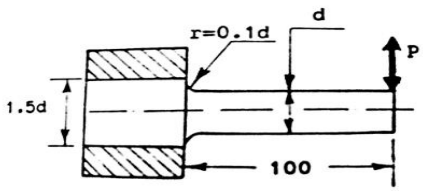

Fig 5A

5B. A helical spring is to be designed for an operating load range of 1 kN to 1.3 kN. The initial compression of the spring is 60mm for a load of 1 kN. Assume the spring index as 10. The shear stress in the spring material is 500 MPa and modulus of rigidity is 82.7 GPa. **(05)**