Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2016

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 pair of spur gears with 20˚ full depth involute teeth. The pinion is connected to 35kW motor and rotates at 1440 RPM. The speed reduction is 10:1. The number of teeth on pinion is 24. Both pinion and gear are made of case hardened steel and allowable bending stress is 200 N/mm^2. The modulus of elasticity is 200X10^3 N/mm^2. The gears are subjected to steady loads and operate 8-10 hours per day. **(10)**

2. A layout of transmission shaft carrying 2 pulleys B and C and supported on bearings A and D is as shown in Fig 2. Power is supplied to the shaft by means of a vertical belt on pulley B. Pulley C transmits power to a lathe through a horizontal belt. Pulley B has a diameter of 500 mm and pulley C has a diameter of 250 mm. The maximum tension in belt on pulley B is 2.5kN. The angle of wrap for both pulley is 180˚ and coefficient of friction is 0.24. The shaft is made of plain carbon steel (Yield strength in shear =200 N/mm^2). For a factor of safety 3, determine the shaft diameter. Consider load is applied gradually with no shocks. **(10)**

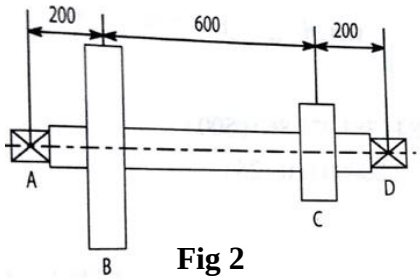

Fig 2

3A. The lead screw of a lathe has single start square threads of 52 mm nominal diameter and 8mm pitch. The screw is required to exert an axial force of 2 kN in order to drive the tool carriage during turning operation. The thrust is carried on a collar of 100 mm outer diameter and 60mm inner diameter. The values of coefficient of friction at the screw threads and the collar are 0.15 and 0.12 respectively. The lead screw rotates at 30 RPM. Calculate **(04)**

a. Power required to drive the lead screw and

b. Overall efficiency of the screw

3B. A circular shaft as shown in fig 3B is subjected to a bending moment of 8000 Nmm and a torque of 6200 Nmm. Determine the shaft size if maximum normal stress induced is limited to 100 N/mm^2. **(06)**

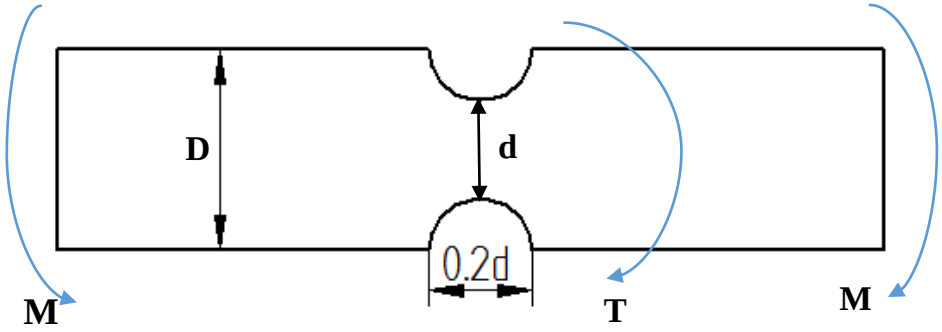

Fig 3B

4A. Select a suitable ball bearing for the shaft of an axial flow compressor having the following details. **(05)**

Radial load=2.5kN

Axial Load=1.5kN

Speed =1000RPM

Shaft diameter d= 50mm

Bearing life = 50 hours/week for 5 years.

4B. A cylinder head is fastened to a cylinder with 8 bolts. The maximum pressure inside the 500mm cylinder is 2MPa. If the initial load due to tightening is 36816N, calculate the total force on bolt assuming that stiffness of the member (gasket) is 3 times the stiffness of the bolt. Also determine the size of the bolt if bolt material is steel with allowable stress of 240 N/mm^2. **(03)**

4C. The standard cross section for a parallel key which is fitted on a 50 mm diameter shaft is 16X10 mm. The key is transmitting 475 Nm torque from **(02)**

shaft to hub. The key is made of commercial steel (Yield strength is 300 N/mm^2). Determine the length of the key if FOS =3.

5A. A cantilever beam made of cold drawn C30 steel of circular cross section is as shown in the figure 5A which is subjected to a load varying from F to -2F. Determine the maximum load this member can withstand for a FOS of 2, notch sensitivity factor of 0.9 and size factor of 0.8. Analyze at the change of cross section only. **(05)**

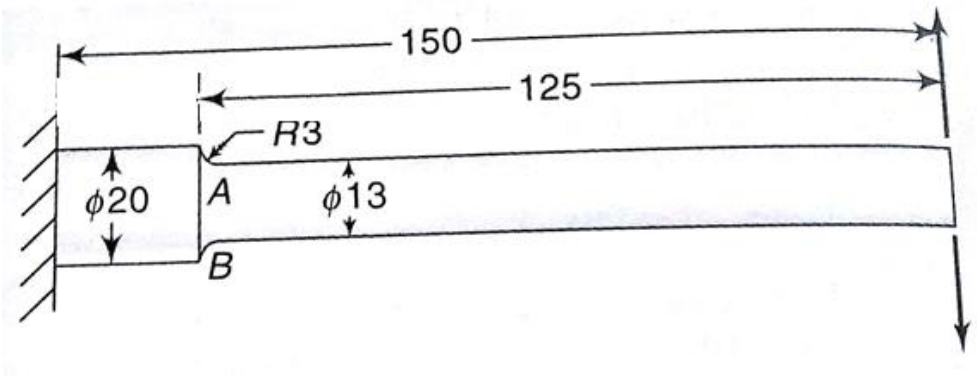

Fig 5A

5B. A helical compression spring is required to carry a load of 500 N with a deflection of 20 mm. The allowable shear stress in the spring material is 350 MPa and modulus of rigidity is $82.7X10^3$ MPa. Spring index is 6. Design the spring completely. **(05)**