Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

V SEMESTER B. TECH (I&P) END SEMESTER

MAKE-UP EXAMINATIONS, DEC 2017

SUBJECT: DESIGN OF MACHINE ELEMENTS [MME 3112]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer All the questions & Assume suitable missing data
- Machine design data hand book permitted to use

1A A flat bar shown in Figure 1 is subjected to an axial load of 100 N. Assuming the stress in the bar is limited to 200 MPa. Determine the thickness of the plate. **4**

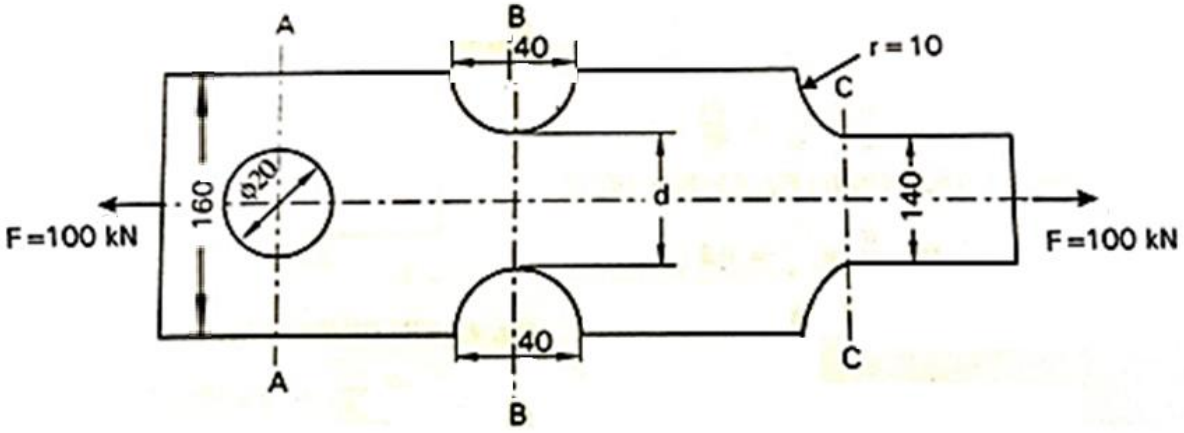

Figure 1

1B Determine the maximum load for a simply supported beam of 50 mm diameter and 600 mm span, centrally loaded, as the load cyclically varies from *W* to *3W*. σ_{en} = 350 MPa, σ_{yp} = 525 MPa and σ_u = 700 MPa. Design factor of safety is 1.3. **6**

2A A pair of spur gears with14.5° full depth involute profile teeth transmits 5 kW with a gear ratio of 4:1. Number of teeth on pinion is 20 and it runs at 600 rpm. The pinion is made of cast steel heat treated and gear is made of phosphor bronze. The gears are subjected to light shocks. Design the gears based on strength. Calculate the dynamic load and check for wear load. **7**

2B Derive the stress and deflection equation for a helical coil spring of circular wire cross section subjected axial load. **3**

3A A section of steel shaft of 2 m long supported between bearings carries a pulley of diameter 600 mm weighing 1 kN at the midpoint. The pulley delivers power to a machine causing tension of 6 kN in the tight side of the belt and 3 kN in the slack side. The belt drive is horizontal. Assume the loads are steady, determine the diameter of the shaft if the allowable shear stress in the shaft material 40 MPa. **6**

3B A machine weighing 500 kN is mounted on 10 springs to protect the building from vibrations. The section of the spring is rectangle with side ratio 1.6. Each spring has 4 active turns and spring index is 6. Determine **4**

a) Section of the spring so that longer side is parallel to the axis of the spring
b) Deflection of the spring when the machine is stationary
c) shear stress induced if the shorter side is parallel to the spring axis. Allowable shear stress is 300 MPa.

4A Determine the dimensions of the bearing and journal to support a load of 6 kN at 750 rpm using hardened steel journal and Babbitt bearing. The oil has a specific gravity of 0.9 at 15 °C and a viscosity of 9 centi stokes at 82°C, which may be taken as limiting temperature of oil. Assume a clearance of 0.003 mm per mm diameter. Also calculate the rate of heat gradient in the bearing. **6**

4B Select a suitable ball bearing for a shaft of an axial flow compressor having the following details. Radial load (F_r) = 2.5 kN, Axial load (F_a) = 1.5 kN, speed (N) = 1000 rpm, bore diameter = 50 mm, bearing life is 50 hrs./weak for 5 years. **4**

5A A steel bolt of size M20×2.5 is used to connect two machine plates of 6 mm thickness each. A copper gasket of 6 mm thick and 25 mm inside diameter and 50 mm outside diameter is placed in between the plates. Determine the resultant load on the bolt if it is subjected to an external load of 10 kN. Take modulus of elasticity of steel and copper 206 GPa & 121 GPa respectively. **4**

5B Briefly explain the following **6**

I. Stress -strain curve of ductile material with important terms
II. Explain the design of key based on crushing and shearing failure.
III. Advantages of helical gear over spur gear