Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL-MAY-2017

SUBJECT: DESIGN OF MACHINE ELEMENTS [MTE 2202]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed
- Use of Machine Design Data Hand Book is permitted

1. A cast steel pinion with design strength of 103 N/mm^2 and 13 teeth rotating at 1000 RPM is to drive a cast iron gear with design strength of 55 N/mm^2 running at 150 RPM. The teeth are of 20˚ stub profile. Maximum power to be transmitted is 25kW. The pinion and gear are hardened to 250 BHN and 180 BHN respectively and are carefully cut gears. The gears have to operate for 8-10 hours with medium shock loads. Design the gear completely. **(10)**

2. In a steel plant, a shaft has to be designed which is driven by a 21kW motor running at 100 RPM. The distance between bearings is 750 mm. Two pulleys are mounted on the shaft in such a way that they divide the shaft in 3 equal parts. The sum of belt tensions is 10kN vertically downwards in left pulley which transmits power to a generator and same horizontal pull in the right pulley which transmits power to a compressor. Take shear stress as 40MN/m^2, C_m=1.5 and C_t=1.25. **(10)**

3A. A power transmission screw having square threads 30mm x 6mm moves a weight of 20kN at a speed of 3m/min. The collar has an inside diameter of 30mm and outside diameter of 60mm. The coefficient of thread friction is 0.15 and collar friction is 0.20. Determine the power required to drive the screw, overall efficiency, nature and magnitude of stresses acting on the screw **(04)**

3B. A shaft as shown in Fig Q 3B has a central load F. The permissible stress in the material is 70 MPa. Investigate the effect of load F at different sections and suggest a suitable diameter. **(06)**

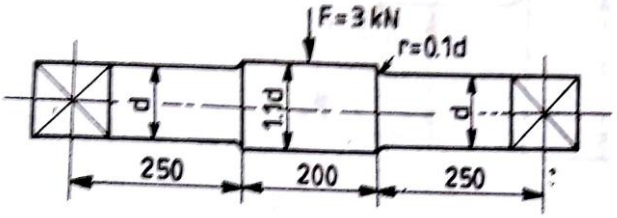

Fig Q3B

4A. A shaft is supported between 2 bearings 0.5m apart. It carries a pulley weighing 1200N. The tensions in the belt in the horizontal directions are 5500 N and 1250 N on tight and slack side respectively. Select a suitable rolling contact bearing for the shaft diameter of 50 mm. There is an axial thrust of 2000 N. Desired life of bearings is 6000 hours at 300 RPM. **(05)**

4B. A 45mm diameter hot rolled steel shaft is subjected to a static tensile axial load of 125kN. Also a completely reversed bending moment of 358 Nm is superimposed on the shaft. Due to the presence of notches, the fatigue stress concentration factor was estimated to be 1.5. Find the factor of safety using the following material data: Ultimate tensile strength = 620 MPa, endurance limit=250 MPa. **(03)**

4C. It is required to design a square key for fixing a gear on a shaft of 25mm diameter. 15 kW of power at 720 RPM is transmitted from the shaft to the gear. Key is made of steel with yield strength of 460 N/mm^2 and FOS of 3. For the key material, the yield strength in compression is taken to be same in as that in tension. Determine the key dimensions. **(02)**

5A. A simply supported beam has a concentrated load at the center which fluctuates from a value of P to 4P. The span of the beam is 0.5m and its cross section is circular with a diameter of 0.06m. Using an ultimate stress of 700 MPa, yield stress of 500 MPa, endurance limit of 330 MPa, and FOS of 1.3, calculate maximum value of P. Take size factor of 0.85 and surface finish factor of 0.9. **(05)**

5B. A bumper consisting of two helical springs, of circular cross section, brings to rest a railway wagon of mass 1500 kg and moving at 1.2 m/s. By doing so, the springs are compressed by 150 mm. The mean diameter of the coil is 6 times the wire diameter. The permissible shear stress is 400 MPa and G=0.84 x 10^5 MPa. Determine **(05)**

a. Maximum force on each spring
b. Wire diameter of the spring
c. Mean diameter
d. No of active coils