Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent institution of MAHE, Manipal)

IV SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL 2018

SUBJECT: DESIGN OF MACHINE LEMENTS [MTE 2202]

(23/04/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed with justification

1A A hot rolled steel bar with ultimate stress of 460 MN/m^2 and yield stress of 310 MN/m^2 is subjected to a torsional load that varies from 440 Nm to -110 Nm. Determine the required diameter of the rod using a factor of safety of 1.75. Take B=0.85 **05**

1B Design a helical tension spring for a spring-loaded safety valve to meet the following requirements. **05**

Diameter of the valve seat = 70 mm

Operating pressure (when the valve begins to lift) =0.7 N/mm^2

Maximum pressure (when the valve blows-off freely) = 0.75 N/mm^2

Lift of the valve during change of pressure= 4mm

Permissible shear stress, τ=560 MPa

G= 0.84 X 10^5 MPa and C=6

2A Completely design a pair of spur gear required for transmitting 8 kW. The pinion is driver and has a speed of 500 RPM while the gear rotates at 250 RPM. The teeth are 20° full depth involute. The approximate centre distance between the shafts is 500 mm, the material for pinion and gear is cast iron FG 200 having design stress of 75 N/mm^2 and 180 BHN hardness. The gears are carefully cut and operate 8 hours/day with medium shock loads. **08**

2B. The inner diameter of a cylindrical pressure vessel is 500 mm and is subjected to an internal pressure of 2 N/mm^2. The cylinder cover is fixed to the cylinder body by means of 16 bolts of M20 X1 size. Each bolt is initially tightened with a preload of 20 kN. The yield strength of the bolt material is 320 MPa. Soft packing with through bolts is used for fixing the cover to the cylinder. Are the bolts safe from design point of view? **2**

3A The free end of a horizontal cantilever beam is directly over and in contact with a vertical coil spring as shown in Fig Q3A. The width of the beam is 600 mm, its length is 800 mm, and its height is 12 mm. The coil spring has 10 active coils of 12.5 mm wire diameter and has an outside diameter of 100 mm. Take G= 83 GN/m^2 and E= 200 GN/m^2. **5**

a. What force if gradually applied at the end of cantilever beam is required to cause a deflection of 40 mm?

b. What is the bending stress in the beam at a section 400 mm from the fixed end?

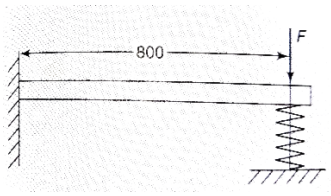

Fig Q3A

3B The following figure (Fig Q3B) shows a differential type of a screw jack. In the design shown, the two screws do not rotate. The nut is rotated by the operator by applying a force of 120 N at a radius of 500 mm. The coefficient of thread friction is 0.15. Determine **5**

a. The load that can be raised

b. Efficiency of the screw jack

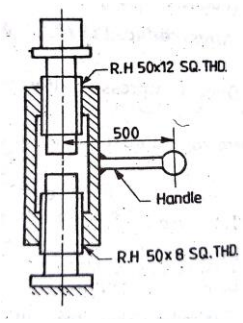

Fig Q3B

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4A Two pulleys A and B are mounted on a simply supported shaft of 3m span at distances of 1 m and 1.5 m respectively from the left bearing. The diameters of pulley A and B are 500 mm and 700 mm respectively. An electric motor supplies

15 kW power to the shaft at 240 RPM. A horizontal drive is arranged for pulley A. The drive from pulley C is 45° to the drive A and in a downward direction. Allowable shear stress for the shaft is 45 MPa. Angle of lap on each pulley is 180° and coefficient of friction between belt and pulley is 0.3. Determine the shaft diameter. Take shock and fatigue factors as 1.

4B. A flat key is used to prevent slipping of a cast-iron gear mounted on a shaft, 50 mm in diameter. Determine the appropriate dimensions of the key if the gear delivers 95 kW at 250 rpm. Assume design stresses for shear and bending as 131 MPa and 255 MPa respectively. **2**

5A Fig Q 5A shows a shaft with a central load of 5 kN. Determine the length of the shaft between the supports if the bending stress at the fillets is equal to the bending stress at the center. **03**

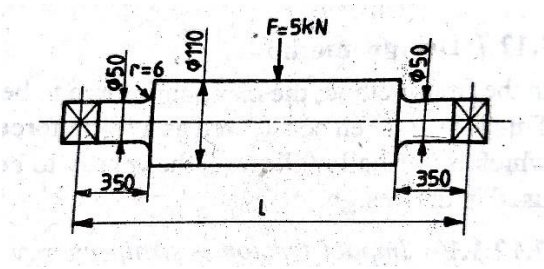

Fig Q5A

5B Select a ball bearing for the lower bearing of the vertical shaft shown in Fig Q5B driven by a belt. The bearing should run for 4000 hours at 300 RPM. Estimated weight of shaft and pulley is 1500N. First calculate the minimum shaft diameter if material used has an allowable shear stress of 40 MPa. Neglect axial load for calculating shaft diameter only. The shaft transmits 15 kW power. **07**

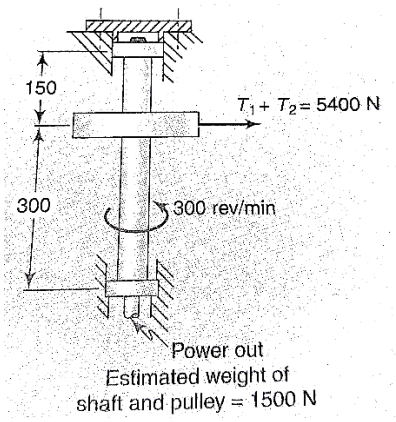

Fig Q5B