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MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent institution of MAHE, Manipal)

IV SEMESTER B.TECH. (MECHATRONICS ENGINEERING) END SEMESTER EXAMINATIONS, JUNE 2018

SUBJECT: DESIGN OF MACHINE LEMENTS [MTE 2202]

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Data not provided may be suitably assumed with justification
- 1A The load F on a simply supported shaft shown in Fig Q1A is 4 kN. Find the radius 05 of the fillet if the stresses at both the fillets are same. Length of the shaft between two bearings is 1200 mm.



Fig Q1A

- **1B** A spring-loaded safety valve for a boiler is required to blow off at a pressure of 1.5 N/mm^2 . The diameter of the valve is 60 mm. Design a suitable compression spring for the safety valve assuming spring index to be 6 and 25mm initial compression. The maximum lift of the valve is 15 mm. The shear stress in the spring is to be limited to 450 MPa. Take G= 0.84X 10⁵ MPa.
- 2A A pair of spur gears have 20° full depth involute teeth. The pinion is connected to
 08 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

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allowable bending stress is 200 N/mm². The modulus of elasticity is 200 X 10^3 N/mm². The gears are subjected to steady loads and operate 8-10 hours per day. Design the gears.

- 2B. A steel bolt of size M20 is used to connect 2 plates of each 16mm thick. A soft copper gasket of 3mm thickness is used in between the plates for the joint to be leak proof. The outside and inside diameters of the gasket are 50mm and 22mm respectively. Take modulus of elasticity of bolt material as 200MPa and for gasket material as 120 MPa. The bolt is subjected to an axial load of 15KN. Determine the stress induced in the bolt.
- 3A A deep groove ball bearing is subjected to a radial load of 2.5 kN and an axial load
 5 of 0.9 kN. The shaft runs at 3000 RPM and expected to run for 15000 hours. Take shaft diameter as 80 mm. Select a suitable bearing.
- 3B Square thread of a screw jack has specifications of 80×16 and is to raise a load of 100KN. The mean radius of the thrust collar is 65mm. The coffecient of friction for threads and collar are 0.1 and 0.12 respectively. Determine:
 - (i) Torque required to raise the load.
 - (ii) The overall efficiency.
 - (iii) Check for overhauling.
- 4A A section of commercial shafting 2m long between bearings carries a 1000N
 8 pulley at its midpoint as shown in Fig Q4A. The pulley is keyed to the shaft and receives 30kW at 150RPM which is transmitted to a flexible coupling just outside the right bearing. The belt drive is horizontal and the sum of the belt tensions is 8000N. Assume Cm=Ct=1.5. Calculate the necessary shaft diameter.



Fig Q4A

4B. It is required to design a square key for fixing a gear on a shaft of 25 mm diameter.2 15 kW of power at 720 RPM is transmitted from the shaft to the gear. Key is made

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of steel 50C4 with yield stress 460 N/mm2 and FOS of 3. Determine the key dimensions

5A The following figure Fig Q5A shows a flat plate under a tensile load. Using a design stress of 80 MPa, determine the thickness of the plate.



Fig Q5A

5B A cantilever beam of rectangular cross section has a span of 800mm. The depth is 200mm. The free end of the beam is subjected to a transverse load that fluctuates 80KN upwards to 50KN downwards. It is made of steel having $\sigma_u = 550$ MPa and $\sigma_y = 400 MPa$. Find the width of section taking factor of safety 2.5. The size and surface factors are 0.8 and 0.85 respectively.