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**MANIPAL INSTITUTE OF TECHNOLOGY**  
(Constituent Institute of MAHE –Deemed University)  
Manipal – 576 104



**THIRD SEM. B.E. (MANUFACTURING) DEGREE END SEMESTER  
(MAKE-UP) EXAMINATION JAN.2007  
SUBJECT : DESIGN OF MACHINE ELEMENTS (MME-225)  
11/ 01/2007**

Time: 3 Hours.

MAX.MARKS: 50

**Instructions to Candidates:**

- ❖ Answer **ANY FIVE** full questions.
- ❖ Missing data, if any, may be appropriately assumed.
- ❖ Use of Design Data Hand Book is permitted.

- 1a) Discuss the mechanism of fatigue failure. (04)
- 1b) A solid round shaft is loaded with a torque which fluctuates between zero and  $T_{max}$ . The strengths of the material are  $\sigma_u = 1190$  MPa and  $\sigma_{yp} = 800$  MPa. The critical point is a fillet, ground to 2mm radius at a square shoulder between sections of 12.5 mm and 10mm diameter. Estimate the value of maximum torque  $T_{max}$  which would cause failure. (06)
- 2a) It is required to design a square key for fixing a gear on the shaft which transmits 10 kW power at 720 rpm. The shaft and the key are both made of plain carbon steel C45 and the factor of safety is 3.0. (04)
- 2b) A propeller shaft in a ship is of 400 mm diameter. The allowable shear stress is 50 MPa and the allowable twist is  $1^\circ$  per 10m length. Determine the maximum torque that can be transmitted by the shaft. If the shaft is hollow with the inner to outer diameter ratio of 0.8, determine the revised dimensions of the shaft (06)
- 3a) A shaft of 20mm diameter is welded coaxially with another shaft of much larger diameter. The shaft is to transmit a torque which is just safe for it. Calculate the size of the peripheral fillet weld between two shafts. The permissible shearing stress for the shaft material is 70 MPa and that for weld is 50 MPa. (04)
- 3b) A helical coiled spring having a spring constant of 18 N/mm gets compressed to solid length when it undergoes a deflection of 30mm. The permissible shearing stress is 345 MPa and  $G = 83$  GPa. Design the spring assuming a spring index of 8 with square and ground ends. (06)

- 4a) A triple threaded power screw of square form, used in a screw jack has a nominal diameter of 50mm and a pitch of 8mm. Length of nut is 48mm. The screw jack is used to lift a load of 7.5 kN. The coefficient of friction at the threads is 0.12 and the collar friction is negligible. Calculate
- principal shear stresses in the screw body
  - unit bearing pressure.
  - state whether the screw is self-locking. (06)
- 4b) Explain the principle of hydrodynamic lubrication. (04)
- 5a) Design a pair of helical gears to transmit 30kW power at a speed reduction ratio of 4:1. The input shaft rotates at 2000 rpm. The helix angle and normal pressure angles equal to  $25^\circ$  and  $20^\circ$  respectively. Both pinion and gears are made of steel. Number of teeth on the pinion may be taken as 30. (10)
- 6a) Design a journal bearing to carry a radial load of 3000N. The journal having 50mm diameter rotates at 1500 rpm. The viscosity of oil at the operating temperatures 25 cp. Assume that the journal bearing is designed for a generator. (06)
- 6b) A bearing, supporting a power transmitting shaft, is subjected to 3000 N radial load and 4500N axial thrust. The shaft rotates at 400 rpm and expected life of the bearing is 10,000 hours. Select a suitable ball bearing, if the diameter of the shaft is 40mm. (04)