

### MANIPAL INSTITUTE OF TECHNOLOGY MANIPAL

A Constituent Institution of Manipal University

## V SEMESTER B.TECH. (I & P ENGINEERING)

### **END SEMESTER EXAMINATIONS, NOV/DEC 2016**

# SUBJECT: DESIGN OFMACHINE ELEMEMNTS [MME 3112] REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

#### Instructions to Candidates:

- ✤ Answer ALL the questions.
- Missing data may be suitable assumed.
- Use of Design data hand book permitted
- **1A.** Explain briefly the selection of materials in the process of machine design
- 3
- 1B. What is mechanical engineering design? State steps involved in mechanical engineering design.
- 1C. State and briefly explain the theories of failure applicable to ductile materials. 3
- 2A. What is stress concentration? Explain the factors effecting the stress 3 concentration.
- 2B. A plate of rectangular cross section 60 mm wide carries a tensile load of 54 kN. For some reason, a circular hole of 10 mm diameter is to be drilled exactly at the centre of the plate. Determine the suitable thickness of the plate which is made of C40 steel.
- 2C. A steel connecting rod of rectangular cross section having side ratio as 2, is subjected to a completely reversed axial load of 18 kN. The normal endurance stress for the material of connecting rod is 300 MPa and yield stress is 420 MPa. Determine suitable cross sectional dimensions of the connecting rod. Taking factor of safety as 1.8, the size factor may be taken as 0.9, stress concentration factor is 1.5.
- 3A. Compare the strength of a hollow shaft with that of a solid shaft for same 3 diameter and material. Diameter ratio of hollow shaft is 0.75.

- **3B.** Determine the diameter of the solid shaft required to sustain a bending **3** moment of 1.2 kN-m and a twisting moment of 0.9 kN-m. The allowable tensile and shear stress of shaft material are 120 MPa and 75 MPa respectively.
- 3C. A mild steel shaft transmits 15 kW at 300 rpm. It is supported on two bearings 1.2 m apart. The shaft receives power through a 450 mm diameter pulley mounted at 300 mm to the right of right bearing. The belt drive is horizontal and the gear drives with a downward tangential force. Find suitable diameter of the shaft if yield stress for shaft material is 234 MPa and factor of safety 2. Tension ratio of belt is 3.
- **4A.** What is power screw? What are its applications and advantages of power **2** screws?
- **4B.** The free end of a horizontal constant strength cantilever beam is in contact with a vertical coil spring. The coil spring is situated directly below the free end of the beam. The width of the beam at the fixed end is 400 mm. its length is 800 mm and thickness is 15 mm. the coil spring has 10 active coils of 15 mm diameter wire and has an outer diameter of 100 mm. take E = 207 GPa.
  - (i) What force F if gradually applied at the end of the cantilever beam is required to cause a deflection of 30 mm?
  - (ii) What is the bending stress at the middle of the beam?
  - (iii) How much energy is absorbed by the coil spring?
- **4C.** What is overhauling of power screw? What is the condition for overhauling? **3**
- 5A. A pair of spur gears of minimum size with 20<sup>0</sup> stub involute profile is used to transmit 18 KW at 1200 revolutions per minute of pinion. The material used for both pinion and gear is chrome vanadium steel whose allowable static stress may be taken as 516.8 MN/m<sup>2</sup>. Determine the module and face width for strength requirement only. The gears are subjected to 8 to 10 hours per day of service with medium shocks. Take velocity ratio as 3.5:1
- 5B. The main bearing of a steam turbine runs at 1500 rpm and the diameter of journal is 40 mm. he load on the bearing is estimated to be 3 kN. Determine (i) whether fluid film lubrication can be expected?
  - (ii) Is artificial cooling necessary?
  - (iii)Amount of oil flow and (iv) minimum film thickness.