

MANIPAL

(A constituent unit of MAHE, Manipal)

# V SEMESTER B. TECH (MECHANICAL ENGG.) END SEMESTER

## MAKE- UP EXAMINATIONS, DECEMBER 2018

# SUBJECT: MECHANICAL DESIGN - I [MME 3102]

### **REVISED CREDIT SYSTEM**

#### Time: 3 Hours

#### MAX. MARKS: 50

#### **Instructions to Candidates:**

- ✤ Answer ALL the questions.
- Missing data may be suitably assumed.
- ✤ Use of Design data hand book is permitted
- 1A. A bolt is subjected to a tensile load of 18 kN and a shear load of 12 kN. The (05) material has yield strength of 326.8 MPa. Taking factor of safety as 2.5, determine the minor diameter according to the following theories of failure i) Rankine's theory ii) Maximum Shear stress theory iii) Shear energy theory iv) St. Venant's theory. Take Poissons ratio equal to 0.298.
- **1B.** Define stress concentration and briefly describe any 3 methods of reducing **(05)** stress concentration with a neat sketch.
- 2A. A section of a C-clamp is shown in Fig.Q.2A. Analyse along section AB and (05) determine the force F that can be exerted by the screw if the maximum compressive stress in the clamp is limited to 120 MPa.
- **2B.** Derive the Soderberg equation for fatigue.(03)

### **2C.** Define the following i) Endurance limit. ii) Fatigue failure (02)

**3A.** A shaft is mounted between 2 bearings located 1.5 m apart. A pinion of pitch (05) circle diameter 0.4 m is keyed to the shaft 0.45 m to the right of the left bearing. A pulley is keyed to the shaft 1 m to the left of the right bearing. The pulley receives power from a motor by a belt drive inclined at an angle of 30<sup>0</sup> below the horizontal to the left as seen from the left bearing. The pinion drives another gear mounted directly in front of it such that the tangential force acting on pinion is vertically upwards. The tangential and radial forces on the shaft are 2865 N and 1043 N respectively. The sum of the belt tensions is 5730 N. The weight of the pinion and pulley are 200 N and 300 N respectively. Determine the diameter of the shaft considering gradually applied load .Take allowable shear stress as 50 MPa.

- **3B.** State the design guidelines for a shaft based on ASME code. (03)
- **3C.** Prove that a square key is equally strong in shear and crushing. (02)
- **4A.** With neat sketches discuss the different types of failures in riveted joints **(05)**
- 4B. A 16 mm thick plate is welded to a vertical support by two fillet welds as (05) shown in Fig.Q.4B. Determine the size of the weld if the permissible shear stress for the weld material is 80 MPa.
- 5A. A bracket shown in Fig.Q.5A supports a load of 10 kN. It is fixed to the (05) horizontal channel by means of four identical bolts, two at A and two at B. The bolts are made of 30C8 steel and the factor of safety is 6. Determine the size of the bolt.
- 5B. A machine vice shown in Fig.Q.5B has single start, square threads with 22 (05) mm nominal diameter and 5 mm pitch. The outer and inner diameters of the friction collar are 55 mm and 45 mm respectively. The coefficients of friction for thread and collar are 0.15 and 0.17 respectively. The machinist can comfortably exert a force of 125 N on the handle at a mean radius of 150 mm. Assuming uniform wear theory for the collar, calculate:
  - i) The clamping force developed between the jaws.
  - ii) The overall efficiency of the clamp.



All dimensions in mm





Fig.Q.4B



All dimensions in mm

Fig.Q.5A



All dimensions in mm

Fig.Q.5B