

Total No. of Questions :10]

SEAT No. :

**P3474**

**[5560]-111**

[Total No. of Pages : 4

**T.E. (Mechanical ) Examination, May-2019**

**DESIGN OF MACHINE ELEMENT-I**

**(2012 Pattern)(Semester-II)**

*Time : 3 Hours]*

*[Max. Marks : 70*

*Instructions to the candidates:*

- 1) *Answer five questions from following.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Use of electronic pocket calculator is allowed.*
- 5) *Use of programmable calculator is not permitted.*
- 6) *Assume suitable data if necessary.*

**Q1) a)** Explain the following. **[6]**

- i) Factor of safety and service factor.
- ii) Preferred series

b) Design a key for muff coupling which connect two shaft of 30 mm diameter. Transmits 35 KW at 1440 RPM. The maximum torque is 25% greater than average torque. Allowable shear stress and crushing stress for key material are  $= 65 \text{ N/mm}^2$  and  $160 \text{ N/mm}^2$ . **[4]**

OR

**Q2) a)** Classify keys. Obtain the equation for shear stress and crushing stress in key. **[4]**

b) Draw neat labeled sketch knuckle joint. Write design steps. **[6]**

**Q3) a)** Explain ASME code design for shaft. **[4]**

b) A forged steel made with 40 C8 of 50 mm diameter is subjected to completely reversed bending stress of  $300 \text{ N/mm}^2$ . Determine the life of bar. Use following data: **[6]**

- i)  $S_{ut} = 600 \text{ N/mm}^2$ .
- ii) Surface finish factor  $= 0.43$
- iii) Size factor  $= 0.85$

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- iv) Reliability factor = 0.897 at 90% reliability.
- v) Factor of safety = 1.5
- vi) Notch sensitivity = 0.8
- vii) Theoretical stress concentration = 2.6

OR

**Q4) a)** A cantilever of beam made of cold drawn steel 40C8 with  $S_{ut} = 600 \text{ N/mm}^2$  and  $S_{yt} = 380 \text{ N/mm}^2$ . The maximum and minimum force at free end varies from -50 N to +150 N. Reliability factor is 0.897, surface finish factor and size factor are 0.77 and 0.85 respectively. Notch sensitivity at fillet is 0.9 and theoretical stress concentration factor is 1.44. If factor of safety is 2 determine diameter of beam according to Goodman's criteria. Assume effective length of beam 100 mm. [6]

b) Explain design of shaft based on torsional rigidity. [4]

**Q5) a)** Explain with neat sketch Re-circulating Ball screw. [4]

b) A power screw having tripple start square threads nominal diameter 50 mm and pitch 8 mm subjected to axial load of 15KN. The outer and inner diameter of the screw collar is 100 and 65 mm respectively. The coefficient of friction for collar thread and screw thread are 0.15. The screw rotates at 12 rpm. Assume uniform wear condition. Determine. [12]

- i) Torque required to raise the load
- ii) Torque required to lower the load
- iii) Force required to raise load if applied at 500mm radius.

OR

**Q6) a)** Following data refers to C-Clamp. [13]

- i) Maximum clamping force = 4000N
- ii) Screw type - single start trapezoidal threaded
- iii) Nominal diameter = 12 mm
- iv) Pitch = 12 mm
- v) Coefficient of collar friction = 0.25
- vi) Coefficient of screw friction = 0.12
- vii) Mean collar diameter = 12mm
- viii) Operator force at the end of handle = 80 N
- ix) Distance between the axis of handle and surface of nut in clamped condition = 150 mm
- x) Nut height = 25 mm

Determine,

- 1) Length of handle is 50 mm additional length for gripping
  - 2) Stresses in screw body at two critical sections
  - 3) Bearing pressure on screw thread
- b) Derive the efficiency of square threaded screw is less than 50%. [3]
- Q7) a)** Explain with neat sketch any two types of screw fastenings. [6]
- b) Determine the size of bolt for joint as shown in figure 1 below. The bracket is made of steel with  $\sigma_{ys}$  254 Mpa. Assume factor of safety 2. [12]

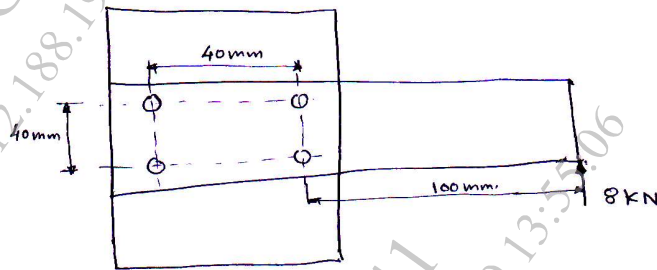


figure - 1

All dimensions are in mm

OR

- Q8) a)** Prove that stress acting on throat is equal to force on weld upon  $0.707h$ . Where  $h$  = leg size of weld and  $l$  = length of fillet weld. [5]
- b) A welded bracket is shown in figure 2 below, carries a load of 30 kN. Calculate size of weld if shear stress in weld is  $80 \text{ N/mm}^2$ . [13]

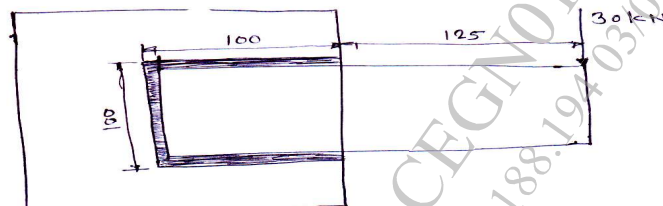


figure - 2

All dimensions are in mm

**Q9) a)** Draw a neat labeled sketch of laminated leaf spring. State function of any two components. **[5]**

b) An elevator 20 identical spring with spring index 5 are arranged in parallel to absorb the shock due to impact during. In case of failure of rope maximum possible free fall is 12 m. The total weight of elevator is 7.5 KN. If maximum permissible compression of each spring in case of free fall is 120 mm, design the spring. Take permissible shear stress at 650 N/mm<sup>2</sup> and modulus of rigidity 85 Gpa. **[11]**

OR

**Q10) a)** Explain the following terms. **[4]**

i) Wahl's factor

ii) Active and Inactive coils

b) A composite compression spring has two closed coil. Outer spring is of 20 mm longer than inner spring. The outer spring has 7 coils of outer diameter 240 mm & wire diameter 40 mm. The inner spring has 10 coils of outer diameter 150 mm & wire diameter 25 mm. When spring is subjected to an axial load 100KN, Modulus of rigidity may be taken as 80000N/mm<sup>2</sup>. Find. **[12]**

i) Deflection of each spring.

ii) Load shared by each spring

iii) Combine spring stiffness

iv) Shear stress induced in each spring

