

**CS/B.TECH (AUE-OLD)/SEM-4/AUE-405/2012**

**2012**

**DESIGN OF MACHINE ELEMENTS**

*Time Allotted : 3 Hours*

*Full Marks : 70*

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words  
as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for the following :  $10 \times 1 = 10$

i) According to Indian Standard specifications, a plain carbon steel designated by 40C8 means that

a) carbon content is 0.04 per cent and manganese is 0.08 per cent

b) carbon content is 0.4 per cent and manganese is 0.8 per cent

c) carbon content is 0.35 to 0.45 per cent and manganese is 0.60 to 0.90 per cent

d) carbon content is 0.60 to 0.80 per cent and manganese is 0.8 to 1.2 per cent.

ii) According to Indian Standard specifications, 100 H 6/g 5 means that the

a) actual size is 100 mm

b) basic size is 100 mm

c) difference between the actual size and basic size is 100 mm

d) none of these.

iii) Shock resistance of steel is increased by adding

- a) nickel
  - b) chromium
  - c) nickel and chromium
  - d) sulphur, lead and phosphorus.
- iv) In transverse fillet welded joint, the size of weld is equal to
- a)  $0.5 \times$  Throat of weld b) Throat of weld
  - c)  $1.414 \times$  Throat of weld d)  $2 \times$  Throat of weld.
- v) In a flat belt drive, if the slip between the driver and belt is 1% that between follower and belt is 3% and driver and following pulley diameters are equal, then the velocity ratio of the drive will be
- a) 0.99 b) 0.98
  - c) 0.97 d) 0.96.
- vi) Two shafts *A* and *B* are made of same material. The diameter of shaft *B* is twice that of shaft *A*. The ratio of power which can be transmitted by shaft *A* to shaft *B* is
- a) 0.5 b) 0.25
  - c) 0.125 d) 0.0625.
- vii) To ensure self locking in a screw jack, it is essential that the helix angle is
- a) larger than friction angle
  - b) smaller than friction angle
  - c) equal to friction angle
  - d) such as to give maximum efficiency in lifting.
- viii) Which of the following screw thread is adopted for power transmission in either direction ?
- a) Acme threads
  - b) Square threads

- c) Buttress threads
- d) Multiple threads.
- ix) A cotter joint is used to transmit
  - a) axial tensile load only
  - b) axial compressive load only
  - c) combined axial and twisting loads
  - d) axial tensile or compressive loads.
- x) Stress concentration factor is defined as the ratio of
  - a) maximum stress to the endurance limit
  - b) nominal stress to the endurance limit
  - c) maximum stress to the nominal stress
  - d) nominal stress to the maximum stress.

**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following.  $3 \times 5 = 15$

2. Design the rectangular key for a shaft of 50 mm diameter.

The shearing and crushing stresses for the key material are

42 MPa and 70 MPa. 5

3. a) What is meant by hole basis system ?

b) A hole is dimensioned as  $25 - 0.03$

$+ 0.03$  mm and the shaft is

dimensioned as  $25 - 0.02$

$+ 0.00$  mm.

Determine the hole tolerance and allowance of the fit.

What type of fit will be established ? 2 + 3

4. Define Rankine's theory and Guest's theory of failure under static load. 2 × 2

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5. A solid shaft is transmitting 1 MW at 240 r.p.m. Determine

the diameter of the shaft if the maximum torque transmitted exceeds the mean torque by 20%. Take the maximum allowable shear stress as 60 MPa. 5

6. a) Show that the efficiency of self locking screws is less than 50 per cent.

b) Discuss the various types of power threads with relative advantages and disadvantages. 2 + 3

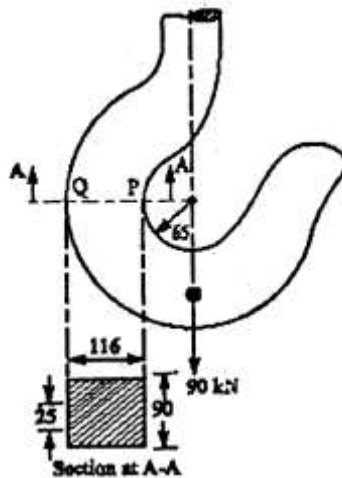
### GROUP – C

#### ( Long Answer Type Questions )

Answer any *three* of the following.  $3 \times 15 = 45$

7. A crane hook has a rectangular section at A-A as shown in

Fig. 1. Find the maximum stresses at points P and Q. 15



All dimensions are in mm.

Fig. 1

8. Design and draw a cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically. Tensile stress = compressive stress = 50 MPa ; shear stress = 35 MPa and crushing stress = 90 MPa. 15

9. The diameters of the driver and follower pulleys of a open flat belt drive are 900 mm and 1200 mm respectively and centre distance is 3 m. The output of the follower shaft is 110 kW.

Assuming,

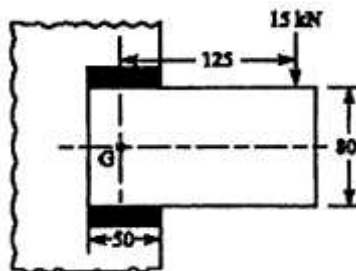
Belt speed = 21 m/s, Co-efficient of friction = 0.30,

Slip = 1.5% at each pulley, Belt thickness = 20 mm,

Determine :

- a) The length of belt
- b) The rev/min of each shaft
- c) Difference in belt tensions
- d) Width of belt, if  $\sigma_t$  of belt material is  $3.0 \text{ N/mm}^2$  . 15

10. A bracket carrying a load of 15 kN is to be welded as shown in Fig. 2. Find the size of weld required if the allowable shear is not to exceed 80 MPa. 15

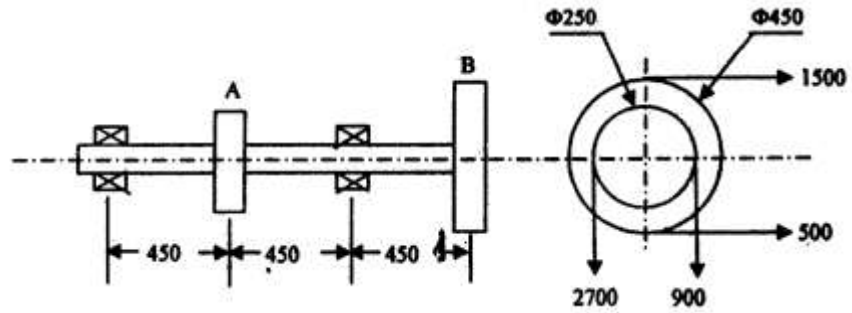


All dimensions are in mm.

Fig. 2

11. A line shaft supporting two pulleys *A* and *B* is shown in Fig. 3. Power is supplied to the shaft by means of a vertical belt on pulley *A*, which is then transmitted to pulley *B* carrying a horizontal belt. The ratio of belt tensions on tight and loose sides is 3 : 1 and the maximum tension in either belt is limited to 2.7 kN. The shaft is made of plain carbon steel 40C8 ( $\sigma_{ut} = 650 \text{ MPa}$  and  $\tau_{yt} = 380 \text{ MPa}$  ). The pulleys

are keyed to the shaft. Determine the shaft diameter according to A.S.M.E. code if  $k_b = 1.5$  and  $k_t = 1.0$ .



Lengths and forces indicated are in mm. and N respectively.

Fig. 3