



Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech (AUE)/SEM-4/AUE-405/2011

2011

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.*

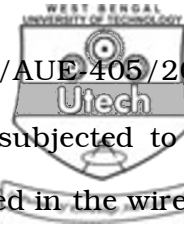
GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$
 - i) The energy stored in a body when strained within elastic limit is known as
 - a) resilience
 - b) proof resilience
 - c) strain energy
 - d) impact energy.
 - ii) The algebraic difference between the maximum limit and the basic size is called
 - a) actual deviation
 - b) upper deviation
 - c) lower deviation
 - d) fundamental deviation.
 - iii) Two shafts A and B are made of the same material. The diameter of the shaft A is twice as that of shaft B. The power transmitted by the shaft A will be of shaft B.
 - a) twice
 - b) four times
 - c) eight times
 - d) sixteen times.



- iv) A double strap butt joint (with equal straps) is
- a) always in single shear
 - b) always in double shear
 - c) either in single shear or double in shear
 - d) any one of these.
- v) The taper on cotter varies from
- a) 1 in 15 to 1 in 10
 - b) 1 in 24 to 1 in 20
 - c) 1 in 32 to 1 in 24
 - d) 1 in 48 to 1 in 24.
- vi) A keyway lowers
- a) the strength of the shaft
 - b) the rigidity of the shaft
 - c) both the strength and rigidity of the shaft
 - d) the ductility of the material of the shaft.
- vii) All stresses produced in a belt are
- a) compressive stresses
 - b) tensile stresses
 - c) both tensile and compressive stresses
 - d) shear stresses.
- viii) The centrifugal tension in the belt
- a) increases the power transmitted
 - b) decreases the power transmitted
 - c) has no effect on the power transmitted
 - d) is equal to maximum tension on the belt.



- ix) When a helical compression spring is subjected to an axial compressive load, the stress induced in the wire is
- a) tensile stress
 - b) compressive stress
 - c) shear stress
 - d) bending stress.
- x) The type of stresses developed in the key is/are
- a) shear stress alone
 - b) bearing stress alone
 - c) both shear and bearing stresses
 - d) shearing, bearing and bending stresses.

GROUP – B

(Short Answer Type Questions)

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

2. Find the diameter of a solid steel shaft to transmit 20 kW at 200 r.p.m. The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 8. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside diameters is 0.5.

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3. Explain the following terms of any *five* of the spring :

- i) Free length
- ii) Solid height
- iii) Spring rate
- iv) Active and inactive coils
- v) Spring index
- vi) Stress factor.

4. 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. Calculate the tolerances, fundamental deviations and limits of sizes for the shaft designated as 40 H8/f7.

6. What is the difference between caulking and fullering ?

Explain with the help of the neat sketches.



GROUP – C

(Long Answer Type Questions)

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

7. Design a knuckle joint for a tie rod of a circular section to transmit pull of 60 kN. The ultimate strength of the material of the rod against tearing is 400 MPa, shearing is 300 MPa and crushing is 600 MPa respectively. The ultimate tensile and shearing strength of the pin materials are 500 MPa and 400 MPa respectively. Determine the tie rod section and pin section. Take factor of safety = 5.
8. Design and draw a double riveted double strap butt joint for the longitudinal seam of a boiler shell, 750 mm in diameter, to carry a maximum steam pressure of 1.05 N/mm^2 gauge. The allowable stresses are : tearing = 45 MPa
shearing = 30 MPa and crushing = 60 MPa.
Assume the efficiency of the joint as 75%.

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9. Two shafts made of plain carbon steel are connected by a rigid protective type flange coupling. The shafts are running at 500 r.p.m. and transmit 25 kW power. Design the coupling completely for overload capacity 25 per cent in excess of mean transmitted torque capacity. Assume the following permissible stresses for the coupling components :

Shaft — Permissible tensile stress = 60 MPa; Permissible shear stress = 35 MPa

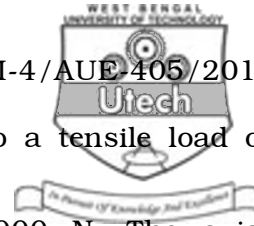
Keys — Rectangular formed end sunk key having permissible compressive strength = 60 MPa

Bolts — made of steel having permissible

shear stress = 28 MPa

Flanges — Cast iron having permissible

shear stress = 12 MPa.



10. A close coiled helical spring subjected to a tensile load of magnitude varying from 2500 N to 3000 N. The axial deflection of the spring for this range of load is 6.5 mm. Design the spring, taking the spring index as 6 and the safe shear stress for the materials of the spring equals to 465 MPa.
11. Design a belt drive to transmit 110 kW for a system consisting of two pulleys of diameters 0.9 m and 1.2 m, centre distance of 3.6 m, a belt speed 20 m/s, coefficient of friction 0.3. A slip of 1.2% at each pulley and 5% friction loss at each shaft are 20% overload.
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