

**GANPAT UNIVERSITY**  
**B. Tech. IV Sem. Mechanical and Mechatronics Engineering**  
**Regular Examination April/June 2017**  
**2ME401 Fundamentals of Machine Design**

[Time: 3 Hour]

[Total marks: 60]

**Instructions:**

- (1) All questions are compulsory.
- (2) Right figure indicate full marks.
- (3) Assume suitable data if necessary.
- (4) Only scientific calculator is allowed.

**SECTION-I****Que.1 Attempt the followings.**

- (a) Explain the types of design and factors influencing the design. [3]
- (b) Draw and explain the stress-strain diagram for ductile material. [3]
- (c) The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to maximum principal stress theory. [3]

**OR****Que.1 Attempt the followings.**

- (a) Enumerate the most commonly used any six engineering materials and state at least one important property and one application of each. [3]
- (b) State the statement of maximum principal stress theory and explain the construction for region of safety for this theory with neat sketch. [3]
- (c) Find the shaft size and standardise the shaft sizes between 20 mm to 900 mm diameter if geometrical ratio is 1.413. [3]

**Que.2 Attempt the followings.**

- (a) Explain the following failures with neat sketches for socket and spigot cotter joint: [3]
  - (1) Failure of spigot in tension across the weakest section
  - (2) Failure of socket collar in crushing
- (b) Design a sleeve and cotter joint to resist a tensile load of 60 kN. All parts of the joint are made of the same material with the following allowable stresses: [6]
 
$$\sigma_t = 60 \text{ N/mm}^2, \sigma_c = 125 \text{ N/mm}^2 \text{ and } \tau = 70 \text{ N/mm}^2.$$

**OR****Que.2 Attempt the followings.**

- (a) Explain the design of gib and cotter joint for square rod with neat sketch. [3]
- (b) If a cotter foundation bolt is subjected to the pull of 140 kN, design the bolt and the cotter. [6]
 

Assume the following values of the permissible stresses.

$$\sigma_t = 55 \text{ N/mm}^2, \sigma_c = 80 \text{ N/mm}^2 \text{ and } \tau = 40 \text{ N/mm}^2.$$

**Que.3 Attempt the any three.**

- (a) Enlist the types of the keys. Using neat sketch explain the following keys with necessary usual proportions of each key. [4]
  - (1) Rectangular sunk key
  - (2) Gib-headed key
- (b) A shaft supported at the ends in ball bearings carries a straight tooth spur gear at its mid span and is to transmit 7.5 kW at 300 rpm. The pitch circle diameter of the gear is 150 mm. The distances between the centre line of bearings and gear are 100 mm each. If the shaft is [4]



- made of steel and the allowable shear stress is 45 MPa, determine the diameter of the shaft. The pressure angle of the gear may be taken as  $20^\circ$ .
- (c) Explain the types of screw threads used for power screw with neat sketch. [4]
- (d) Explain the design of hub, key and flange for unprotected type flange coupling. Also show the notations used. [4]

### SECTION - II

Que:4 Attempt the followings.

- (a) Write short note on nut locking devices covering the necessity and various types. Your answer should be illustrated with neat sketches. [3]
- (b) A bracket is riveted to a column by 6 rivets of equal size as shown in Fig. 1. It carries a load of 60 kN at a distance of 200 mm from the centre of the column. If the maximum shear stress in the rivet is limited to 150 MPa, determine the diameter of the rivet. [7]

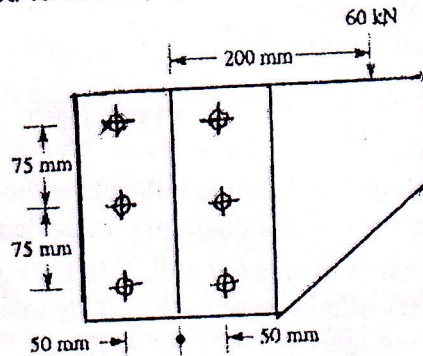


Fig. 1

OR

Que:4 Attempt the followings.

- (a) Draw neat sketch of double riveted zigzag lap joint with all terminology. [3]
- (b) Design a boiler joint for double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of  $0.95 \text{ N/mm}^2$ . Assume joint efficiency as 75%, allowable tensile stress in the plate 90 MPa; compressive stress 140 MPa; and shear stress in the rivet 56 MPa. (Assume value of  $C = 3.5$ ). [7]

Que:5 Attempt the followings.

- (a) Explain three basic types of levers with practical examples. [3]
- (b) The bell crank lever of a Hartnell governor has vertical arm (ball arm) of 120 mm length and horizontal arm (Sleeve arm) of 100 mm length. The maximum centrifugal force acting on ball arm is 1500 N. Design the lever with completely along with the fulcrum pin for mounting the lever. The allowable stresses are 70 MPa in tension, 40 MPa in shear and bearing pressure is 10 MPa. [8]

OR

Que:5 Attempt the followings.

- (a) Briefly explain general procedure for lever design. [3]
- For operating the exhaust valve of a petrol engine, the maximum load required on the valve is 5000 N. The rocker arm oscillates around a pin whose centre line is 250 mm away from the valve axis. The two arms of the rocker are equal and make an included angle of  $160^\circ$ . Design the rocker arm with the fulcrum if the tensile stress is 70 MPa and the bearing pressure is  $7 \text{ N/mm}^2$ . Assume the cross-section of the rocker arm as rectangular. [8]

Que:6 Attempt any three.

- (a) Classify the spring according to their shapes and draw their neat sketches. [3]
- (b) What do you understand by a column or strut? Explain the various end conditions of a column or strut. [3]
- (c) A close coiled helical compression spring of 12 active coils has a spring stiffness of  $k$ . It is cut into two springs having 5 and 7 turns. Determine the spring stiffnesses of resulting springs. [3]
- (d) What is an eccentric riveted joint? Explain the method adopted for designing such a joint? [3]