Exam.Code:0941
Sub. Code: 33862

2125

B.E. (Mechanical Engineering)

Fifth Semester

MEC-501: Design of Machine Elements - I

Time allowed: 3 Hours | Max. Marks: 50

*NOTE: Attempt <u>five</u> questions in all, including Question No. 1 which is compulsory and selecting two questions from each Part.*

***x-x-x***

I. Write briefly: **(2x5)**

a. What do you understand by Ergonomic considerations in machine design.

b. What is stress concentration. How will we account for stress concentration in Machine Design.

c. Give two advantages and two disadvantages of welded joint over riveted joint.

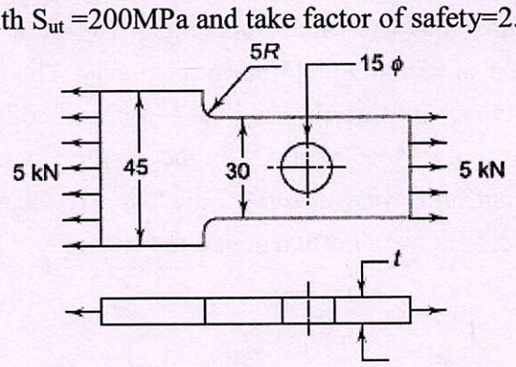
d. Discuss the modes of failure of a key.

e. What is self-locking property of threads and where it is necessary.

**PART A**

II. (a) What is Endurance limit. Endurance limit in true sense is not the property of a material. Discuss. **(4)**

(b) A flat plate subjected to a tensile load of 5 kN is as shown in Figure below. Calculate the thickness of plate if the theoretical stress concentration factor, $k_t = 1.8$ at the fillet section and $k_t = 2.16$ at the hole section. The plate is made up of material with $S_{ut} = 200$MPa and take factor of safety=2.5. **(6)**




III. (a) Explain the procedure for designing an axially loaded unsymmetrical welded section. **(4)**

(b) Discuss the different ways of failure of a riveted joint. Also, discuss the terms (i) Strength of a Riveted Joint, (ii) Efficiency of a Riveted joint **(6)**

IV. (a) Design a right angled bell crank lever. The horizontal arm is 500 mm long and a load of 4.5 kN acts vertically downward through a pin in the forked end of this arm. At the end of the 150 mm long arm which is perpendicular to the 500 mm long arm, a force P act at right angles to the axis of 150 mm arm through a pin into a forked end. The lever consists of forged steel material and a pin at the fulcrum. Take the following data for both the pins and lever material: **(6)**

Safe stress in tension = 75 MPa

Safe stress in shear = 60 MPa

Safe bearing pressure on pins = 10 N/mm$^2$

(b) What is bolt of uniform strength. What is its significance. **(4)**

P.T.O.

## PART B

V. A machine shaft, supported on bearings having their centers 750 mm apart, transmitted 185 kW at 600 r.p.m. A gear of 200 mm and 20° tooth profile is located 250 mm to the right of left hand bearing and a 450 mm diameter pulley is mounted at 200 mm to right of right-hand bearing. The gear is driven by a pinion with a downward tangential force while the pulley drives a horizontal belt having 180° angle of contact. The pulley weighs 1000 N and tension ratio is 3. Find the diameter of the shaft, if the allowable shear stress of the material is 63 MPa. Take torsion and bending factor 1.5 and 2 respectively. **(10)**

VI. It is required to design a flange coupling for connecting two shafts: **(10)**

(i) Power to be transmitted : 18.5 kW at 1000 r.p.m.

(ii) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.

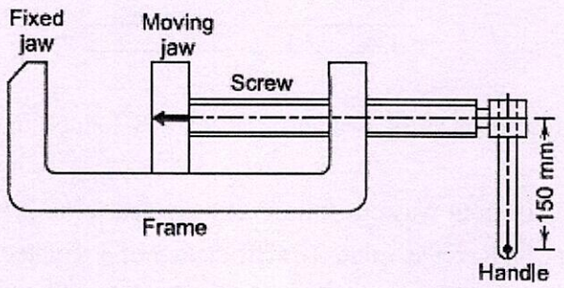
(iii) The allowable shear stress for cast iron is 15 MPa.

(iv) The allowable bearing pressure for rubber bush is 0.8 $N/mm^2$.

(v) The material of the pin is same as that of shaft and key.

Design the coupling completely with hub, driving and driven flanges, pin and key. Also draw a neat sketch of the coupling.

VII. (a) A machine vice as shown in Figure below has single start square threads with 22mm nominal diameter and 5mm pitch. The outer and inner diameter of friction collar is 55mm and 45mm respectively. The coefficient of friction is 0.15 for the screw threads and 0.17 for the collar. The machinist can comfortably apply a load of 125N on the handle at a mean radius of 150 mm. Assuming uniform wear theory, Calculate (i) Clamping force developed between jaws (ii) Overall efficiency of the clamp. **(6)**




(b) Discuss the various types of stresses induced in a power screw. **(4)**

*x-x-x*