Reg. No:

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR
(AUTONOMOUS)
B.Tech III Year I Semester Supplementary Examinations December-2021
DESIGN OF MACHINE ELEMENTS-I
(Mechanical Engineering)

Time: 3 hours   Max. Marks: 60

PART-A
(Answer all the Questions **5 x 2 = 10** Marks)

|				
1	a	Distinguish between brittle fracture and ductile fracture.	L4	2M
	b	What is brittle fracture and What is ductile fracture?	L1	2M
	c	Define the terms caulking and fullering.	L1	2M
	d	What are the main functions of the knuckle joints?	L1	2M
	e	What is the main use of woodruff keys?	L2	2M

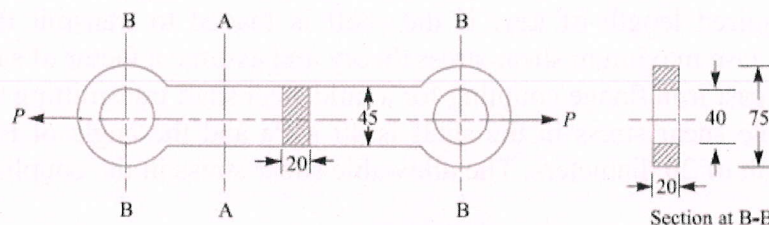### PART-B
(Answer all Five Units **5 x 10 = 50** Marks)

UNIT-I

2 a A hydraulic press exerts a total load of 3.5 MN. This load is carried by two steel rods,   **L3**   **5M**
supporting the upper head of the press. If the safe stress is 85 MPa and E = 210 kN/mm^2,
find: 1. diameter of the rods, and 2. extension in each rod in a length of 2.5m.

   b The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force   **L3**   **5M**
of 5 kN. Find the diameter of bolt required according to 1.Maximum shear stress theory; 2.
Maximum distortion energy theory.

OR

3 a A pump lever rocking shaft is shown in Fig. The pump lever exerts forces of 25 kN and 35   **L3**   **5M**
kN concentrated at 150 mm and 200 mm from the left and right hand bearing respectively.
Find the diameter of the central portion of the shaft, if the stress is not to exceed 100 MPa
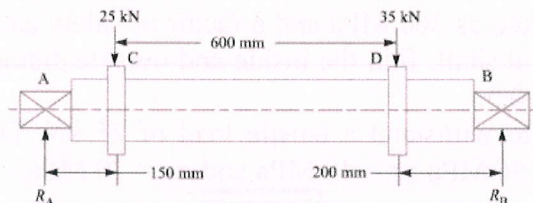
   b A cast iron link, as shown in Fig., is required to transmit a steady tensile load of 45 kN.   **L3**   **5M**
Find the tensile stress induced in the link material at sections A-A and B-B.

UNIT-II

4 a A machine component is subjected to a fluctuating stress that varies from 40 N/mm^2 to 100   **L3**   **5M**
N/mm^2. The corrected endurance limit of the machine component is 270 N/mm^2 . The
ultimate stress and yield point stress of the material are 600 and 400 N/mm^2 respectively.
Find the factor of safety using: (i) Gerber formula. (ii) Solderberg line. (iii) Goodman line.

   b Explain stress concentration in detail and various methods to reduce stress concentration in   **L2**   **5M**
machine members?

OR

5 a A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a   **L3**   **5M**
central concentrated cyclic load having a minimum value of 20 kN and a maximum value
of 50 kN. Determine the diameter of bar by taking a factor of safety of 1.5, size effect of
0.85, surface finish factor of 0.9. The material properties of bar are given by: ultimate
strength of 650 MPa, yield strength of 500 MPa and endurance strength of 350 MPa.

   b A machine component is subjected to a flexural stress which fluctuates between + 300   **L2**   **5M**
MN/m^2 and – 150 MN/m^2 . Determine the value of minimum ultimate strength according to
1. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. Take yield
strength = 0.55 Ultimate strength; Endurance strength = 0.5 Ultimate strength; and actor of
safety = 2.

UNIT-III

6 a A lever loaded safety valve has a diameter of 100 mm and the blow off pressure is 1.6   **L3**   **5M**
N/mm^2 . The fulcrum of the lever is screwed into the cast iron body of the cover. Find the
diameter of the threaded part of the fulcrum if the permissible tensile stress is limited to 50
MPa and the leverage ratio is 8.

   b Mentioned the important terms used in screw threads with a neat sketch.   **5M**

OR

7 a Explain Stress in screw fasteners due to Combined Forces.   **L2**   **6M**
   b Discuss on bolts of uniform strength giving examples of practical applications of such   **L3**   **4M**
bolts.

UNIT-IV

8 a The big end of a connecting rod, as shown in Fig. is subjected to a maximum load of 50 kN.   **L3**   **6M**
The diameter of the circular part of the rod adjacent to the strap end is 75 mm. Design the
joint, assuming permissible tensile stress for the material of the strap as 25 MPa and
permissible shear stress for the material of cotter and gib as 20 MPa.

   b A hollow shaft has greater strength and stiffness than solid shaft of equal weight.   **L3**   **4M**
Explain.

OR

9 a Find the diameter of a solid steel shaft to transmit 20 kW at 200 r.p.m. The ultimate shear   **L3**   **5M**
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 to outside diameters is 0.5.

   b A knuckle joint is required to withstand a tensile load of 25 kN. Design the joint if the   **L3**   **5M**
permissible stresses are :σt = 56 MPa ; τ = 40 MPa and σc = 70 MPa.

UNIT-V

10 a A 45 mm diameter shaft is made of steel with yield strength of 400 MPa. A parallel key of   **L2**   **5M**
size 14 mm wide and 9 mm thick made of steel with yield strength of 340 MPa is to be
used. Find the required length of key, if the shaft is loaded to transmit the maximum
permissible torque. Use maximum shear stress theory and assume a factor of safety of 2.

   b Design and draw a cast iron flange coupling for a mild steel shaft transmitting 90 kW at 250   **L3**   **5M**
r.p.m. The allowable shear stress in the shaft is 40 MPa and the angle of twist is not to
exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30
MPa.

OR

11 a Discuss the function of a coupling. Give at least three practical applications.   **L2**   **5M**
   b Design a cast iron protective type flange coupling to transmit 15 kW at 900 r.p.m. from an   **L3**   **5M**
electric motor to a compressor. The service factor may be assumed as 1.35. The following
permissible stresses may be used : Shear stress for shaft, bolt and key material = 40 MPa
Crushing stress for bolt and key = 80 MPa Shear stress for cast iron = 8 MPa Draw a neat
sketch of the coupling.