Reg. No.											

Question Paper Code	11552

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV/DEC 2022
Fifth Semester
Production Engineering
20PRPC502 - MACHINE ELEMENT DESIGN
(Regulations 2020)
(Use of approved PSG Design Data Book is permitted)

Duration: 3 Hours   Max. Marks: 100

PART - A (10 × 2 = 20 Marks)
Answer ALL Questions

		Marks, K-Level, CO
1.	What are the three basic modes of failure of mechanical components?	2,K1,CO1
2.	What do you mean by factor of safety?	2,K1,CO1
3.	What is caulking? What is its objective?	2,K1,CO2
4.	What are the different types of rivet heads?	2,K1,CO2
5.	Sketch a protective type flange coupling and indicate there on its leading dimensions for shaft size of 'd'.	2,K2,CO4
6.	What is the function of the transmission shaft?	2,K1,CO4
7.	Define creep of a belt.	2,K1,CO5
8.	Name the four important types of gears.	2,K1,CO5
9.	What is surge in spring?	2,K1,CO6
10.	List the important physical characteristics of a good bearing material.	2,K1,CO6

PART - B (5 × 13 = 65 Marks)
Answer ALL Questions

11. a) The frame of a hydraulic press consisting of two identical steel plates   *13, K3,CO1*
is shown in Fig. The maximum force P acting on the frame is 20 kN.
The plates are made of steel 45C8 with tensile yield strength of 380
N/mm^2. The factor of safety is 2.5. Determine the plate thickness.
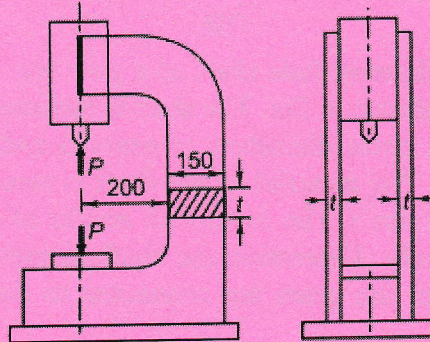
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **11552**

OR

b) A cantilever beam made of cold drawn steel 40C8 (S_{ut} = 600 N/mm^2 *13, K3,CO1*
    and S_{yt} = 380 N/mm^2) is shown in Fig. The force P acting at the free
    end varies from –50 N to +150 N. The factor of safety is 2. The notch
    sensitivity factor at the fillet is 0.9. Determine the diameter 'd' of the
   beam at the fillet cross-section.
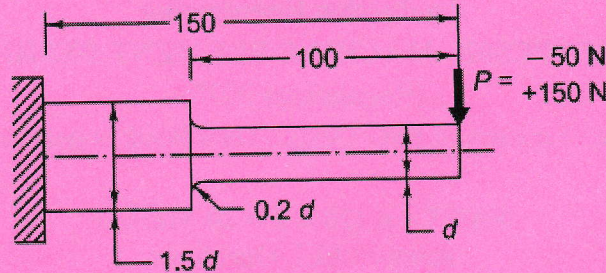
12. a) Find the efficiency of the following riveted joints: *13, K3,CO2*
        (i) Single riveted lap joint of 6 mm plates with 20 mm diameter rivets
        having a pitch of 50 mm.
        (ii) Double riveted lap joint of 6 mm plates with 20 mm diameter rivets
        having a pitch of 65 mm.
        Assume, Permissible tensile stress in plate = 120 MPa; Permissible
        shearing stress in rivets = 90 MPa; Permissible crushing stress in rivets
        = 180 MPa

OR

b) Design a double riveted butt joint with two cover plates for the   *13, K3,CO2*
    longitudinal seam of a boiler shell 1.5 m in diameter subjected to a
    steam pressure of 0.95 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.

13. a) Design a muff coupling to connect two steel shafts transmitting 25 kW *13, K3,CO4*
        power at 360 rpm. The shafts and key are made of plain carbon steel
        30C8 (S_{yt} = S_{yc} = 400 N/mm^2). The sleeve is made of grey cast iron FG
        200 (S_{ut} = 200 N/mm^2). The factor of safety for the shafts and keys are
        4. For the sleeve, the factor of safety is 6 based on ultimate strength.

OR

b) The layout of an intermediate shaft of a gear box supporting two spur *13, K3,CO4*
    gears B and C is shown in Fig. The shaft is mounted on two bearings A
    and D. The pitch circle diameters of gears B and C are 900 and 600
    mm respectively. The material of the shaft is steel FeE 580 (S_{ut} =770
    and Syt = 580 N/mm^2). The factors kb and kt of ASME code are 1.5
    and 2.0 respectively. Determine the shaft diameter using the ASME
    code. Assume that the gears are connected to the shaft by means of
    keys.

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **11552**
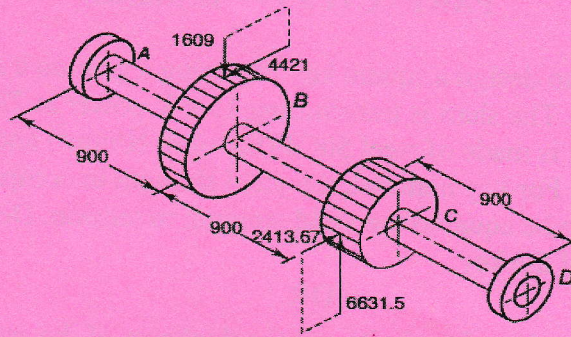
14. a) It is required to select a flat belt drive for a compressor running at 720 *13, K3,CO5*
rpm, which is driven by a 25 kW, 1440 rpm motor. Space is available
for a centre distance of 3 m. The belt is open-type.

OR

b) Explain, with the help of neat sketches, the types of various flat belt *13, K2,CO5*
drives.

15. a) Design a close coiled helical compression spring for a service load *13, K3,CO6*
ranging from 2250 N to 2750 N. The axial deflection of the spring for
the load range is 6 mm. Assume a spring index of 5. The permissible
shear stress intensity is 420 MPa and modulus of rigidity, G = 84
kN/mm^2.Neglect the effect of stress concentration. Draw a fully
dimensioned sketch of the spring, showing details of the finish of the
end coils.

OR

b) A semi-elliptic leaf spring used for automobile suspension consists of *13, K3,CO6*
three extra full-length leaves and 15 graduated-length leaves, including
the master leaf. The centre-to-centre distance between two eyes of the
spring is 1 m. The maximum force that can act on the spring is 75 kN.
For each leaf, the ratio of width to thickness is 9:1.The modulus of
elasticity of the leaf material is207 000 N/mm^2. The leaves are pre-
stressed in such a way that when the force is maximum, the stresses
induced in all leaves are same and equal to 450N/mm^2.
Determine,
(i) the width and thickness of the leaves;
(ii) the initial nip; and
(iii) the initial pre-load required to close the gap C between extra full-
length leaves and graduated-length leaves.

PART - C (1 × 15 = 15 Marks)

16. a) It is required to design a square key for fixing a gear on a shaft of 25 mm diameter. The shaft is transmitting 15 kW power at 720 rpm to the gear. The key is made of steel 50C4 (S_{yt} =460 N/mm^2) and the factor of safety is 3. For key material, the yield strength in compression can be assumed to be equal to the yield strength in tension. Determine the dimensions of the key.

15,K3,CO3

OR

b) Determine the size of the bolts and the thickness of the arm for the bracket as shown in Fig., if it carries a load of 40 kN at an angle of 60° to the vertical. The material of the bracket and the bolts is the same for which the safe stresses can be assumed as 70, 50 and 105 MPa in tension, shear and compression respectively.

15,K3,CO3

All dimensions in mm.