Reg. No.													

Question Paper Code	12886

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024
Fifth Semester
Mechanical and Automation Engineering
20MUPC501 – MACHINE DESIGN
Regulations - 2020
(Use of PSG Design Data Book is permitted)

Duration: 3 Hours   Max. Marks: 100
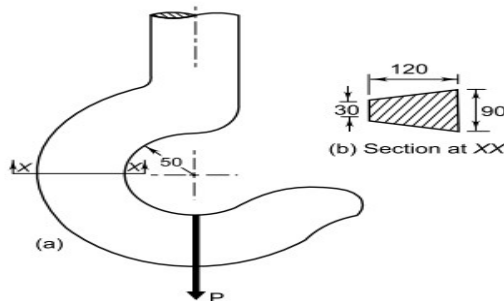
PART - A (10 × 2 = 20 Marks)
Answer ALL Questions

		Marks	K-Level	CO
1.	List out the various phases of design process.	2	K1	CO1
2.	Distinguish between direct stress and bending stress.	2	K2	CO1
3.	Write the advantages that hollow shafts offer as compared to solid shafts.	2	K1	CO2
4.	What are the types of flexible coupling and rigid couplings?	2	K1	CO2
5.	Differentiate with a neat sketch the fillet welds subjected to parallel loading and transverse loading.	2	K2	CO3
6.	Define the term Reliability of a Bearing.	2	K1	CO3
7.	Write the advantage of V belts over flat belts?	2	K1	CO4
8.	Why do you prefer helical gears than spur gears?	2	K1	CO4
9.	List any two principles to be followed to obtain optimum design in gear box.	2	K1	CO5
10.	What is multi speed gear box?	2	K1	CO5

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

11. a) A crane hook having an approximate trapezoidal cross-section is shown in Fig. 1. It is made of plain carbon steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 3.5. Determine the load carrying capacity of the hook.   13 K3 CO1
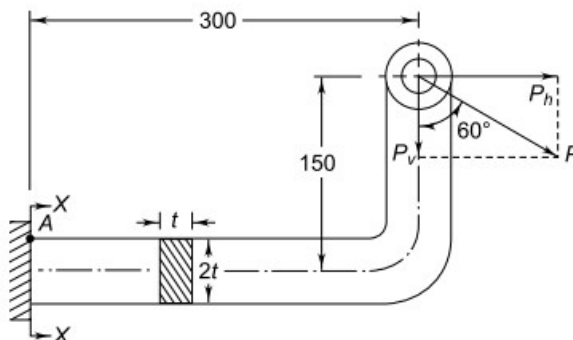

All Dimensions are in mm
Figure 1

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **12886**

1

OR

b) A wall bracket with a rectangular cross-section is shown in Fig. 2. The depth of the cross-section is twice of the width. The force P acting on the bracket at 600 to the vertical is 5kN. The material of the bracket is grey cast iron FG 200 (S_{yt} = 200 N/mm^2) and the factor of safety is 3.5. Determine the dimensions of the cross-section of the bracket. Assume maximum normal stress theory of failure.   *13 K3 CO1*
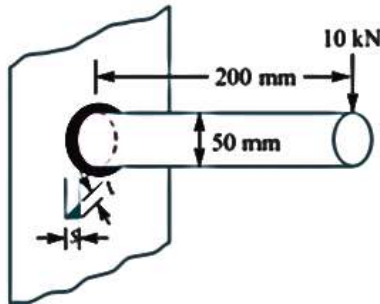

All Dimensions are in mm
Figure 2

12. a) A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is 180° and μ = 0.24. Determine the suitable diameter for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley.   *13 K3 CO2*

OR

b) Design a cast iron protective type flange coupling to transmit 15 kW at 900 r.p.m. from an 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.   *13 K3 CO2*

13. a) A 50 mm diameter solid shaft is welded to a flat plate as shown in Fig.3. If the size of the weld is 15 mm, find the maximum normal and shear stress in the weld.   *13 K3 CO3*

All Dimensions are in mm
Figure 3

OR

b) Select a single row deep groove ball bearing for a radial load of 4000   *13 K3 CO3*
N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for
an average life of 5 years at 10 hours per day. Assume uniform and
steady load.

14. a) Design a V – belt drive to the following specification: Power to be   *13 K3 CO4*
transmitted 75kW at 1440 rpm; Speed of driven wheel 400 rpm;
diameter of driving wheel 300mm; centre distance 2500mm; service 16
hours / day.

OR

b) Design a spur gear drive to transmit a power of 8 kW. Pinion speed is   *13 K3 CO4*
764 rpm. Speed ratio is 2. The gears are to be made of C 45. Life is to
be 10000 hours.

15. a) Design the layout of a 12 speed gear box for a lathe. The minimum and   *13 K3 CO5*
maximum speeds are 100 rpm and 1200 rpm. Power is 5kW from 1440
rpm induction motor. Construct the speed diagram using a standard
step ratio. Calculate the number of teeth in each gear wheel and sketch
the arrangement of the gear box

OR

b) Design an 18 speed gear box from a source of 1000 rpm. Maximum   *13 K3 CO5*
and minimum speeds are to be around 650 rpm and 35 rpm
respectively.

PART - C (1 × 15 = 15 Marks)

16. a) Fig. 4. Shows a shaft carrying a pulley A and a gear B and supported in   *15 K3 CO2*
two bearings C and D. The shaft transmits 20 kW at 150 r.p.m. The
tangential force Ft on the gear B acts vertically upwards as shown. The
pulley delivers the power through a belt to another pulley of equal
diameter vertically below the pulley A. The ratio of tensions T_1 / T_2 is
equal to 2.5. The gear and the pulley weigh 900 N and 2700 N
respectively. The permissible shear stress for the material of the shaft
may be taken as 63 MPa. Assuming the weight of the shaft to be

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **12886**

negligible in comparison with the other loads, determine its diameter. Take shock and fatigue factors for bending and torsion as 2 and 1.5 respectively.
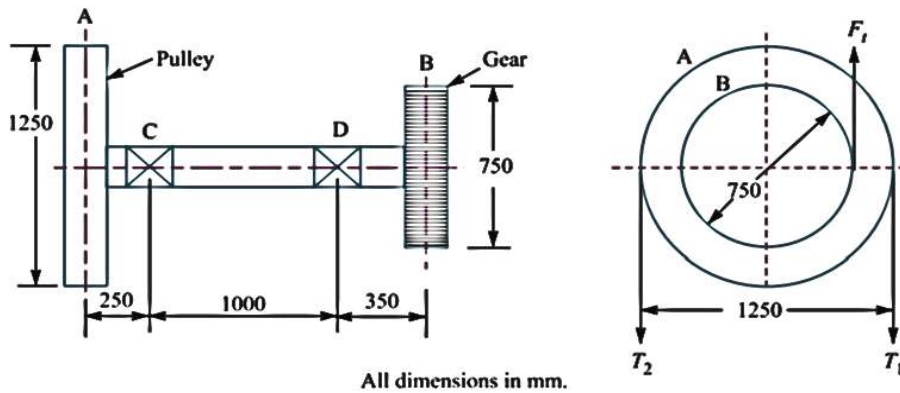

All dimensions in mm.
Figure 4
OR

b) A 9 speed gear box, used as head stock gear box of a turret lathe, is to provide a speed range of 180 to 1800 rpm using standard step ratio. Draw the speed diagram and kinematic arrangement showing number of teeth in all gear.   15   K3   CO5