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Question Paper Code	13584

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Fifth Semester

Mechanical and Automation Engineering

20MUPC501 - MACHINE DESIGN

Regulations - 2020

(Use of PSG Design Data Books is permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	The ratio of the ultimate stress to the design stress is known as (a) elastic limit (b) strain (c) factor of safety (d) bulk modulus	1	K1	CO1
2.	Rankine's theory is used for (a) brittle materials (b) ductile materials (c) elastic materials (d) plastic materials	1	K1	CO1
3.	Two shafts A and B are made of the same material. The diameter of the shaft A is twice as that of shaft B. The power transmitted by the shaft A will be..... of shaft B. (a) twice (b) four times (c) eight times (d) sixteen times	1	K1	CO2
4.	The type of stresses developed in the key is/are (a) shear stress alone (b) bearing stress alone (c) both shear and bearing stresses (d) shearing, bearing and bending stresses	1	K1	CO2
5.	The parallel fillet welded joint is designed for (a) tensile strength (b) compressive strength (c) bending strength (d) shear strength	1	K1	CO3
6.	In a full journal bearing, the angle of contact of the bearing with the journal is (a) 120° (b)180° (c) 270° (d) 360°	1	K1	CO3
7.	The power transmitted by means of a belt depends upon (a) velocity of the belt (b) tension under which the belt is placed on the pulleys (c) arc of contact between the belt and the smaller pulley (d) all of the above	1	K1	CO4
8.	The size of gear is usually specified by (a) pressure angle (b) pitch circle diameter (c) circular pitch (d) diametral pitch	1	K1	CO4
9.	Which of the following is the need of the gearbox? (a) To vary the speed of the vehicle (b) To vary the torque of the vehicle (c) To vary the power of the vehicle (d) To vary the acceleration of the vehicle	1	K1	CO5
10.	In which of the gearbox all gears are always in contact? (a) Constant-mesh gearbox (b) Sliding mesh gearbox (c) Synchromesh gearbox (d) Epicyclical gearbox	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

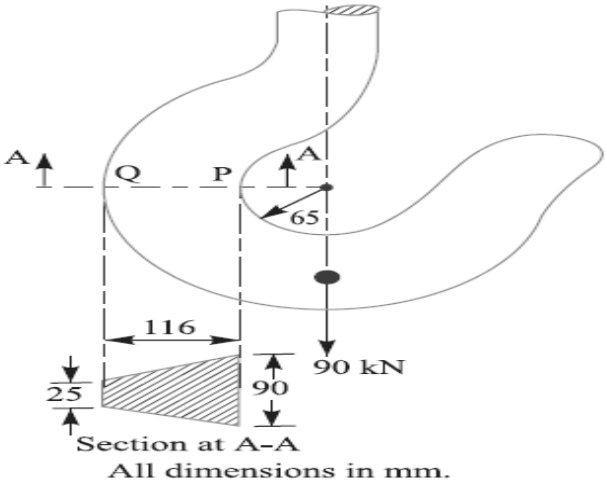
11.	List the factors that influence the process of machine design.	2	K1	CO1
12.	A component is loaded with normal and shear stresses as σ_x= 15 MPa ; σ_y = 5 MPa ; and τ_{xy} = 10 MPa. Find the maximum shear stress developed in the component.	2	K2	CO1
13.	Define equivalent bending moment.	2	K1	CO1
14.	Why generally? Hollow shafts are preferred over solid shafts.	2	K1	CO2

15.	Differentiate between rigid and flexible couplings.	2	K2	CO2
16.	Explain the function of splines in mechanical power transmission.	2	K2	CO2
17.	Why preloading of bolted joints is done?	2	K1	CO3
18.	Define life of a bearing.	2	K1	CO3
19.	What is crowning of pulley?	2	K1	CO4
20.	State law of gearing.	2	K1	CO4
21.	For what purpose we are using gear-box?	2	K1	CO5
22.	Draw the kinematic layout of 18-speed gear box.	2	K2	CO5

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	A crane hook has a trapezoidal section at A-A as shown in Figure. Find the maximum stress at points P and Q.	11	K3	CO1



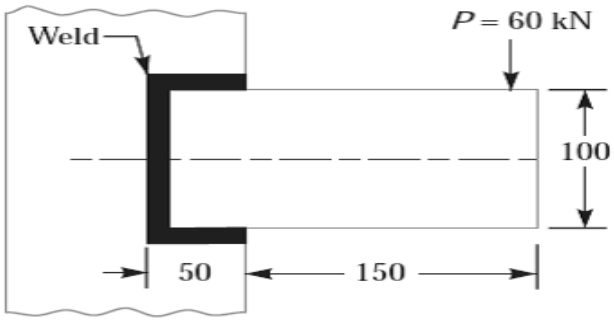
OR

	b)	A hot rolled steel shaft is subjected to a torsional moment that varies from 330 N-m clockwise to 110 N-m counterclockwise and an applied bending moment at a critical section varies from 440 N-m to – 220 N-m. The shaft is of uniform cross-section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MN/m^2 and a yield strength of 410 MN/m^2. Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.85 and a surface finish factor of 0.62.	11	K3	CO1
24.	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 $\mu = 0.24$. 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.	11	K3	CO2

OR

	b)	Design a cast iron protective flange coupling to connect two shafts in order to transmit 7.5 kW at 720 r.p.m. The following permissible stresses may be used: Permissible shear stress for shaft, bolt and key material = 33 MPa. Permissible crushing stress for bolt and key material = 60 MPa. Permissible shear stress for the cast iron = 15 MPa.	11	K3	CO2

25. a) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P, as shown in Figure. Determine the weld size if shear stress in the same is not to exceed 140 MPa. *11 K3 CO3*



OR

b) A plate 75 mm wide and 12.5 mm thick is joined with another plate by a single transverse weld and a double parallel fillet weld as shown in Fig. The maximum tensile and shear stresses are 70 MPa and 56 MPa respectively. Find the length of each parallel fillet weld, if the joint is subjected to both static and fatigue loading. *11 K3 CO3*

26. a) Design a V-belt drive to the following specifications : *11 K3 CO4*
Power to be transmitted = 7.5 kW
Speed of driving wheel = 1440 rpm
Speed of driven wheel = 400 rpm
Diameter of driving wheel = 300 mm
Centre distance = 1000 mm
Service = 16 hours/day.

OR

b) Design a Chain Drive to actuate a compressor from an 11 kW electric motor at 970 rpm. The compressor speed is 350 rpm. Assume minimum centre distance as 550 mm. The chain tension may be adjusted by shifting the motor on rails. The compressor is to work 8 hours a day. *11 K3 CO4*

27. a) A gear box is to be designed to provide 12 output speeds ranging from 160 rpm to 2000 rpm. The input speed of motor is 1600 rpm. Choosing a standard speed ratio, construct the speed diagram and the kinematic arrangement. *11 K3 CO5*

OR

b) The nine speed gear box, used as a head stock gear box of a turret lathe is to provide a speed range of 180 rpm to 1800 rpm. Using standard step ratio, draw the speed diagram, and the kinematic layout. Also find and fix the number of teeth on all gears. *11 K3 CO5*

28. a) (i) If a motor driven blower is to run at 650 rpm, is driven by an electric motor of 7.5 kW at 1800 rpm. Design the V – Belt Drive. *6 K3 CO4*

(ii) Outline the all possible arrangements to achieve 16 speed gear box. *5 K3 CO5*

OR

b)(i) Summarize the design procedure for V belt drive. *6 K3 CO4*

(ii) Design the layout of a 12 speed gear box for a lathe. The minimum and 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. *5 K3 CO5*