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Question Paper Code	14067

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Fifth Semester

Mechanical and Automation Engineering

20MUPC501 - MACHINE DESIGN

Regulations - 2020

(Use of *Design Data* Book is permitted)

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	The energy stored in a body when strained within elastic limit is known as (a) resilience (b) proof resilience (c) strain energy (d) impact energy	1	K1	CO1
2.	The maximum bending stress, in a curved beam having symmetrical section, always occur, at the (a) centroidal axis (b) neutral axis (c) inside fibre (d) outside fibre	1	K1	CO1
3.	If a solid circular shaft of steel 2 cm in diameter is subjected to a permissible shear stress of 10 kN/cm^2, then the value of the twisting moment will be (a)10π kN-cm (b) 20π kN-cm (c) 15π kN-cm (d) 5π kN-cm	1	K1	CO2
4.	A key connecting a flange coupling to the shaft is likely to fail in (a) Torsion (b) Tension (c) Shear (d) Bending	1	K1	CO2
5.	In an arc welding process, welding speed is doubled. Assuming all other process parameters to be constant, the cross sectional area of the weld bead will (a) Increase by 25% (b) Increase by 50% (c) Reduce by 25% (d) Reduce by 50%	1	K1	CO3
6.	Select the most appropriate classification for rolling contact bearings. (a) Antifriction bearings (b) Elastic bearings (c) Thin lubricated bearings (d) Thick lubricated bearings	1	K1	CO3
7.	The advantage of V- belt drive over flat-belt drive is (a) Noiseless drive (b) Higher velocity ratio (c) Used for smaller center distance (d) All of above	1	K1	CO4
8.	Total interference in an external involute spur gear pair can be reduced by (a) decreasing center distance between gear pair (b) decreasing module (c) decreasing pressure angle (d) increasing number of gear teeth	1	K1	CO4
9.	What is harmonic progression? (a) The difference between the reciprocal of two successive spindle speeds is constant (b) The difference between two successive spindle speeds is constant (c) The ratio of two successive spindle speeds is constant (d) The ratio of two successive spindle speeds is variable	1	K1	CO5
10.	If the number of stages in a gearbox is 'n', how many vertical lines will be drawn at a convenient distance in a structure diagram? (a) n (b) n+1 (c) n-1 (d) n/2	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

		Marks	K – Level	CO
11.	How the machine design may be classified?	2	K1	CO1
12.	Which theory of failure is suitable for the design of cast iron component subjected to steady state loading?	2	K1	CO1
13.	What is meant by design of a shaft based on rigidity?	2	K1	CO2
14.	Show the possible modes of failure of the pin (bolt) in a flexible coupling.	2	K2	CO2
15.	What is Caulking and Fullering process in riveted joints?	2	K1	CO3
16.	Define the term Reliability of a Bearing.	2	K1	CO3

17.	What do you mean by crowning of pulley?	2	K1	CO4
18.	Show the advantages of chain drive.	2	K2	CO4
19.	For what purpose we are using gear-box.	2	K1	CO5
20.	Why geometric progression is selected for arranging the speeds in gear boxes?	2	K1	CO5
21.	Write the profiles of a spur gear?	2	K1	CO4
22.	What is R20 series?	2	K1	CO5

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	A C-clamp is subjected to a maximum load of W, as shown in Fig.1. If the maximum tensile stress in the clamp is limited to 140 MPa, find the value of load W.	11	K3	CO1

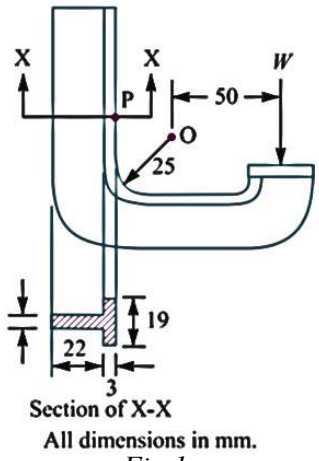

Fig 1.

OR

	b)	A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 N-m and a torque T. If the yield point of the steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to 1. The maximum principal stress; 2. The maximum shear stress; and 3. The maximum distortion strain energy theory of yielding.	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 and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa.	11	K3	CO2

25. a) 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.2 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*

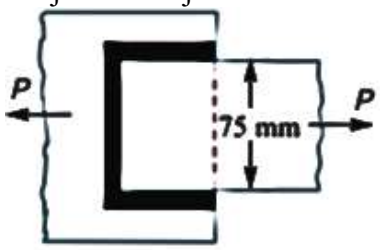

Fig.2.

OR

b) Select a single row deep groove ball bearing for a radial load of 4000 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. *11 K3 CO3*

26. a) It is required to select a Flat Belt Drive for a fan running at 300 rpm which is driven by a 10 kW, 1200 rpm motor. The belt drive is open type and space available for centre distance is 1.5 m. The diameter of the driven pulley is 800 mm. *11 K3 CO4*

OR

b) Design a pair of spur gears to transmit 20 kW at a pinion speed of 1400 rpm. The transmission ratio is 4. Assume 15Ni2Cr1Mo15 for pinion and C 45 for gear. *11 K3 CO4*

27. a) Draw the kinematic diagram and speed diagram of the head stock gear box of a turret lathe having arrangement for 9 spindle speed, ranging from 31.5 rpm to 1050 rpm. Calculate the number of teeth on each gear. Minimum number of teeth on a gear is 25. Also calculate the percentage deviation of the obtainable speeds from the calculated ones. *11 K3 CO5*

OR

b) 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. Calculate the number of teeth in each gear wheel and sketch the arrangement of the gear box. *11 K3 CO5*

28. a) It is required to design a V – Belt Drive to connect 15 kW, 1440 rpm induction motor to a fan running at approximately 480 rpm for 24 hour a day. Space available for centre distance is 1m. *11 K3 CO4*

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*