Model Question Paper-1 with effect from 2022-23 (CBCS Scheme)

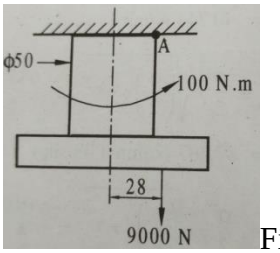
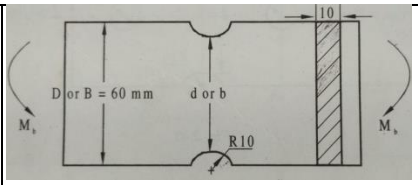
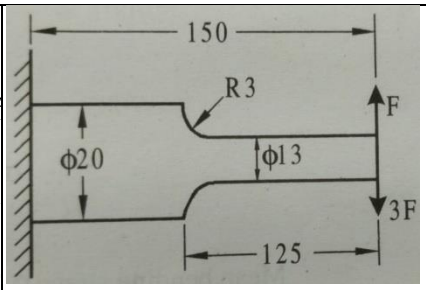
USN | | | | | | | | | | |

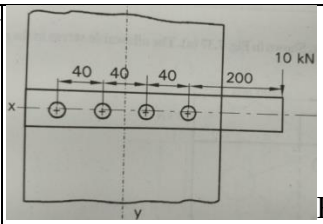
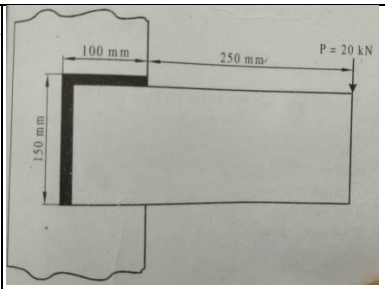
6th Semester B.E. Degree Examination

Machine Design (21ME63)

TIME: 03 Hours **Max.Marks:100**

Note: 01.Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. Use of Machine Design Data Hand Book is permitted.
03. Missing data may be suitably assumed.

		Module-1	*Bloom's Taxonomy Level	Marks
Q.01	**a**	Enumerate important mechanical properties of engineering materials	**L1**	**4**
	b	A steel saw blade 1 mm thick is bent into an arc of a circle of 500 mm radius. Determine the flexural stress induced and bending moment required to bend the blade, which is 15mm wide. Take E= 210 GPa.	**L3**	**8**
	c	A 50 mm diameter steel rod supports a 9.0 kN load and in addition is subjected to a torsional moment of 100 N-m as shown in Fig.1(c). Determine the maximum tensile and the maximum shear stress.  Fig 1(c)	**L3**	**8**
		OR		
Q.02	a	A notched flat plate shown in Fig 2(a) is subjected to bending moment of 10 N-m. Determine the maximum stress induced in the member by taking the stress concentration into account.  Fig 2(a)	**L3**	**7**
	b	Derive an expression for instantaneous stress due to axial impact	**L2**	**6**
	c	A cantilever beam made of cold drawn carbon steel (σ_u = 550 MPa, σ_y = 470 MPa, σ_{-1} = 275 MPa) of circular cross-section shown in Fig 2(c) is subjected to load which varies from –F to 3F. Determine the maximum load that the cantilever can withstand for an infinite life, using a factor of safety of 2.  Fig. 2 (c)	**L3**	**7**

Module-2				
Q.03	**a**	Design the shaft of the armature of a motor, if the magnetic pull on the shaft is equivalent to a uniformly distributed load of 10N per mm length over the middle one third of the 600 mm length of the shaft between bearings. The motor transmits a power of 15 kW at 1200 rpm. The allowable shear stress is 50 MPa. Take C_m = 1.5 and C_t = 1.25.	**L3**	**16**
	b	Mention the design steps for flange coupling	**L1**	**4**
OR				
Q.04	**a**	Design a Flange Coupling to connect the shafts of a motor and centrifugal pump for the following specifications: Pump output = 3000 liters/minute; Total head = 20 m; Pump speed = 600 rpm; Pump efficiency = 70 %. Select C40 steel (σ_y = 328.6 MPa) for shaft and C35 steel (σ_y = 304 MPa) for bolts with factor of safety 2. Use allowable shear stress in cast iron flanges equal to 15 N/mm^2.	**L3**	**16**
	b	What are the types of springs?	**L1**	**4**
Module-3				
Q.05	**a**	A double riveted lap joint is to be made between 9 mm plates. If the safe working stresses in tension, crushing and shear are 80 N/mm^2 and 60 N/mm^2 respectively, design the riveted joint.	**L3**	**12**
	b	A riveted bracket is supported by means of four rivets of same size as shown in Fig. Q5 (b). Determine the diameter of the rivet if the maximum shear stress in the rivet is 90 N/mm^2.  Fig Q 5(b)	**L3**	**8**
OR				
Q.06	**a**	A plate of 80 mm wide and 10 mm thick is to be welded to another plate by means of two parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of weld so that maximum stress does not exceed 50 N/mm^2. Consider the joint under static loading and then under dynamic loading.	**L3**	**10**
	b	A 16 mm thick plate is welded to a vertical support by two fillet welds as shown in Fig. 6 (b). Determine the size of weld, if the permissible shear stress for the weld material is 75 MPa.  Fig. Q 6 (b)	**L3**	**10**
Module-4				
Q.07		A pair of carefully cut spur gears with 20° full depth involute profile is used to transmit 12 kW at 1200 revolutions per minute of pinion. The gear has to rotate at 300 revolutions per minute. The material used for both pinion and gear is medium carbon steel whose allowable bending stress may be taken as 230 MPa. Determine the module and face width	**L3**	**20**

		of the spur pinion and gear. Suggest suitable hardness. Take 24 teeth on pinion. Modulus of elasticity may be taken as 210 GPa.		
		OR		
Q.08		Design a pair of helical gears to transmit a power of 20kW from a shaft running at 1500 rpm to a parallel shaft to be run at 450 rpm. Suggest suitable hardness for the gear pair.	**L3**	**20**
		Module-5		
Q.09	**a**	Design a single plate clutch consists of two pairs of contacting surfaces for a torque capacity of 200 Nm. Due to space limitations the outside diameter of the clutch is to be 250 mm.	**L3**	**10**
	b	A simple band brake of drum diameter 600 mm has a band passing over it with a angle of contact of 225°, while one end is connected to the fulcrum, the other end is connected to the brake lever at a distance of 400mm from the fulcrum. The brake lever is 1 m long. The brake is to absorb a power of 15 kW at 720 rpm. Design the brake lever of rectangular cross-section, assuming depth to be trice the width. Take allowable stress 80 MPa.	**L3**	**10**
		OR		
Q.10	**a**	Write short note on Hydrodynamic Theory of lubrication, showing pressure distribution and a graph of friction v/s speed.	**L2**	**10**
	b	Explain the types of rolling contact bearings and their applications	**L2**	**10**

Model Question Paper-2 with effect from 2022-23 (CBCS Scheme)

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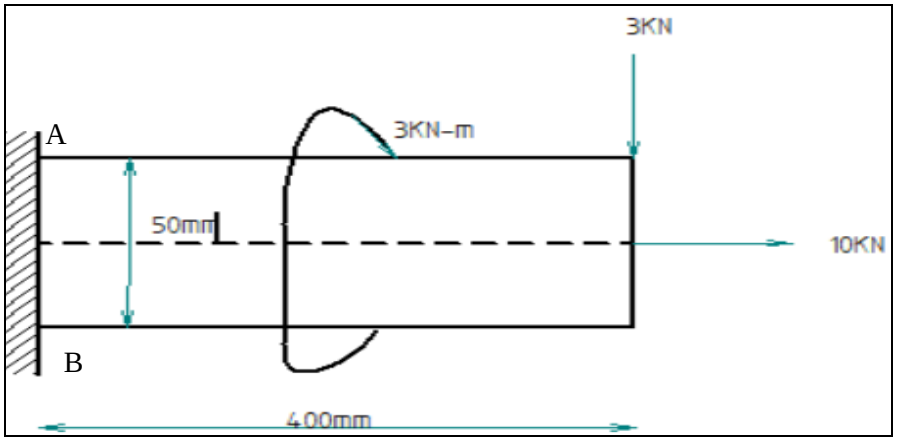
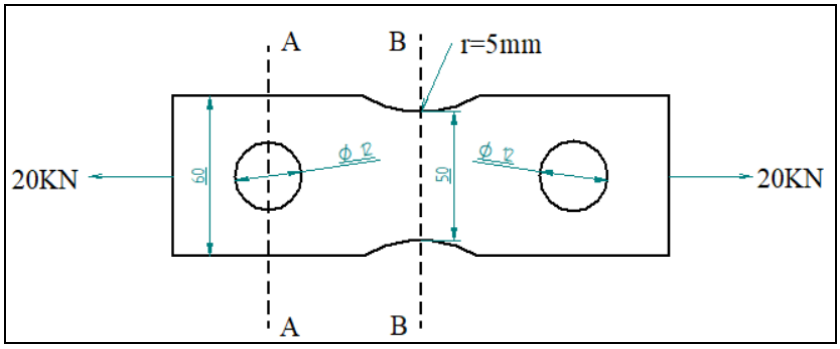
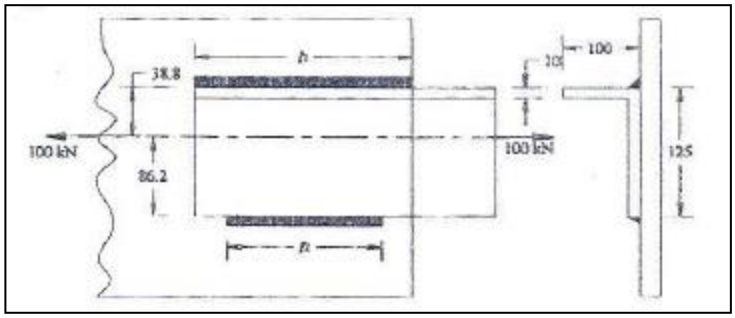
Sixth Semester B.E. Degree Examination

MACHINE DESIGN

TIME: 03 Hours **Max. Marks: 100**

Note: 01.Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. M: Marks, L: Blooms Level, C: Course outcomes
03. Use of Design Data Hand Book is permitted.
04. Assume missing data suitably

		Module-1	M	L	C
Q.01	**a**	Describe six-step process of design with a flow chart.	**5**	**L2**	**CO1**
	b	Describe briefly with a neat sketch Stress-Strain diagram considering an example for Ductile and Brittle Material.	**5**	**L2**	**CO1**
	c	A shaft of 50 mm diameter is subjected to a tensile load of 10kN, bending load of 3kN and a torque of 3kN-m as shown in figure Q1(c), determine the stresses at points A and B.  Figure Q 1(c)	**10**	**L3**	**CO1**
		OR			
Q.02	**a**	Determine the thickness of a flat plate loaded as shown in figure Q2(a) limiting the maximum stress induced in the material to 80 Mpa.  Figure Q 2(a)	**10**	**L3**	**CO1**

	b	Derive an equation for Impact stress induced in a member subjected to axial impact loading.	**10**	**L3**	**CO1**
		Module-2			
Q.03	**a**	A shaft is supported by two bearings placed 1100mm apart. A pulley of diameter 620mm is keyed at 400mm to the right from the left hand bearing and this drives the pulley directly below it with maximum tension of 2.75 kN. Another pulley of diameter 400mm is placed 200mm to the left of right bearing and is driven with a motor placed horizontally to the right. The angle of contact of pulley is 180^0 and μ= 0.3. Find the diameter of the shaft. Take C_m=0.3, C_t=2.5, σ_y= 190 MPa and σ_{ut}= 300 MPa	**20**	**L3**	**CO2**
		OR			
Q.04	**a**	Design a flexible flanged coupling to transmit a power of 25kW at speed of 500rpm. Assume Shaft, Keys, Pins are made of C40 steel with FOS=2 and flanges are made of Cast iron with FOS=6. Assume bearing pressure=0.5Mpa.	**10**	**L3**	**CO2**
	b	Derive an expression for stresses and deflection induced in a helical spring, with usual notations.	**10**	**L3**	**CO2**
		Module-3			
Q.05	**a**	Explain Caulking and Fullering with a neat sketch.	**5**	**L2**	**CO3**
	b	Explain in brief, the types of failures in riveted joints.	**5**	**L2**	**CO3**
	c	Design a double riveted lap joint to connect two plates each 20mm thick. The allowable stress for rivets and plates are 90MPa in tension, 60MPa in shear and 150MPa in crushing.	**10**	**L3**	**CO3**
		OR			
Q.06	**a**	A 125 X 100 X 10mm unequal leg angle section is to be welded to a steel plate by fillet welds along the edges of the 125mm legs as shown in Fig. Q6(a). The angle is subjected to a tensile load of 100kN passing through the center of gravity of angle. Determine the weld length if the size of the weld in 8mm and the allowable shear stress in the weld is 102MPa. All dimensions in the figure are in mm.  Fig Q6(a)	**10**	**L3**	**CO3**
	b	The cylinder head of a steam engine is subjected to a steam pressure of 0.7N/mm^2 It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak proof. The effective diameter of the cylinder is 300mm. Find the size of the bolt so that the stress in the bolt is not to exceed 100N/mm^2	**10**	**L3**	**CO3**
		Module - 4			
Q. 07	**a**	Derive Lewis beam strength equation for a spur gear tooth.	**5**	**L3**	**CO4**
	b	Design a pair of spur gear to transmit 20kW power from a shaft rotating at	**15**	**L3**	**CO4**

		1000rpm to a parallel which is to rotate at 310rpm. Assume number of teeth on pinion as 31 and 20^{o} full depth tooth form. The material of the pinion is C45steel untreated and for gear cast steel 0.20%C untreated.			
		OR			
Q.08		Design a pair of bevel gears to connect two shafts at 120 degree and to transmit 6kW at 1200 rpm of the pinion. The driven shaft is to rotate at 800rpm. The design should be as compact a possible.	**20**	**L3**	**CO4**
		Module - 5			
Q. 09	**a**	Design a single plate clutch to transmit 30kW at 1200rpm. The outside diameter of friction lining is 1.5 times the inside diameter. It is lined with asbestos having allowable pressure of 0.24MPa and coefficient friction of 0.3	**10**	**L3**	**CO5**
	b	A cast iron fly wheel rotating at 600rpm is brought to rest by a break in 2sec. The flywheel may be considered as a solid circular disc having a diameter of 400mm and thickness 100mm. The density of cast iron is 7200 kg/m^3. Determine: i. Energy absorbed by the brake ii. Number of turns drum rotates before coming to rest iii. The Braking Torque	**10**	**L3**	**CO5**
		OR			
Q. 10	**a**	Derive an expression for Petroff's equation for coefficient of friction.	**10**	**L3**	**CO5**
	b	A journal bearing of 100mm in diameter and 100mm in long supports a load of 50KN at 1400rpm. The radial clearance is 0.12mm and the absolute viscosity of the oil is 16CP. Determine: i) Co-efficient of friction. ii) Power loss due to friction iii) Minimum oil film thickness iv) Flow rate of lubricant.	**10**	**L3**	**CO5**