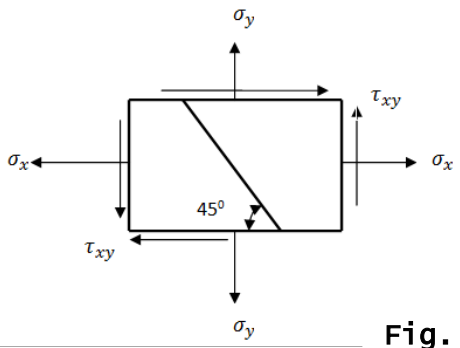
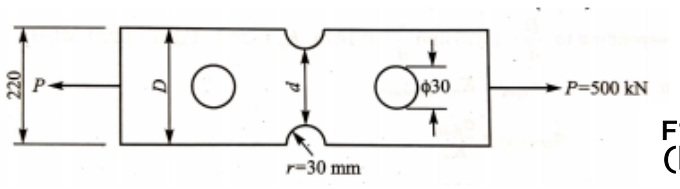
Model Question Paper -1 with effect from 2020-21(CBCS Scheme)

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

Fifth Semester B.E. Degree Examination
DESIGN OF MACHINE ELEMENTS-I

TIME: 03 Hours Max. Marks: 100

Note:
01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02. Use of design data hand book is permitted.
03. Any missing data may be suitably assumed.

Module – 1			
Q.1	(a)	Explain the phases of design with flow diagram	05
	(b)	List the factors which govern the selection of appropriate material for a machine element	05
	(c)	A point in a structural member is subjected to plane stress as shown in Fig. Q.1 (c). Determine the values of normal and tangential stresses on a plane inclined at 45^0 with vertical. σ_x = 120 N/mm^2, σ_y = 70 N/mm^2, τ_{xy} = 40 N/mm^2  Fig. Q.1(c)	10
		OR	
Q.2	(a)	State and explain the following theories of failure: (i) Maximum normal stress theory (ii) Distortion energy theory	08
	(b)	A bar of rectangular section is subjected to an axial pull of 500kN. Calculate its thickness if the allowable tensile stress in the bar is 200MPa.  Fig. Q.2 (b)	12
Module – 2			
Q.3	(a)	Derive an expression for impact stress induced in a member subjected to bending	10
	(b)	A cantilever beam of width 60mm, depth 140mm is 1.2 m long. A weight of 1kN is dropped from a height of 20mm at its free end. Determine, (i) Impact factor (ii) Instantaneous maximum deflection (iii) Instantaneous maximum stress (iv) Instantaneous maximum load. Take	10

		E=200Gpa.	

		OR	
Q.4	(a)	Define endurance limit and explain the factors affecting it.	10
	(b)	A steel shaft is subjected to a bending moment varies from 120Nm to 220Nm and transmits 15kW at 200rpm. The torque varies over a range of ± 30%. The shaft is made of steel whose yield stess=450N/mm^2 and endurance stress = 350 N/mm^2. Surface coefficient factor=0.9, size factor=1.2, factor of safety=4 and stress concentration factor=1.96. Determine the diameter of the shaft for infinite life.	10
		Module – 3	
Q.5		A power transmission shaft 1200mm long is supported at its extreme ends. The shaft receives a power of 50kW through a gear drive located 400mm to the right of the left end of the shaft at a rated speed of 500rpm. PCD of gear is 200mm, pressure angle 20^0 and weight 500N. This gear receives power from another gear directly behind. This power is delivered through a belt drive located at a distance of 400mm to the left of the right support. The belt pulley has a pitch diameter of 300mm and weighs 800N. The belt moving on the pulley is directed towards the observer below the horizontal and inclined at 45^0 to it. The ratio of belt tensions is 3. Selecting carbon steel C40 and factor of safety is 3. Design a solid circular shaft considering the loading with minor shocks.	20
		OR	
Q.6	(a)	Design a square key for a gear shaft of diameter 30mm. 30kW power at 1000 rpm is transmitted from the shaft to the gear. The yield strength of key material in tension is 400MPa and the factor of safety is 3. The yield strength in compression can be assumed to be equal to the yield strength in tension. Determine the dimensions of the key.	10
	(b)	Design a cast iron flange coupling (protected type) to connect two shafts and transmit torque of 500 N-m. Permissible shear stress for shaft, bolt and key material is 50MPa. Permissible crushing stress for bolt and key material is 150MPa. Permissible shear stress for C. I. is 8MPa.	10
		Module – 4	
Q.7		Design a longitudinal joint for a boiler of inner diameter 1.5m. The steam pressure in the boiler is 3Mpa. The longitudinal joint is triple riveted double cover plates butt joint of unequal width. The pitch in the outer row is twice the pitch of rivets in the inner rows. The efficiency of the joints is 82%. Assume the rivets in double shear are 1.875 times stronger than in single shear. The allowable stresses in shear and crushing of rivets are 60MPa and 120MPa respectively. Tensile stress for material of plate= 80MPa.	20
		OR	

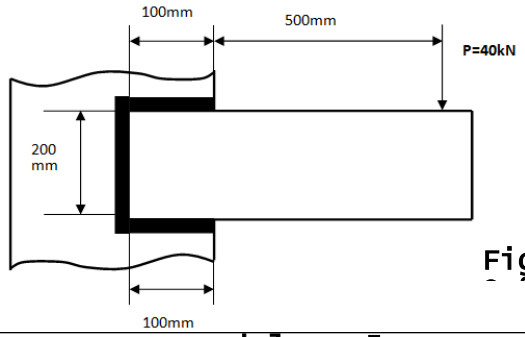
Q.8		A steel plate welded by fillet welds to a structure is loaded as shown in Fig.8. Calculate the size of the weld if the load is 40kN and allowable shear stress for the weld material is 80 MPa.  Fig.	20
		Module – 5	
Q.9	(a)	Design a cotter joint for socket and spigot type to sustain an axial load of 120kN. The material selected for the joint has the following design stresses. σ_t = 120 MPa, σ_c = 180 MPa, τ = 80 MPa	10
	(b)	The cylinder head of a steam engine is held in position by 10 bolts. The diameter of the cylinder is 400mm and the maximum pressure of steam in cylinders is 1MPa. A copper gasket is used to make the joint leak proof. Determine the standard size of bolts required by taking the design tensile stress for bolt material equal to 90MPa.	10
		OR	
Q.10	(a)	Explain self locking and overhauling in power screw	08
	(b)	A machine weighing 30kN is to be raised by a single start square thread of 50mm diameter, 8mm pitchscrew jack at a maximum speed of 8m/min. if the coefficient of friction for threads is 0.2, determine the power required to lift the machine. The thrust collar of screw has inside diameter 30mm and outside diameter 60mm. The coefficient of friction for collar is 0.1.	12

Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome

Question		Bloom's Taxonomy Level attached	Course Outcome	Programme Outcome
Q.1	(a)	L1	CO1	PO1
	(b)	L1	CO2	PO1
	(c)	L2 L3	CO2	PO2
Q.2	(a)	L2	CO3, CO4	PO1
	(b)	L3	CO3, CO4	PO1, PO2
Q.3	(a)	L3	CO3	PO1
	(b)	L3	CO3	PO1, PO2
Q.4	(a)	L3	CO3	PO1
	(b)	L3	CO3	PO1, PO2
Q.5		L3 L4	CO3	PO1, PO2, PO3, PO12
Q.6	(a)	L3 L4	CO3	PO1, PO2, PO3, PO12
	(b)	L3 L4	CO3	PO1, PO2, PO3
Q.7		L3 L4	CO5	PO1, PO2, PO3
Q.8		L3 L4	CO5	PO1, PO2, PO3, PO12
Q.9	(a)	L3 L4	CO5, CO6	PO1, PO2, PO3
	(b)	L3 L4	CO5, CO6	PO1, PO2, PO3, PO12
Q.10	(a)	L2	CO5	PO1
	(b)	L3 L4	CO5, CO6	PO1, PO2, PO3, PO12

Bloom's Taxonomy Levels	Lower order thinking skills		
	Remembering(knowledge): $\square_1$	Understanding Comprehension): $\square_2$	Applying (Application): $\square_3$
	Higher order thinking skills		
	Analyzing (Analysis): $\square_4$	Valuating (Evaluation): $\square_5$	Creating (Synthesis): $\square_6$

Model Question Paper -2 with effect from 2020-21(CBCS Scheme)

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Fifth Semester B.E. Degree Examination
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Note:
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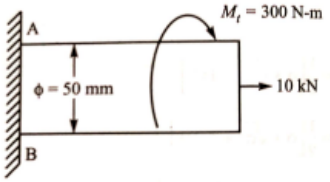
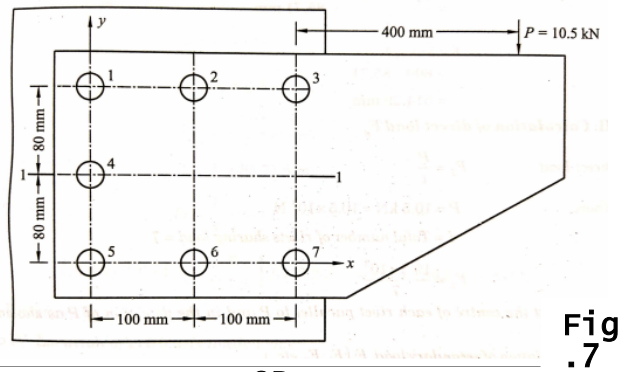
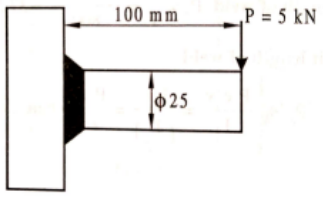
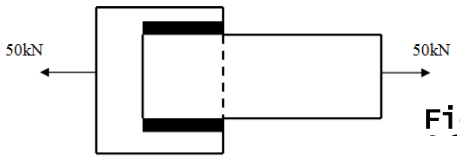
05. Use of design data hand book is permitted.
06. Any missing data may be suitably assumed.

		Module – 1	
Q.1	(a)	The stresses acting at a point in structural member are, σ_x = 140 N/mm^2, σ_y = 80 N/mm^2, τ_{xy} = 40 N/mm^2 using Mohr's circle determine the Principal stresses and maximum shear stress.	10
	(b)	A circular shaft of diameter 50mm fixed at one end is subjected to an axial tensile load of 10kN and torque of 300N-m. Determine the principal stresses and maximum shear stress.  Fig. Q.1 (b)	10
		OR	
Q.2	(a)	What is stress concentration? Explain with neat sketches the methods of reducing stress concentration.	10
	(b)	The state of stresses at a point in a body are σ_x = 100 N/mm^2, σ_y = 70 N/mm^2 and τ_{xy} = 60 N/mm^2. The yield stress of material is 300 MPa. Find the factor of safety by, (i) Maximum shear stress theory (ii) Distortion energy theory	10
		Module – 2	
Q.3	(a)	Derive an expression for the stress induced in a member subjected to axial impact.	08
	(b)	A 500N weight dropped through a height of 25 mm impacts the centre of a 300 mm long simply supported steel square beam. If the maximum allowable bending stress is 100 MPa, find the dimension of side of the beam and maximum deflection. Neglect inertia effect. Take E= 200 GPa.	12
		OR	
Q.4	(a)	Derive Soderberg's relation for a member subjected to fatigue loading.	06
	(b)	A round rod of diameter 1.2d is reduced to a diameter d with a fillet radius of 0.1d. This rod is to sustain a twisting moment that fluctuates between +2.5kN-m and 1.5kN-m together with a bending moment that fluctuates between +1kN-m and -1kN-m. the rod is made of carbon steel 40C8. Determine a suitable value for d.	14

		Module – 3	
Q.5		A steel shaft 800 mm long supported between bearings has a cast iron pulley of 600 mm diameter weighing 750N overhanging the right bearing by 150mm. This pulley receives 25kW at 1000 rpm by a belt inclined at 60^0 to the horizontal (inclined upward). The power from the shaft is transmitted through a 14.5^0 spur pinion of module 5mm having 40 teeth to a spur gear mounted directly above the pinion. The pinion is keyed to the shaft at a distance of 200 mm to the right of left bearing. Taking the ratio of belt tension as 3:1, ultimate stress and yield stress for material of shaft as 600 MPa and 300 MPa respectively, determine the shaft diameter. Use $K_b = 2$ and $K_t = 1.5$.	20
		OR	
Q.6	(a)	Determine the length of the key required in terms of shaft diameter taking width of key b = d/4 and thickness of key $h=(3/16)d$, If a shaft and key are made of same material.	06
	(b)	Design a pin type flexible coupling to transmit 20kW at 600rpm. Assume C40 as shaft, bolt (pin) and key material with allowable yield stress of 330MPa and allowable ultimate stress for hub material is 125 MPa.	14
		Module – 4	
Q.7		Determine the diameter of the rivets for the eccentrically loaded riveted joint shown in Fig. Q.7, permissible shear stress for rivets is 60 MPa.  Fig.Q .7	20
		OR	
Q.8	(a)	A solid circular shaft of diameter 25mm is welded to a support by means of fillet weld as shown in Fig.Q. 8(a). Determine the leg dimensions of the weld if the permissible shear stress is 80 MPa.  Fig.Q.	12

Q.8	(b)	Two plates are joined by means of fillet weld as shown in Fig. Q.8(b). The leg dimension of the weld is 12mm and the permissible shear at throat cross section is 80MPa. Determine the length of each weld.  Fig.Q.	08
		Module – 5	
Q.9	(a)	Design a knuckle joint to connect two mild steel rods subjected to an axial pull of 120kN. The allowable stresses for rods and pin are 120 MPa, 140 MPa and 60 MPa in tension, crushing and shear respectively. The bending of pin is prevented by selection of proper fit.	10
	(b)	A cylinder head of a steam engine is subjected to a pressure of 1MPa. It is held in position by means of 12 bolts. Each bolt is subjected to an initial tension of 5kN. A soft copper gasket is used to make the joint leak proof. Effective diameter of the cylinder is 300mm. Find the size of bolts so that the stress in the bolt is not to exceed 120MPa.	10
		OR	
Q.10		A screw jack is to lift a load of 100kN through a height of 500mm, ultimate strength of screw material in tension and compression is 250 MPa and in shear 120 MPa. The material for the nut is phosphor bronze for which the ultimate strength is 100 MPa in tension, 80 MPa in compression and 60 MPa in shear. The bearing pressure between the nut and the screw is not to exceed 20MPa. Design the screw and nut and check for stresses. Take FOS=2, μ = 0.14. Design the jack for 20% overload.	20

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	(b)			
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