Model Question Paper-1 with effect from 2023-24 (CBCS 2022 Scheme)

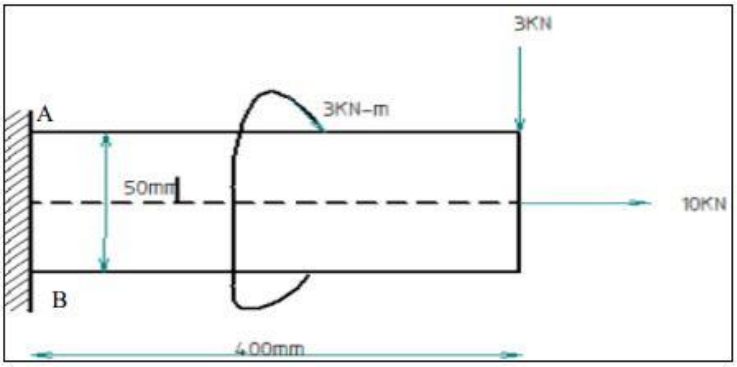
USN										

Fifth Semester B.E Degree Examination

Design of Machine Elements

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

Note:
1. Answer any ***FIVE*** full questions, choosing at least ***ONE*** question from each ***MODULE***.
2. Use of ***Design Data Handbook*** is permitted.
3. Missing data if any may be suitably assumed.

			*Bloom's Taxonomy Level	CO's	Marks
Module -1					
Q.01	a	With a flow chart, Explain the detailed procedure of design of a machine element.	L1,2	CO1	10
	b	A round rod of 60mm diameter is subjected to bending moment of 900 N-m and a twisting moment of 1200 N-m. Determine the maximum normal and shear stresses induced in the rod.	L1,2,3	CO1	10
OR					
Q.02	a	What is stress concentration? Explain with neat sketches methods to mitigate stress concentration in machine elements.	L1,2	CO1	10
	b	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, determine the stresses at points A and B. 	L1,2,3	CO1	10
Module-2					
Q. 03	a	Derive the Goodman equation for designing the member subjected to fatigue loading	L1,2,3	CO2	10
	b	A hot rolled steel shaft is subjected to a torsional load varying from	L1,2,3	CO2	10

		330 N-m clockwise to 110 N-m counterclockwise and an applied bending moment varies from + 440 N-m to -220 N-m. Determine the required shaft diameter. The ultimate strength of the material is 550 MPa and yield stress is 410 MPa, factor of safety as 1.5, endurance limit as half the ultimate strength and the size factor as 0.85. Neglect the effect of stress concentration.			
OR					
Q.04	a	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/mm2 and endurance stress = 350 N/mm2. 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.	L1,2,3	CO2	10
	b	Define endurance limit and explain the factors affecting it.	L1,2	CO2	10
Module-3					
Q.05	a	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 200 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 450 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.	L1,2,3	CO3	20
OR					
Q.06	a	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 600 to the horizontal (inclined upward). The power from the shaft is transmitted through a 14.50 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 Kb = 2 and Kt = 1.5.	L1,2,3	CO3	20

Module-4					
Q.07	a	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 of the spur pinion and gear. Suggest suitable hardness. Take 24 teeth on pinion. Modulus of elasticity may be taken as 210 GPa.	L1,2,3	CO4	20
OR					
Q.08	a	Derive Lewis beam strength equation for a spur gear tooth.	L1,2,3	CO4	05
	b	Design a pair of spur gear to transmit 20kW power from a shaft rotating at 1000rpm to a parallel which is to rotate at 310rpm. Assume number of teeth on pinion as 31 and 20o full depth tooth form. The material of the pinion is C45steel untreated and for gear cast steel 0.20%C untreated.	L1,2,3	CO4	15
Module-5					
Q.09	a	Explain in brief the failures of riveted joints.	L1,2	CO5	10
	b	Derive an expression for stresses and deflection induced in a helical spring, with usual notations.	L1,2	CO5	10
OR					
Q.10	a	Write advantages and disadvantages of welded joint over riveted joint	L1,2	CO5	10
	b	Two lengths of a flat tie bar of 18mm thick are connected by a butt joint with equal cover plates on either side. If a load of 400 kN is acting on the bar. Design the joints such that the section of the bar is not weakened by more than one rivet hole. The working stresses for the material of a bar is 100 MPa in tension, for the material of the rivet 70 MPa in shear and 160 MPa in crushing.	L1,2,3	CO5	10

Model Question Paper-2 with effect from 2023-24 (CBCS 2022 Scheme)

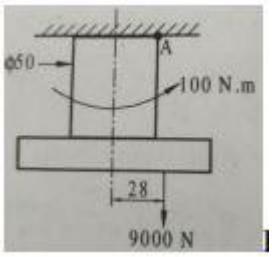
USN										

Fifth Semester B.E Degree Examination

Design of Machine Elements

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

Note:
1. Answer any ***FIVE*** full questions, choosing at least ***ONE*** question from each ***MODULE***.
2. Use of ***Design Data Handbook*** is permitted.
3. Missing data if any may be suitably assumed.

			*Bloom's Taxonomy Level	CO's	Marks
Module -1					
Q.01	a	Briefly discuss about codes and standards.	L1,2	CO1	08
	b	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. Determine the maximum tensile and the maximum shear stress. 	L1,2,3	CO1	12
OR					
Q.02	a	List the theories of failure. Explain any two theories of failure in detail.	L1,2	CO1	10
	b	Derive an expression for instantaneous stress due to axial impact.	L1,2,3	CO1	10
Module-2					
Q. 03	a	Sketch S-N diagram and explain in detail the significance of S-N diagram.	L1,2,3	CO2	10
	b	A steel shaft is subjected to a bending moment varies from 100Nm to 200Nm and transmits 25kW at 250rpm. The torque varies over a range of ± 30%. The shaft is made of steel whose yield stess=450N/mm2 and endurance stress = 350 N/mm2. 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.	L1,2,3	CO2	10
OR					

Q.04	a	Derive Soderberg's equation for a member subjected to fatigue loading	L1,2,3	CO2	10
	b	A hot rolled steel shaft is subjected to a torsional load varying from 250 N-m clockwise to 90 N-m counter clockwise and an applied bending moment varies from + 340 N-m to -220 N-m. Determine the required shaft diameter. The ultimate strength of the material is 550 MPa and yield stress is 410 MPa, factor of safety as 1.5, endurance limit as half the ultimate strength and the size factor as 0.85. Neglect the effect of stress concentration.	L1,2,3	CO2	10
Module-3					
Q.05	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 1800 and μ= 0.3. Find the diameter of the shaft. Take C_m=0.3, Ct=2.5, σ_y= 190 MPa and σ_{ut}= 300 MPa	L1,2,3	CO3	20
OR					
Q.06	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.	L1,2,3	CO3	20
Module-4					
Q.07	a	Discuss in detail classification of gears.	L1,2	CO4	06
	b	Design a pair of spur gears to transmit a power of 20kW from a shaft at 1000 rpm to a parallel shaft which is to rotate at 310 rpm. Assume number of teeth on pinion 31 and 20^0 full depth involute tooth form. The material for pinion is C40 steel interated and for gear cast steel 0.20% C untreated.	L1,2,3	CO4	14
OR					
Q.08	a	Derive an expression for Beam strength of a spur gear tooth (Lewis equation)	L1,2,3	CO4	06
	b	Design a pair of spur gear 20^0 involute to transmit 30kW of power at 600 rpm of pinion. Number on teeth on pinion is 15, transmission ratio is 5:1. Material of the pinion is cast steel (σ = 137.34MPa) and that of gear is high grade cast iron (σ = 103MPa)	L1,2,3	CO4	14

Module-5					
Q.09	a	Discuss in detail different types of springs along with their applications.	L1,2	CO5	06
	b	A triple-riveted butt-joint with equal cover plates is used to connect two plates 16 mm thick. Design the joint if the allowable crushing stress for rivet and plates is 60 MN/m2. Find the joint efficiency. Allowable shear stress for rivets: 45 MN/m2. Draw to scale two views of the designed joint giving all dimensions.	L1,2,3	CO5	14
OR					
Q.10	a	Design and draw a fully dimensioned neat sketch in two view of a double riveted butt joint with double cover plates for the longitudinal seam of a boiler 1.5m in diameter when working pressure is 1 MPa. Use the following data: a. Allowable stress in tension for steel plate = 80MPa b. Allowable stress in shear for rivets = 60 MPa c. Allowable stress in crushing for rivets = 120 MPa.	L1,2,3	CO5	10
	b	A truck spring has 12 numbers of leaves, two of which are full length leaves. The spring supports are 1.05m apart and the central bond is 85mm wide. The central load is to be 5.4kN with a permissible stress of 280N/mm^2. Determine the thickness and width of the steel spring leaves. The ration of the total depth to the width of the spring is 3. Also determine the deflection of the spring. Take E= 0.26×10^6 MPa	L1,2,3	CO5	10