Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2024

Subject Code:3141907 Date:20-07-2024

Subject Name: Fundamentals of Machine Design

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	Explain parallel axes theorm.	**03**
	(b)	Define Hardness, Ductility, Poisons ratio, Bulk Modulus	**04**
	(c)	A Steel beam section is of I section with top flange 80 x 20 mm thick, bottom flange 160 x 40 mm thick and web 200 mm deep and 20 mm thick. The beam is freely supported on span of 10 meters. If tensile stress is not to exceed 40 N/mm^2. Find the safe uniformly distributed load which the beam can carry ? Also find maximum compressive stress.	**07**
Q.2	**(a)**	Derive the flexural formula for beam $\sigma/y = E/R$ with usual notations	**03**
	(b)	What is function of key in shaft ? State their failure equations in brief.	**04**
	(c)	A shaft is made of mild steel transmitting 100 KW at 300 rpm. The supported length of shaft 3 m. It carries two pulleys each weighing 1500 N supported at a distance of 1 meter from end respectively. The strength in shear stress is 0.5Syt, Assume factor of safety is 2, Syt = 240 N/mm^2. Also check the rigidity of shaft 0.25 per meter of spindle assume G= 84 x 10^3 N/mm^2.Fatigue shock factor Kb is 1.5 and Kt is 1.0	**07**
		OR	
	(c)	Design a square key for fixing a gear on shaft having 25 mm diameter. The gears rotates at 550 rpm and transmits 12 KW power to the meshing gear. The key is made of steel having yiels strength in tension as 400 N/mm^2 . The yield stress in tension and compression may be taken equal to each other. Assume factor of safety 2.5. Assume τ_s =0.577	**07**
Q.3	**(a)**	Find out the number of R5 basic series	**03**
	(b)	Explain Manufacturing consideration in design.	**04**
	(c)	Derive the following relation for torsion $T/J = \tau/R = G\theta/L$	**07**
		OR	
Q.3	**(a)**	Define IS coding of steels and explain 45C8, 25Cr4Mo2, 10C8S10, SG80/2, FG60	**03**
	(b)	What is factor of safety ? Discuss the factors affecting the values of factor of safety.	**04**
	(c)	Enlist theory of failure and explain von mises theory of failure.	**07**
Q.4	**(a)**	What is lever? Why hose is provided at the fulcrum of lever.	**03**

(b) Calculate diameter of piston rod for cylinder of 1.5 m diameter in which the greatest difference in steam pressure on the two sides of piston may be assumed to be 0.2N/mm2. The rod is made of mild steel and is secured to the piston by a tapper nad nut and to the cross head bya cotter. Assume modulus of elasticity as 200 KN/mm^2 and factor of safety 8.The length of rod may be assumed as 3 meter take rankine constant a= 1/7500 **04**

(c) Design a knuckle joint to connect two mild steel rods which transmit a tensile force of 25 KN, Safe working stress for tension ,shear crushing 100 N/mm^2, 60 N/mm^2, 160 N/mm^2 **07**

OR

Q.4 **(a)** Explain rankine formula for buckling of columns **03**

(b) Why cotter is provided with tapper ? Enlist application of cotter joint. **04**

(c) Design a simple lever of a safety valve for a boiler having a gauge pressure of 1.5 MN/m^2, the valve diameter is 90 mm. The lever is 1 m long and distance between the fulcrum and valve point is 100 mm and distance between valve point to where load given is 900 mm. Assume the permissible stress for bending for C20 steel is 100N/mm^2, permissible shear stress for pin is 50 N/mm2. Assume lever section rectangle h/b is 4. **07**

Q.5 **(a)** Explain varios methods for reducing stress concentrations(three methods only) **03**

(b) What is self locking and overhauling of power screw ? Explain condition for self locking. **04**

(c) A Power screw having double start square thread of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 KN. The outer and inner diameter of screw collar are 50 mm and 20 mm respectively. The screw rotates at 15 rpm assuming uniform wear condition at the collar and allowable thread bearing pressure of 6 N/mm2. Find the torque required to rotate screw and number of threads of nut in engagement with screw. **07**

OR

Q.5 **(a)** Discuss the advantages and disadvantages of threaded joints. **03**

(b) What is endurance limit ? Explain Goodman line in fatigue design. **04**

(c) A steel rod is subjected to a reversed axial load of 200 KN. Find the diameter of rod for factor of safety 2. Neglect column action. The material has ultimate tensile strength of 100 MPa and yield strength of 900MPa. The endurance limit in reversed bendingmay be assumed to be half of ultimate tensile strength. The correction factor may be taken as follows. Ka = Axial load correction factor =0.7, for machined surface factor =0.8, size factor =0.85, stress concentration factor is 1.0 **07**

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