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Scheme of Marking

Faculty of Engineering
End Sem Examination May-2023
RA3CO29 Design of Machine Elements and Transmission System
Programme: B.Tech. | Branch/Specialisation:

Q.1	i)	Factor of safety for fatigue loading is the ratio of c. Endurance limit to the working stress	1
	ii)	In static loading, stress concentration is more serious in a. Brittle Materials	1
	iii)	A bolt of M 24 ×2 means that d. The nominal diameter of the bolt is 24 mm and the pitch is 2 mm.	1
	iv)	A key made from a cylindrical disc having segmental cross-section, is known as b. Flat saddle key	1
	v)	A transmission shaft subjected to bending loads must be designed on the basis of a. Maximum normal stress theory	1
	vi)	The sleeve of Muff coupling is designed as a d. Hollow Shaft	1
	vii)	A spur gear with pitch circle diameter D has number of teeth T. The module m is defined as a. m = D/T	1
	viii)	The width of the pulley should be c. Greater than the width of the belt	1
	ix)	When a helical compression spring is subjected to an axial compressive load, the stress induced in the wire is c. Shear Stress	1
	x)	In thrust bearings, the load acts a. Along the axis of the rotation	1
Q.2	i	What are the main design considerations for mechanical component design, explain. List of Design considerations - 03 Marks	3

Any three: (i) Type of load & Stress caused (ii) kinematics of M/c (iii) Material Selection (iv) Form & Size of parts (v) frictional resistances & lubrication (vi) convient & Economical (vii) Safe operation (viii) workshop facilities (ix) No. of M/c to be mfd (x) Cost of Construction (xi) Assembling

(i) max. Principal or Normal Stress theory (iv) max. Strain Energy theory
(ii) max. Shear Stress theory (v) max. Distortion Energy theory
(iii) max. Principal Strain theory
Strain Energy: Shear Strain Energy / volume

	ii	Explain in detail three commonly used theory of failures. What is the purpose of using these theories? About three theory of failures - 05 Marks Purpose - 02 Marks	7
OR	iii	Explain Soderberg Criterion and Goodman Criterion for designing for Fatigue Loading. How these both criteria help to find factor of safety? Soderberg Criterion - 03 Marks Goodman Criterion - 03 Marks Criteria to find FoS - 01 Marks	7
Q.3	i.	What do you understand by single start and double start threads? Single start and double start threads - 03 Marks	3
	ii.	The diameter of an engine cylinder is 200 mm and the head is held in position by 10 bolts of M 16 ×2 size. The internal gas pressure is 1 N/mm². The head is connected to the cylinder by soft copper corrugated gasket with long through bolts to make the joint leak proof. Calculate the stress produced in the bolt. Note: Value for the factor considered for corrugated gasket may be taken as 0.4 Initial tension due to tightening 22.4 kN - 01 Marks External load on each bolt 3141.6 N - 01 Marks Bolt load 23656.6 N - 02 Marks Stress area for M16 ×2 bolt, 157 mm² - 01 Marks Stress produced in bolt 150.68 N/mm² - 02 Marks	7
OR	iii.	What is a key? How are the keys classified? Draw neat sketches of different types of keys and state their applications. Key - 01 Marks Classification - 02 Marks Sketches - 02 Marks Applications - 02 Marks	7
Q.4	i.	For what purposes shaft couplings are used? What are the requirements of a good shaft coupling? Purpose - 02 Marks Requirements - 02 Marks	4

Key → Piece of mild steel
Key Classification: Sunk key → Rectangular / Flat Saddle; Saddle key → Square / Hollow Saddle; Tangent key → Gib Head; Round key → Feather key; Splines
Sketches
Applications → Temporary fastening for Power transmission

Purpose: (i) Connection of Shafts & disconnection (ii) Provide misalignment of the shaft (iii) Reduce transmission shock load (iv) Introduce Protection against overloads
Requirements: (i) Easy connection & disconnection (ii) Transmit full power (iii) Hold shafts in perfect alignment (iv) Reduce transmission shocks (v) have no projection parts

	ii.	Design a Muff coupling which is used to connect two steel shafts transmitting 40 kW at 350 rpm. The material for the shafts and key is plan carbon steel for which allowable shear and crushing stresses may be taken as 40 MPa and 80 MPa respectively. The material for the muff is cast iron for which the allowable shear stress may be assumed as 15 mPa. Design of shaft, diameter 55 mm - 01 Marks Design of sleeve diameter of muff 125 mm - 01 Marks Length of muff 195 mm - 01 Marks Design of key, width 18 mm, thickness 18 mm, length 97.5 mm - 03 Marks	6
OR	iii.	Find the diameter of a solid steel shaft to transmit 20 kW at 200 rpm. The ultimate shear stress for the may be taken as 360 mPa and a factor of safety as 8. If a hollow shaft is to be need in place of the solid shaft, find the inside and outside diameter, when the ratio of inside to outside diameters is 0.5. Diameter of solid shaft 50 mm - 02 Marks Outside diameter of hollow shaft 50 mm - 02 Marks Inside diameter of hollow shaft 25 mm - 02 Marks	6
Q.5	i.	What are the requirements that must be met in the design of a gear drive? Requirements - 03 Marks	3
	ii.	A bronze spur pinion rotating at 600 rpm drives a cast iron spur gear at a transmission ratio of 4:1. The allowable static stresses for the bronze pinion and cast-iron gear are 84 MPa and 105 MPa respectively. The pinion has 16 standard 20^0 full depth involute teeth of module 8 mm. The face width of both the gears is 90 mm. find the power that can be transmitted from the stand point of strength. PCD of pinion 0.128 m - 01 Marks Pitch line velocity 4.02 m/s - 02 Marks Tangential load on teeth 7870 N - 02 Marks Power that can be transmitted 31.64 W - 02 Marks	7
OR	iii.	A belt drive consists of two V-belts in parallel, on grooved pulleys of the same size. The angle of the groove is 30^0. The cross-sectional area of each belt is 750 mm^2 and μ= 0.12. the density of the belt material is 1.2 Mg/m^3 and the maximum safe stress in the material is 7 MPa. Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1500 rpm. Find also the shaft speed in rpm at which the power transmitted would be a maximum. Power transmitted 171.75 kW - 04 Marks Shaft speed 2809 rpm - 03 Marks	7
Q.6			
	i.	What do you understand by Buckling of compression spring? Explain one method of avoiding the tendency of a compression spring to buckle. Buckling - 03 Marks Method - 02 Marks	5
	ii.	Explain wedge film and squeeze film journal bearing. wedge film - 03 Marks squeeze film - 02 Marks	5
	iii.	How do you express the life of a bearing? What is an average or median life? Life of bearing - 03 Marks Average or mean life - 02 Marks	5

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