



P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Industrial and Production Engineering

Semester End Examination; February / March - 2022

Design of Machine Elements

Time: 3 hrs

Max. Marks: 100

Course Outcomes

The Students will be able to:

CO1: Describe the theories of failures and determine the dimensions of mechanical components subjected to different types of static load.

CO2: Compute the dimensions of the machine elements subjected to fatigue and impact loads.

CO3: Distinguish between different mechanical joints and design welded and riveted joints for various loads.

CO4: Design spur gear and different types of spring for different applications.

CO5: Design the shaft for different load condition and comprehend the mechanism of lubrication and compare design of bearing for different applications.

Note: I) PART - A is compulsory. Two marks for each question.

II) PART - B: Answer any Two sub questions (from a, b, c) for Maximum of 18 marks from each unit.

Q. No.	Questions	Marks	BLs	COs	POs
I : PART - A		10			
I a.	Define factor of safety for ductile and brittle materials.	2	L1	CO1	PO1
b.	Define low cycle fatigue and high cycle fatigue.	2	L1	CO2	
c.	Define the terms, diagonal pitch and caulking used in riveted joints.	2	L1	CO3	
d.	Differentiate between spur gear and helical gear.	2	L1	CO4	
e.	Write the properties of lubricants.	2	L1	CO5	
II : PART - B		90			
UNIT - I		18			
1 a.	Discuss the factors influencing selection of appropriate value for the factor of safety.	9	L2	CO1	
b.	The load on a bolt consists of an axial pull of 10000 N and transverse shear load of 5000 N. The permissible tensile stress at the elastic limit is 100 N/mm^2 and $\mu = 0.3$. Find the dia of the bolt on the basis of,	9	L3	CO1	
	i) Maximum principal strain theory				
	ii) Maximum strain energy theory				
	iii) Maximum shear stress theory				
c.	A round rod of diameter 1.2 d has a semicircular groove of diameter 0.2 d. The rod is subjected to a bending moment of 10 kN-m. The material of the rod is 30C8 steel. Determine a safe value for 'd'. Factor of safety is 2.	9	L3	CO1	

Contd... 2

UNIT - II

18

- 2 a. Define endurance limit. State and explain the factors for modifying it. 8 L2 CO2
- b. Determine the thickness of a 120 mm wide uniform plate for safe continuous operations. If the plate is subjected to tensile load that has maximum value of 25000 N and minimum value of 10000 N. The properties of the material are given where $\sigma_{en} = 2250 \text{ N/mm}^2$, $\sigma_{yp} = 3000 \text{ N/mm}^2$ and FOS = 1.5. 10 L3 CO2
- c. With neat sketch, explain the four types of stress cycles. 8 L2 CO2

UNIT - III

18

- 3 a. Briefly explain with sketches type of welded joints. 6 L2 CO3
- b. 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 , 120 N/mm^2 and 60 N/mm^2 respectively. Design the riveted joint. 12 L3 CO3
- c. A plate of 50 mm wide and 10 mm thick is to be welded to another plate by means of transverse fillet weld at the ends, if the allowable tensile stress is 100 N/mm^2 . Determine the length of weld. 6 L3 CO3

UNIT - IV

18

- 4 a. A pair of spur gear has to transmit 14.914 kW at 1500 rpm of the pinion to 450 rpm of the gear. Pitch circle dia of the pinion has to be 75 mm. The tooth form is $14\frac{1}{2}^\circ$ full depth. What are your recommendation for module, number of teeth and face width of the gear. Check the gears for wear. Assuming pinion is made of C = 30 (heat treated) and gear is made of steel grade 35(heat treated). 12 L3 CO4
- b. A cantilever beam of uniform stress is made of C-50 steel which is 10 mm thick to absorb an impact of 19620 N-mm with a deflection of 50 mm. determine length of spring and maximum width, take FOS = 3. 12 L3 CO4
- c. Derive Lewis equation. 6 L4 CO4

UNIT - V

18

- 5 a. Derive an equation to find the shaft diameter based on strength. 6 L4 CO5
- b. Find the diameter of a solid steel shaft to transmit 20 kW at 200 rpm, the ultimate shear stress for the steel may be taken as 360 N/mm^2 , a factor of safety 8. If a hollow shaft is to be used in place of a solid shaft, find the ID and OD. Where the ratio of inside dia to outside dia is 0.5? 12 L3 CO5
- c. Write the design procedure for journal bearing. 6 L2 CO5