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**B.Tech. Degree II Semester Regular/Supplementary Examination in
Marine Engineering June 2023**

**19-208-0206 MECHANICS OF SOLIDS
(2019 Scheme)**

Time: 3 Hours

Maximum Marks: 60

Course Outcome

On successful completion of the course, the students will be able to:

- CO1: Understand and apply the concept of stress and strain to analyze statically determinate and indeterminate problems and design structural members and machine parts.
 CO2: Determine principal stresses strains and apply the concept of theories of failure for design.
 CO3: Determine the stresses and strains in the members subjected to axial, bending and torsional loads.
 CO4: Evaluate the slope and deflection of beams subjected to loads.
 CO5: Analyze and design thin, thick cylinders and springs.
 Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 – Analyze,
 L5 – Evaluate, L6 – Create
 PI – Programme Indicators

(Answer *ALL* questions)

(5 × 15 = 75)

		Marks	BL	CO	PI
I.	(a) A solid steel cylinder 500 mm long and 70 mm diameter is placed inside an aluminium cylinder having 75 mm inside diameter and 100 mm outside diameter. The aluminium cylinder is 0.16 mm longer than the steel cylinder. An axial load of 500 kN is applied to the bar and cylinder through rigid cover plates. Find the stress developed in the steel cylinder and aluminium tube. ($E_s = 220$ GPa and $E_a = 70$ GPa).	10	L3	1	1.4.1
	(b) Explain about superposition principle with an example.	5	L2	1	1.4.1
OR					
II.	(a) A point is subjected to perpendicular stresses of 50 MN/m^2 and 30 MN/m^2 , both tensile. Calculate the normal, tangential and resultant stress and its obliquity on a plane making an angle of 30° C with the axis of second stress.	10	L3	1	1.4.1
	(b) Explain about maximum shear stress theory and its application.	5	L2	1	1.4.1
III.	(a) (i) What are all assumptions in Theory of Bending? (ii) Explain about section modulus and its importance.	5	L1	2	1.4.1
	(b) Two wooden planks $150 \text{ mm} \times 50 \text{ mm}$ each are connected to form a T section of a beam. If a moment of 3.4 kNm is applied around the horizontal neutral axis, inducing tension below the neutral axis, find the stresses at extreme fibres of the cross section. Also calculate the total tensile force on the cross section.	10	L3	2	1.4.1

OR**(P.T.O.)**

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		Marks	BL	CO	PI
IV.	(a) Explain the relation between load, shear and bending moment.	5	L1	2	1.4.1
	(b) Draw the bending moment and shear force diagrams for the beam loaded as shown in below figure.	10	L3	2	1.4.1
V.	A beam AB of length L simply supported at the ends carries a point load W at a distance 'a' from the left end. Find:	15	L2	3	3.1.1
	(i) The deflection under the load (ii) The maximum deflection.				
OR					
VI.	A fixed beam of 8 m span carries a uniformly distributed load of 40 kN/m run over 4 m length starting from left hand end and a concentrated load of 80 kN at a distance of 6 m from the left hand. Find:	15	L3	3	3.2.1
	(i) Moment at the support (ii) Deflection at centre of the beam. Take $EI = 15000 \text{ kNm}^2$.				
VII.	(a) A hollow C.I column whose outside diameter is 200 mm has a thickness of 20 mm. It is 4.5 m long and is fixed at both ends. Calculate the safe load by Rankine-Gordan formula using factor of safety of 4. Take $\sigma_c = 550 \text{ MPa}$; $a = 1/1600$.	10	L3	4	3.1.1
	(b) Find the equivalent length for the following columns:	5	L3	4	3.1.1
	(i) Both ends fixed				
	(ii) One end fixed and other end hinged				
OR					
VIII.	(a) Compute the relation between torque, shear stress and modulus of rigidity of a shaft.	6	L2	4	3.2.1
	(b) A hollow shaft is to transmit 300 kW at 80 r.p.m. If the shear stress is not to exceed 60 MN/m^2 and internal diameter is 0.6 of the external diameter, find the external and internal diameters assuming that the maximum torque is 1.4 times the mean.	9	L3	4	3.2.1

(Continued)

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		Marks	BL	CO	PI
IX.	(a) A built up cylindrical shell of 300 mm diameter, 3 m long and 6 mm thick is subjected to an internal pressure of 2 MPa. Calculate the change in length, diameter and volume of the cylinder under that pressure if the efficiencies of the longitudinal and circumferential joints are 80% and 50% respectively. (Take Poisson's ratio = 0.285).	10	L3	5	4.1.1
	(b) Derive the expression for circumferential stress and maximum shear condition in thin shells.	5	L2	5	4.1.1
OR					
X.	For a close coiled helical spring subjected to an axial load of 300 N having 12 coils of wire diameter of 16 mm, and made with coil diameter of 250 mm, find	15	L3	5	4.1.1
	a) Axial deflection				
	b) Strain energy stored				
	c) Maximum torsional shear stress in the wire				
	d) Maximum Shear stress using Wahl's correction factor				
	Take modulus of rigidity = 80 GPa				

Bloom's Taxonomy Levels

L1 = 6.66%, L2 = 24%, L3 = 69.33%.
