B.Tech. Degree IV[th] Semester Examination in
Naval Architecture and Ship Building, April 2025

20-215-0404 ANALYSIS OF STRUCTURES
(*2020 Scheme*)

Time: **3 Hours** Maximum Marks: **100**

Course Outcomes (COs)
On completion of course, student will be able to:

CO1	Apply principles of elasticity and plasticity for statically indeterminate structures
CO2	Analyse the stability of columns and structural behaviour of beam column
CO3	Understanding vibration of continues structures with practical applications
CO4	Analyse one dimensional and two dimensional structures using matrix methods of structural analysis
CO5	Apply FEM principles to solve elastic bodies subjected to mechanical loadings.

BL – Bloom's Taxonomy Levels
(L1- Remember, L2- Understand, L3- Apply, L4- Analyse, L5- Evaluate, L6- Create)
PO – Programme Outcomes

PART A

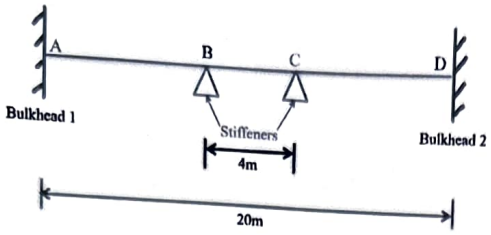
(Answer *ALL* questions) **(5 x 4 = 20)**

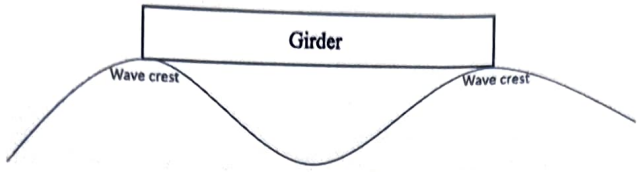
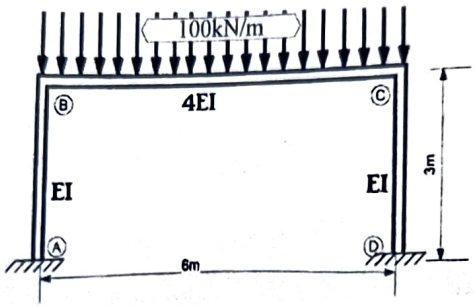
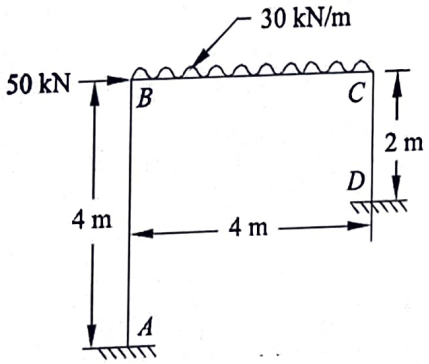
QNo		Marks	BL	CO	PO
1(a)	What is carryover moment in moment distribution method and how you ensure that the iteration is completed by examining the value of the same?	4	L2	CO1	3
(b)	Specify the drawback of Euler's bucking theory. Upto what value of slenderness ratio, we can apply this theory for a pinned mild steel column of crushing stress 350 N/mm^2?	4	L3	CO2	4
(c)	A continuous system has infinite number of degrees of freedom. Justify this statement.	4	L2	CO3	4
(d)	How many ways a two-storey triple bay rigid jointed portal frame can freely move?	4	L4	CO4	3
(e)	Explain why do we need to discretize a structure into finite elements instead of solving it as a whole.	4	L2	CO5	4

PART B

(5 x 16 = 80)

QNo		Marks	BL	CO	PO
2	Cochin metro pillars, Pillar no.347 and Pillar no.348 at Pathadipalam misaligned due to settlement of the pillar foundation by 20 cm and 10cm respectively, relative to the pillars on either side (Pillar no.346 and Pillar no. 349). Assuming these portions of the metro bridge to be a considered as a continuous beam pin-jointed at all these four supports, find out the moments that is induced at the intermediate pillars (Pillar no.347 and Pillar no. 348). Use Clapyron's theorm of three moments and take the dead weight including self-weight, weight of rails etc. throughout the whole spans as 40 kN/m. Also plot the net bending moment variation across these spans. L=10m for each span	16	L3	CO1	2
	OR I=10^6 mm^4				

QNo		Marks	BL	CO	PO
3	In the deck of a ship, a longitudinal girder ABCD is supported by two intermediate transverse stiffeners at B and C at a spacing of 4m as shown in the Figure (i). Assume the stiffeners as pinned supports and the girder as a mild steel beam. The girder is rigidly fixed at the sides by two transverse bulkheads spaced at 20m apart as shown in the figure. A container of load intensity 1.5 kN/m is placed on the deck portion over the spans AB and BC. A radar mast of capacity 4 kN is placed centrally over the span CD. Find out the moments induced at the stiffeners using moment distribution method.  Figure (i)	16	L3	CO1	2
4	a) Explain why beam columns are analyzed in the buckled configuration in contrary to normal beams which are analyzed in the original configuration.	4	L3	CO2	4
	b) Derive the basic differential equations for bending of beam columns.	12	L3	CO2	3
	OR				
5	a) Derive the expression for Euler's buckling load for a pinned column.	6	L3	CO2	4
	b) There are two columns: one hollow and the other solid. Both are made of the same material and have the same length, cross sectional area and end conditions. The internal diameter of hollow column is half of its diameter. Determine the ratio of buckling loads for these columns.	10	L3	CO2	3
6	a) Why a propeller shaft is designed to run above the whirling speed? Explain the context in detail.	4	L2	CO3	2
	b) A vertical shaft of 5 mm diameter is 200 mm long and is supported in long bearings at its ends. A disc of mass 50 kg is attached to the centre of the shaft. Neglecting any increase in stiffness due to the attachment of the disc to the shaft, find the critical speed of rotation and the maximum bending stress when the shaft is rotating at 75% of the critical speed. The centre of the disc is 0.25 mm from the geometric axis of the shaft. $E = 200\ GN/m^2$.	12	L3	CO3	3
	OR				
7	a) A girder in a ship is undergoing a free vibration due to wave loads. Explain some characteristics of this scenario of vibration.	4	L2	CO3	2
	b) Derive an expression for natural frequency in rpm for a uniformly loaded girder present at the bottom of a ship. Assume the crest of	12	L3	CO3	

QNo		Marks	BL	CO	PO
	the sea waves are hinging the girder at its ends as shown in the figure (ii).  Figure (ii)				
8	Analyze the frame by flexibility method. The longitudinal and cross section details are indicated in the figure (iii).  Figure (iii)	16	L4	CO4	2
	OR				
9	Analyze the frame shown in the Figure (iv) below by stiffness method.  Figure (iv)	16	L4	CO4	7
10	a) Explain the basic workflow in an FEA software package and the importance of mesh convergence in an FEA study	4	L3	CO5	7
	b) Derive the shape functions for a quadratic bar element.	12	L3	CO5	3
	OR				
11	a) Discuss the concept of h-refinement and p-refinement in FEM.	4	L3	CO5	5
	b) Derive the element stiffness matrix for a beam element under bending.	12	L3	CO5	7

L2-16%, L3-64%, L4-20%