INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal- 500 043, Hyderabad.

AERONAUTICAL ENGINEERING

TUTORIAL QUESTION BANK

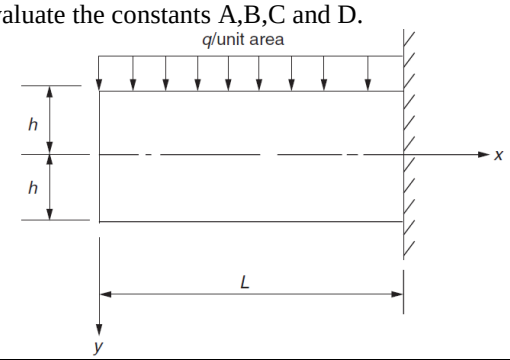
Course Name	**:**	**AEROSPACE VEHICLE STRUCTURES-I**
Course Code	**:**	A42103
Class	**:**	II B. Tech II Semester
Branch	**:**	Aeronautical Engineering
Year	**:**	2016 – 2017
Course Coordinator	**:**	Mr. G S D Madhav, Assistant Professor
Course Faculty	**:**	Mr. G S D Madhav, Assistant Professor

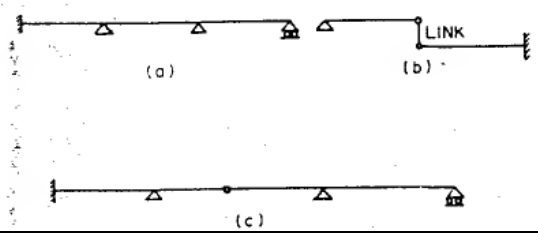
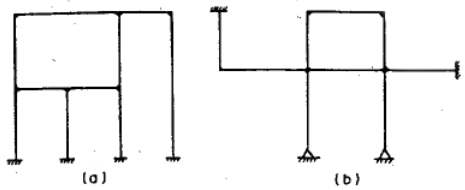
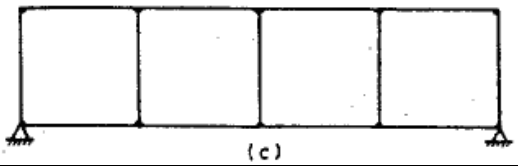
OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

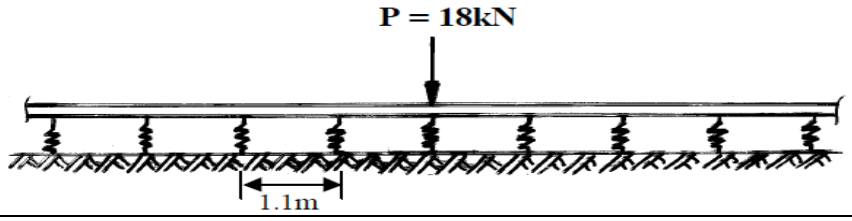
In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

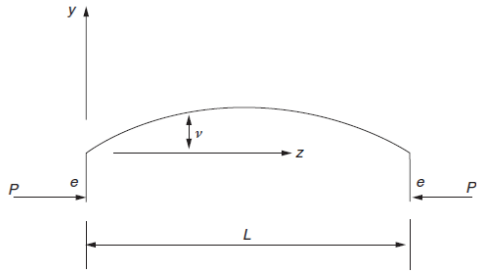
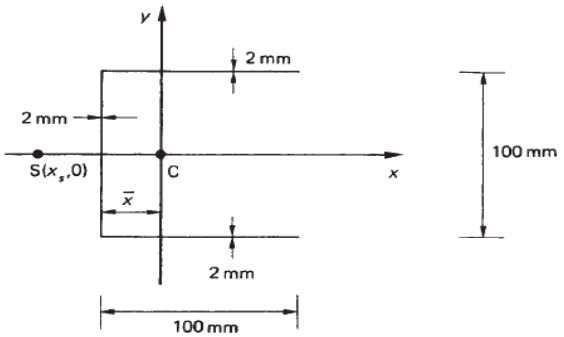
Q. No	Questions	Blooms Taxonomy Level	Course Outcome
	UNIT – I **INTRODUCTION TO THEORY OF ELASTICITY**		
PART – A (Short Answer Questions)			
1	**Write** equations of equilibrium for elastic body under three dimensional force systems. Also draw neat sketch representing forces.	Understand	1
2	**Write** the equations for direct strains in terms of displacement functions for a three mutually perpendicular line elements	Understand	1
3	**Derive** the compatibility equation for two-dimensional problem.	Evaluate	1
4	**Write** condition equations for plane stress and plane strain for 2D elastic body.	Knowledge	8
5	**Define** Airy's stress function for two dimensional problems in elasticity.	Knowledge	8
6	**Give** stress strain relationship for 2D elastic body.	Evaluate	1
7	**Derive** equations of static equilibrium for a two dimensional elastic body.	Understand	1
8	**Derive** the equations for stresses acting on inclined planes and deduce stress equations for principal planes for one directional stress.	Understand	1
9	**Determine** graphically state of stress on inclined plane for a deformable body.	Understand	1
10	**Draw** the Mohr's Circle to determine stresses on inclined plane.	Understand	1
PART – B (Long Answer Questions)			

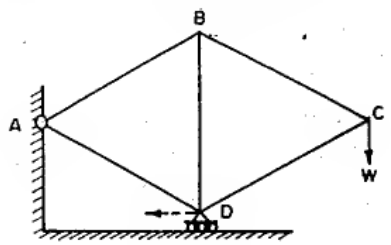
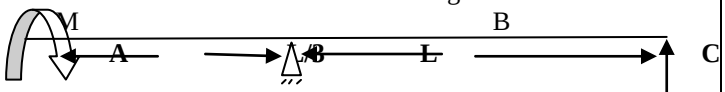
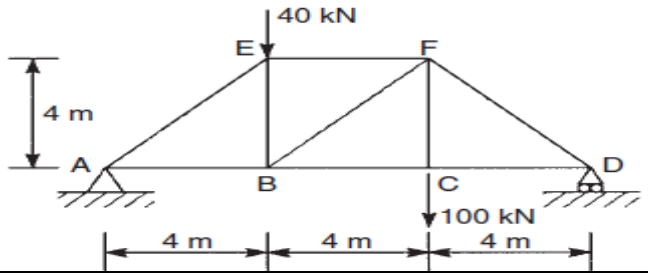
1	**Derive** equations of static equilibrium for a three dimensional elastic body.	Understand	1
2	**Derive** the equations for stresses acting on inclined planes and deduce stress equations for principal planes with biaxial stress.	Understand	1
3	**Determine** graphically state of stress on inclined plane for a deformable body for pure shear condition.	Understand	1
4	**Derive** the strain equations for three mutually perpendicular line elements in terms of displacement functions and deduce compatibility equations.	Understand	1
5	**Derive** equations for stains on inclined planes and deduce strain for principal planes.	Understand	1
6	**Draw** the Mohr's Circle to determine stains on inclined plane.	Understand	1
7	**Derive** the strain equations for three mutually perpendicular line elements in terms of displacement functions and deduce compatibility equations.	Understand	1
8	**Derive** equations for stains on inclined planes and deduce strain for principal planes.	Understand	1
PART – C (Problem Solving and Critical Thinking)			
1	A structural member supports loads which produce, at a particular point, a direct tensile stress of 80N/mm² and a shear stress of 45N/mm² on the same plane. Calculate the values and directions Of the principal stresses at the point and also the maximum stress, stating on which planes this will act.	Apply	1
2	A solid shaft of circular cross-section supports a torque of 50KNm and a bending moment of 25KNm. If the diameter of the shaft is 150mm calculate the values of the principal stresses and their directions at a point on the surface of the shaft?	Apply	1
3	A shear stress τ_{xy} acts in a two-dimensional field in which the maximum allowable shear stress is denoted by τ_{max} and the major principal stress by σ_1. Derive using the geometry of Mohr's circle of stress, expressions for the maximum values of direct stress which may be applied to the x and y planes in terms of three parameters given above.	Apply	1
4	A cantilever of length L and depth 2h is in a state of plane stress. The cantilever is of unit thickness, is rigidly supported at the end x=L and is located as shown in figure. Show that stress function $\phi = Ax^2+Bx^2y+Cy^3+D(5x^2y^3-y^5)$ is valid for the beam and evaluate the constants A,B,C and D. 	Analyze	1
UNIT – II REDUNDANT STRUCTURES			
PART – A (Short Answer Questions)			
1	**Explain** area moment method with neat sketches.	Understand	2
2	**Distinguish** statically determinate and redundant structures.	Knowledge	2
3	**Determine** degree of redundancy for articulated structures.	Understand	2
4	**Define** order of redundancy indeterminate structures.	Understand	3
5	**Classify** different types of supports and write the reactions components.	Knowledge	2
6	**Define** singularity function and explain properties of function.	Knowledge	3
7	**Explain** Claypron's method for statically determinate structures.	Understand	2
8	**Explain** Determinate structures and indeterminate structures	Understand	2

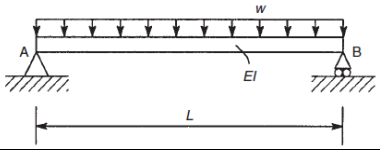
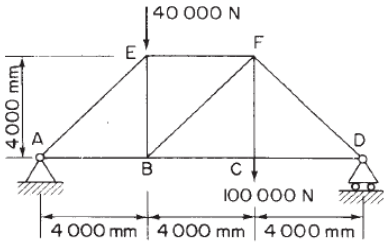
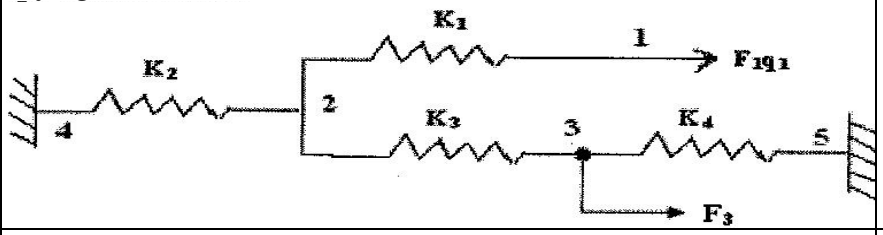
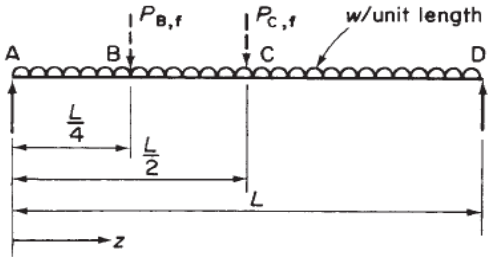
9	**Explain** the types of boundary conditions for structural systems	Understand	2
10	**Define** Concept of stability for structural systems	Understand	2
PART – B (Long Answer Questions)			
1	**Derive** Slope and defection in area moment method	Understand	2
2	**Explain** about concept of Internal redundancy with examples	Understand	3
3	**Explain** Claypron's method to determine the deflection in Continuous beams	Understand	2
4	**Write** singularity function for point load and moment about a point explain about it	Knowledge	3
5	**Explain** about the concept of external redundancy with examples	Knowledge	3
6	**Write** about total redundant in redundant structures and give two examples	Knowledge	3
7	**Write** singularity function for Udl and Uvl loading for beam explain about it	Understand	2
8	**Find** the degree of redundancy for following beam in general loading 	Apply	2
9	**Find** the degree of redundancy for following beam in general loading 	Apply	2
10	**Find** the degree of redundancy for following beam in general loading 	Apply	2
PART – C (Problem Solving and Critical Thinking)			
1	A simply supported beam span 'l' is subjected to uniformly distributed load 'W' kN/m throughout the beam. Find out maximum slope and deflection.	Analyze	2
2	**Derive** deflection for cantilever beam subjected to concentrated load W at the centre.	Analyze	2
3	**Find** the expressions for maximum deflection and bending moment of beam under concentrated load.	Analyze	3
4	**Discuss** about area moment method with example.	Knowledge	2
5	**Find** the deflection of the cantilever beam at the point of application of 1000 N load. Assume elastic deflections with EI = 106 N-m^2	Analyze	2
6	**Discuss** about claypron`s method with example.	Knowledge	2
7	**Derive** deflection for simply supported beam subjected to concentrated load W at the centre using Macaulay's method.	Analyze	3

UNIT – III **BEAMS WITH ELASTIC SUPPORTS AND INITIAL CURVATURE**			
PART – A (Short Answer Questions)			
1	**What** is Winkler Constant?	Remember	4
2	**Write** the four functions for infinite beam.	Remember	4
3	**Explain** the concept of elastic foundation	Remember	4
4	**Write** Four Functions in Semi Infinite beam	Remember	4
5	**Write** the values of β the four functions of infinite beam are maximum and also write maximum values.	Remember	4
6	**Differentiate** Winkler's constant and Modulus of Foundation.	Knowledge	4
7	**Differentiate** the concept of beams on elastic foundation with rigid foundation	Knowledge	4
8	**What** is curved beam?	Remember	4
9	**Differentiate** curved and straight beam.	Remember	4
10	**Differentiate** discrete beam and straight beam.	Remember	4
11	**Write** the deflection equation for curved beam	Knowledge	4
12	**Explain** the concept of curved beam	Remember	4
13	**What** is bulkhead write about load on bulkhead	Remember	4
14	**What** kind of load will act on bulkheads	Remember	4
15	**Explain** stresses developed in curved beams	Remember	4
16	**Draw** the deflected shape of any curved beam	Remember	4
17	**What** is importance of analysis of curved beam?	Knowledge	4
18	**Draw** the diagram of typical curved beam	Remember	4
19	**What** is maximum stress developed in curved beam?	Remember	4
20	**What** is maximum deflection for curved beam?	Knowledge	4
21	**Write** the general boundary conditions for curved beam.	Remember	4
22	**What** is function of bulkheads?	Remember	4
23	**Write** few applications of curved beam	Remember	4
24	**Write** the stress equation for typical curved beam	Remember	4
25	**Draw** the stress variation diagram for bulkhead.	Remember	4
26	**Draw** the deformed diagram of bulkhead	Knowledge	4
PART – B (Long Answer Questions)			
1	**Derive** the differential equation for the elastic line of a beam resting on elastic foundation.	Understand	4
2	**Discuss** the concept of elastic foundation	Understand	4
3	**Derive** maximum stress equations for curved beams.	Understand	4
4	**Derive** equation of deflection for infinite beams	Understand	4
5	**Derive** deflection equation for finite beam	Understand	4

6	**How** do you apply the concept of curved beam on bulkhead?	Knowledge	4
7	**Draw** the different cross-sectional shapes of bulkhead segments	Knowledge	4
8	**What** are the assumptions made in analysis of curved beam?	Knowledge	4
9	**Write** the equation of equilibrium for curved beam	Knowledge	4
10	**Draw** the stress distribution diagram for curved beam	Knowledge	4
PART – C (Problem Solving and Critical Thinking)			
1	An infinite beam rest on equally spaced linear coil springs, located every 1.1m along the beam. A concentrated load of 18kN is applied to the beam, over one of the springs. EI of the beam is 441x109 Nmm^2, K = 275 N/mm for each spring. Compute the largest spring force and largest bending moment in the beam. 	Apply	4
2	A semi-infinite steel bar (E = 200GPa) has a square cross section (b = h = 80mm) and rests on a Winkler foundation of modulus ko = 0.25 N/mm2/mm. A downward force of 50kN is applied to the end. Find the maximum and minimum deflections and their locations. Also find max. Flexural stress and its location.	Apply	4
3	**Derive** governing equations for Uniform Straight beam on elastic foundation	Apply	4
UNIT – IV STABILITY			
PART – A (Short Answer Questions)			
1	**Discuss** two types of instability in columns	Knowledge	5
2	**Discuss** limitations of Euler's column theory.	Understand	6
3	**Classify** types of columns with neat sketches.	Knowledge	6
4	**What** are Eigen value functions and Eigen value Problems?	Knowledge	5
5	**Define** Bifurcation Point for a column with neat sketches.	Knowledge	5
6	**Write** a note on effective length of column. Write effective lengths for different end conditions of columns.	Understand	
7	**Derive** the Rankine's semi empirical formula for columns	Analyze	6
8	**Explain** failure of columns with neat sketches. Also give sign convention for bending of columns.	Understand	5
9	**Write** the assumptions made in Euler's Column Theory	Understand	5
10	**Derive** Johnson's Parabolic Formula for Short Columns	Evaluate	5
PART – B (Long Answer Questions)			
1	**Derive** the expression for crippling load of a column with both ends hinged	Knowledge	5
2	**Obtain** solution for column having initial curvature. Deduce maximum stress and maximum deflection.	Knowledge	5
3	**Evaluate** secant formula for column subjected to eccentric load.	Analyze	6
4	**Derive** expression for crippling load of column when both ends are fixed	Understand	6
5	**Derive** the expression for buckling load when one end of column is fixed and other is free	Knowledge	5
6	A strut length l, moment of inertia of cross section I uniform throughout and modulus of material E, is fixed at its lower end, and its upper end is elastically	Develop	5

	supported laterally by a spring of stiffness k. show from the first principles that the crippling load P is given by $(\tan \alpha l)/(\alpha l) = [1 - (P/kL)]$, where $\alpha^2 = (P/EI)$		
7	**Derive** the expression for maximum deflection when strut is subjected to compressive axial load with both ends pinned.	Knowledge	5
8	**Derive** the expression for crippling load of a column with both ends are fixed	Knowledge	5
9	**Derive** the expression for crippling load of a column with initial curvature	Knowledge	5
10	**Derive** the Rakines and Jonsons formula for columns	Knowledge	5
PART – C (Problem Solving and Critical Thinking)			
1	The pin-jointed column shown in Figure carries a compressive load *P* applied eccentrically at a distance *e* from the axis of the column. Determine the maximum bending moment in the column 	Evaluate	5
2	A column of length 1m has the cross-section shown in Figure. If the ends of the column are pinned and free to warp, calculate its buckling load; E =70 000 N/mm^2, G=30 000 N/mm^2. 	Evaluate	5
3	A column of timber section 15cm×20cm is 6m long. If E=17.5KN/mm^2. Determine crippling load and safe load for the column if both ends are fixed and factor of safety is 3.	Apply	5
4	A solid round bar 3m long and 5cm in diameter is used as a strut. Determine the crippling load if Both ends of strut are hinged One end of strut is fixed and other end is free Both ends of strut are fixed One end is fixed and other is hinged	Apply	5
5	Calculate the Euler's critical load for a strut of T-section, the flange width being 10cm, overall depth 8cm and both flange and stem 1cm thick. The strut is 3m long and is built in at both ends. Take E= 2×10^5 N/mm^2.	Apply	6
UNIT – V ENERGY PRINCIPLES AND METHODS			
PART – A (Short Answer Questions)			
1	**Discuss** principle of virtual work for a particle	Understand	7
2	**State** and explain Maxwell's reciprocal Theorem	Understand	8
3	**Explain** Principle of Superposition with neat sketches.	Knowledge	7
4	**Derive** Bredt-Batho Formula with neat sketches.	Evaluate	8
5	**State** Castigliano's Second theorem	Understand	8

6	**Define** the following terms a. Buckling Load b. Slenderness ratio c. Effective length d. Radius of Gyration	Knowledge	9
7	**State** Castigliano's first theorem and explain about it	Understand	7
8	**Discuss** principle of virtual displacement for a particle	Understand	7
9	**Discuss** about unit load method in Energy principles concept	Understand	7
10	**Write** about shear flow in wing boxes and explain it with neat sketches	Understand	7
PART – B (Long Answer Questions)			
1	**State** and Prove Castigliano's first theorem.	Knowledge	7
2	**Discuss** principle of virtual work for a particle	Knowledge	8
3	**Differentiate** between a single cell and a multiple cell structure.	Knowledge	9
4	**Explain** any two important characteristics of Rayleigh-Ritz method.	Knowledge	7
5	**Derive** the stress-strain and Displacements relationships for a open and single cell closed section thin-walled beams.	Knowledge	8
6	**Discuss** about monocoque and semi-monocoque structures.	Knowledge	9
7	Determine the shearing stress in each wall of a rectangular cross-section of closed tube subjected to torque of 2700 N-m. Consider outer dimension of rectangular tube as width 100mm. height 60mm and thickness, 4 mm	Analyze	10
8	**Calculate** Center deflection and slope at both ends of simply supported beam carrying Uniformly distributed load W per unit length over a span by Castingliano's therom	Analyze	10
9	A frame ABCD consist of two equilateral triangles hinged at A supported on roller at D as show in Fig. Determine the Vertical deflection of C and horizontal moment of D due to load applied vertically at C all the members of lent L and area as 2a 	Analyze	10
10	**Explain** the concept of unit load method with steps involved to slove problems with unit load method	Knowledge	9
PART – C (Problem Solving and Critical Thinking)			
1	Using Castigliano's first theorem, determine the deflection and rotation of the overhanging at end A of the beam loaded as shown in fig. 	Evaluate	7
2	Calculate the vertical deflection of the joint B and the horizontal movement of the support D in the truss shown in Figure. The cross-sectional area of each member is 1800mm^2 and Young's modulus, *E*, for the material of the members is 200 000 N/mm^2. 	Analyze	7

3	Use the principle of virtual work to calculate the vertical displacements at the quarter- and mid-span points in the beam shown in figure. 	Evaluate	7
4	Calculate the vertical deflection of the point B and the horizontal movement of D in the pin-jointed framework shown in Figure All members of the framework are linearly elastic and have cross-sectional areas of 1800mm^2. *E* for the material of the members is 200 000 N/mm^2 	Evaluate	8
5	Calculate the nodal displacement of the spring system shown in fig. below by Rayleigh-Ritz Method? 	Evaluate	9
6	Calculate the vertical displacements of the quarter and mid-span points B and C of thesimply supported beam of length *L* and flexural rigidity *EI* loaded, as shown in figure 	Evaluate	8
7	Determine the variation of shear flow throughout the tube of a rectangular cross section whose outer width and height are 100 mm and 200 mm respectively. The uniform thickness (t) of the tube is 4 mm. the tube is subjected to shear force of 20 kN.	Analyze	9
8	A structural Aluminium tubing of 60 x 100 mm rectangle cross-section was fabricated by extrusion,. Determine the shearing stress in the each of the four walls of such tubing when it is subjected to a torque of 2700 N-m? Take uniform thickness‘t’ of the wall as 4mm.	Analyze	10

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