KUMARAGURU
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B.E. DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Fourth Semester

AERONAUTICAL ENGINEERING

U18AET4003: Aircraft Structures I

COURSE OUTCOMES

CO1: Identify statically determinate and indeterminate structures.

CO2: Analyze the response of statically indeterminate structures under various loading conditions.

CO3: Determine the reactions of structures using strain energy concept.

CO4: Identify different numerical methods available to solve a single structural problem.

CO5: Examine the structural failures using failure theories.

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 1 = 10 Marks)

1. Matching type item with multiple choice code   CO4 [K2]

List I	List II
A. Euler's Theory	i. Strain Energy
B. Castigliano's theorem	ii. Brittle Material
C. Maximum Principle strain theory	iii. Ductile Material
D. Maximum Principle stress theory	iv. Columns

	A	B	C	D
a)	i	ii	iii	iv
b)	ii	iii	i	iv
c)	iv	i	ii	iii
d)	iv	i	iii	ii

2. Which among the following will give the strain energy due to bending   CO3   [K3]

a) $\int(ML^2dx/2EI)$ b) $\int(MLdx/2EI)$

c) $\int(M^2dx/2EI)$ d) $\int(Mdx/2EI)$

3. Which of the following statements are incorrect?   CO2 [K2]
    1. Pin joint has reactions at two perpendicular reactions.
    2. Knife edge support has one reaction.
    3. Fixed support has three perpendicular reaction alone.
    4. Ball and socket support has three perpendicular reaction alone.

a) 1 &4   b) 1 & 3

c) 3 only   d) 1 & 2

4. Simple determinate truss structure will have   CO1 [K2]

   a) 2 truss elements   b) 3 truss elements

   c) 4 truss elements   d) 1 truss element

5. **Assertion (A):** Fixed-Fixed beam is classified under statically determinate structure.   CO1 [K2]
   Reason (R): The unknowns in the structures can be solved using equilibrium conditions alone, then they are called statically determinate structures.
   a) Both A and R are Individually true and   b) Both A and R are Individually true but
     R is the correct explanation of A   R is not the correct explanation of A
   c) A is true but R is false   d) A is false but R is true

6. A pin-ended column of length L, modulus of elasticity E and second moment of the cross-   CO4 [K2]
   sectional area I is loaded concentrically by a compressive load P. The critical buckling load
   (Pcr) as per Euler's critical buckling load formula is given by
   a) EI/π^2L^2 b) π^2EI/L^2

   c) $\pi^2EI/3L^2$ d) $\pi EI/L^2$

7. Specify the sequence correctly when a propped cantilever beam is analyzed using moment   CO2 [K3]
   distribution method.
   1.   Calculate Fixed end moments
   2.   Calculate relative stiffness
   3.   Determine the distribution factors for various members framing into a particular joint.
   4.   Distribute the net fixed end moments at the joints to various members by multiplying
   the net moment by their respective distribution factors in the first cycle.
   5.   Consider this carry-over moment as a fixed end moment and determine the balancing
   moment. This procedure is repeated from second cycle onwards till convergence
   a) 2-3-4-1-5   b) 1-3-2-4-5

   c) 3-4-2-1-5   d) 4-1-3-2-5

8. Failure Theories deals with materials under _____ loading conditions.   CO5 [K2]

   a) Multiple   b) Singular

   c) Complex   d) Zero

9. **Assertion (A):** Strain energy methods can be used to calculate deformations on beams,   CO3 [K2]
   trusses, columns, bars…etc.,
   Reason (R): Strain energy created in a material is a cumulative response of complex loading
   system acted on it.
   a) Both A and R are Individually true and   b) Both A and R are Individually true but
     R is the correct explanation of A   R is not the correct explanation of A
   c) A is true but R is false   d) A is false but R is true

10. Choose the correct relation between the principal stresses and the maximum shear stress.   CO5 [K2]

    a) $\tau_{max}= (\sigma_1 - \sigma_2)/2$ b) $\tau_{max}= (\sigma_1 + \sigma_2)/2$

    c) $\tau_{max}= (\sigma_1 - \sigma_2)$ d) $\tau_{max}= (\sigma_1 + \sigma_2)$

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11. List out the assumptions made while analyzing the truss structures. CO1 [K2]

12. Mention the methods available to solve framed and truss structures. CO1 [K2]

13. What are all the methods available to solve statically indeterminate structures? CO2 [K2]

14. Illustrate the shear force and bending moment diagram of a simply supported beam with midpoint load. CO2 [K2]

15. Define: Resilience CO3 [K2]

16. Find the deflection at the free end of a cantilever which carries a point load at the free end using any one of the strain energy methods. CO3 [K3]

17. List the assumptions made while deriving Euler's equation for columns. CO4 [K2]

18. A solid round bar 3m long and 5cm in diameter is used as a strut with both ends hinged. Determine the crippling load. Take $E=2 \times 10^5 N/mm^2$. CO4 [K3]

19. State Maximum principal stress theory. CO5 [K2]

20. Principal stresses in a cast iron body are 40MPa tensile and 90MPa compressive, third principal stress being zero. Determine the Factor of Safety based on the elastic limit, if the criterion of failure is principal stress theory. Take the elastic limit in simple tension is 80MPa and in simple compression 450MPa for cast iron. CO5 [K3]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 350 words)

21.   Determine the forces in members in the loaded truss. CO1 [K3]
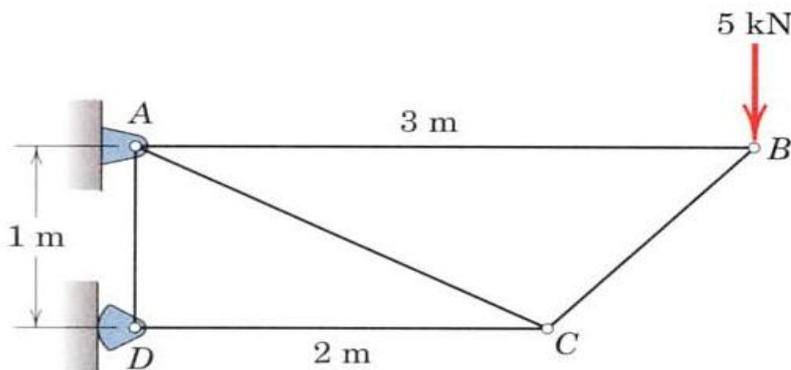
22.   Analyze the continuous beam shown below by using Clapeyron's Three-Moment equation. CO2 [K3]
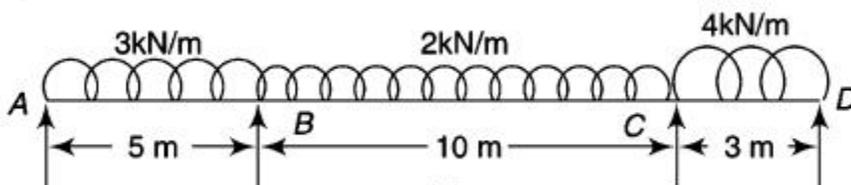
23. The frame ABC supports a concentrated load P at point C. Members AB and BC have lengths h and b, respectively. Determine the vertical deflection δ_C and angle of rotation θ_C at end C of the frame. (Obtain the solution by using the modified form of Castigliano's theorem.)
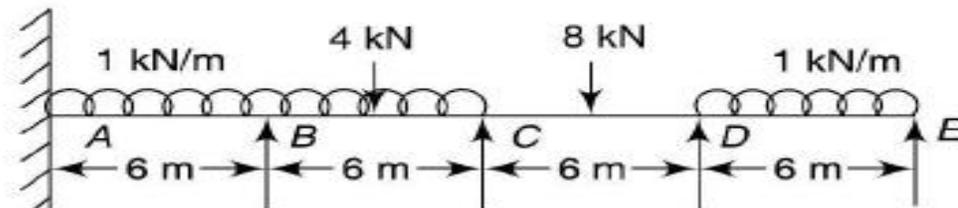
CO3 [K4]
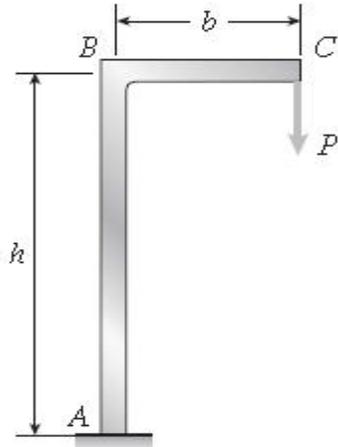
24. An initially straight steel tube of 48mm external diameter and 40mm internal diameter is 2.4m long and has hinged ends. It carries a compressive load of 25kN parallel to the axis at an eccentricity of 2mm. Determine the maximum and the minimum intensities of stresses in the tube. Also find the maximum permissible eccentricity so that no tension exists anywhere in the section. E=205GPa.

CO4 [K4]

25. A steel tube of 40mm mean diameter and 2mm thickness is under simple tension. Determine the torque that can be transmitted by the tube if the criterion of failure is

COL [K4]

    (i)   Maximum shear stress
    (ii)   Maximum strain energy
    (iii)   Maximum shear strain energy

Take factor of safety as 3, elastic limit of steel 240 MPa and Poisson's ratio is 0.3

26. Analyze the Cantilever beam ABCDE, fixed at A and simply supported at B,C,D and E and loaded as shown in figure below using Moment Distribution Method equation.

CO2 [K4]

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