Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – June 2023

Programme Name: B Tech (ME)

Semester: IV

Subject Code: UG11T4401

Subject Name: STRENGTH OF MATERIALS

Date: 26.05.2023	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.

QP setters to specify the following as applicable:-

(iii) Tables (Steam/Log/Nautical Almanac etc) that can be used.
(iv) Chart Work Booklets to be used.
(v) Any other tables/charts to be used.

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. A simply supported beam carries a couple at a point on its span, the shear force
    a) Varies by cubic law
    b) Varies by parabolic law
    c) Varies linearly
    d) Is uniform throughout

2. A beam is said to be loaded in pure bending if
    a) Shear force and bending moment are uniform throughout
    b) Shear force is zero and bending moment is uniform throughout
    c) Shear force can vary but bending moment is uniform throughout
    d) None of the above

3. The first area-moment theorem states that the area of the *M/EI* diagram between two points 1 and 2 gives

a) Slope at point 1
b) Slope at point 2
c) Angle between tangents at 1 and 2
d) Vertical intercept at point 2 from the tangent at 1

4. Select the method of finding beam deflections that uses the considerations of Strain Energy of the Beam.

A) Method of Double Integration.
B) Area Moment Method.
C) Castiglione's Method
D) Clapeyrons Theorem

5. Important assumption made in deriving Differential Equation of Elastic Curve is:

A) Beam is subjected to a very small Bending Moment.
B) Beam is statically determinate.
C) Slopes of the elastic curve are very small and close to zero.
D) Beam is made of isotropic material

6. Select the correct statement(s).

A) Fixed –Fixed Beam is statically indeterminate and Propped Cantilever beam is statically determinate.
B) Fixed –Fixed beam and Propped Cantilever Beam are both statically indeterminate beam.
C) Fixed-Fixed beam and propped cantilever beam are both statically determinate.
D) Fixed-fixed beam is statically determinate and propped cantilever beam is statically indeterminate

7. A continuous beam has

a)One support
b) Two support
c) More than two support
d) Very long span

8. Select the Incorrect Statement.

A) Rankine's Constant is Property of the material.
B) Euler's critical load is directly proportional to the flexural rigidity of the strut.
C) At higher slenderness ratio, Euler critical load formula and Rankine – Gordon formula yield matching results.
D) Euler Critical load is inversely proportional to the square of radius of gyration of column cross section.

9. In a long column with one end fixed and other free, if the slenderness ratio increases, the critical stress

a)Increases
b) Decreases
c)Remains same
d) None of the above

10. The equivalent length of a column fixed at one end and hinged at other end is

a) L
b) 2L
c) L/2
d) 0.707L

Section B

Five Questions of 02 Marks each.

11. What is statically indeterminate structure?

12. A Beam has maximum bending moment of 40 kN-m. What should be its minimum section modulus if maximum permissible stress is 160 MPa?

13. Write the equation of Clapeyron's Three Moment Theorem for continuous beam explaining its terminology with a necessary decent diagram.

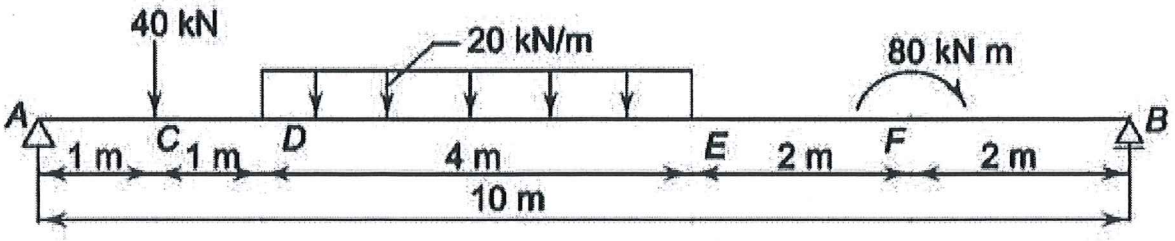
14. Write the Rankine-Gordon Formula to calculate Crippling load on the column and explain its each variable stating its units.

15. Explain the limitation of Euler's formula.

Section C

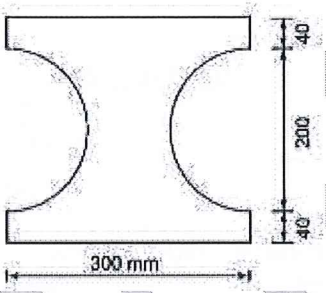
Answer any 05 questions from following 7 questions. Each question is of 10 Marks.

16. Draw the SF and BM diagrams for the beam loaded as shown in Fig. Also, find the value of maximum bending moment. (10 Marks)



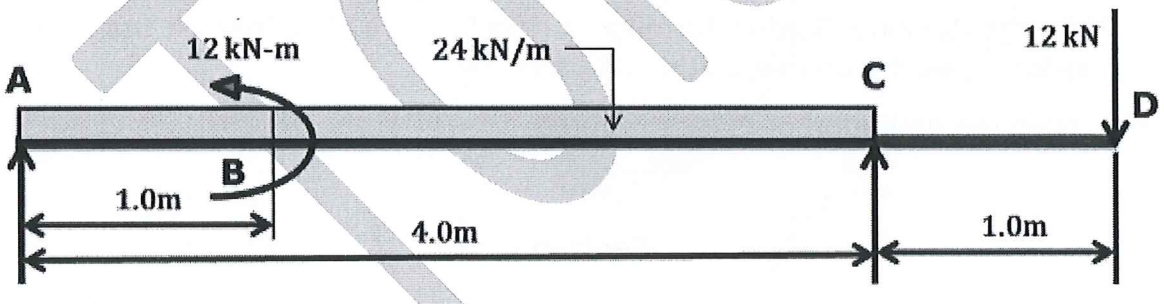
17. (a) A simply supported beam carrying UDL '*w*' throughout its 2m span. The beam having rectangular section with 200mm width and 400mm depth. Find value of '*w*' if permissible stresses are 7 MPa in tension and 15 MPa in compression. (6)

(b) Find moment resistance of the section shown in Fig. Permissible stress are 100 MPa in tension and compression.



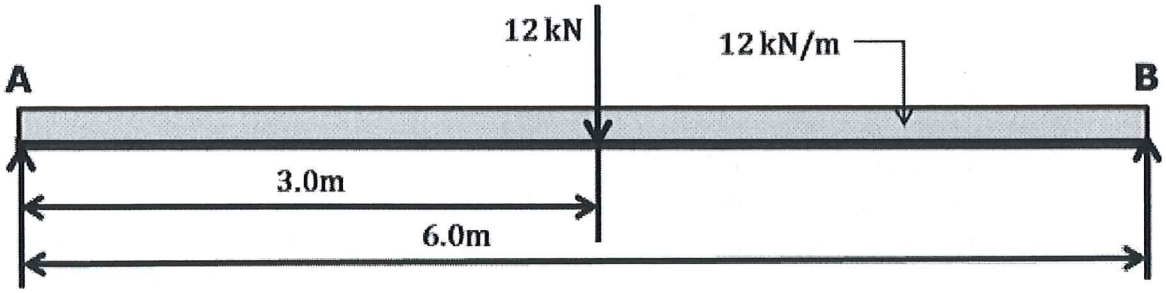
(4)

18. Consider a Hinge supported beam along with the loads subjected on it as shown in the figure bellow. Using Macaulay's method obtain the slope at both support points and deflection at a point 3.0 meter from point A. (10 Marks)

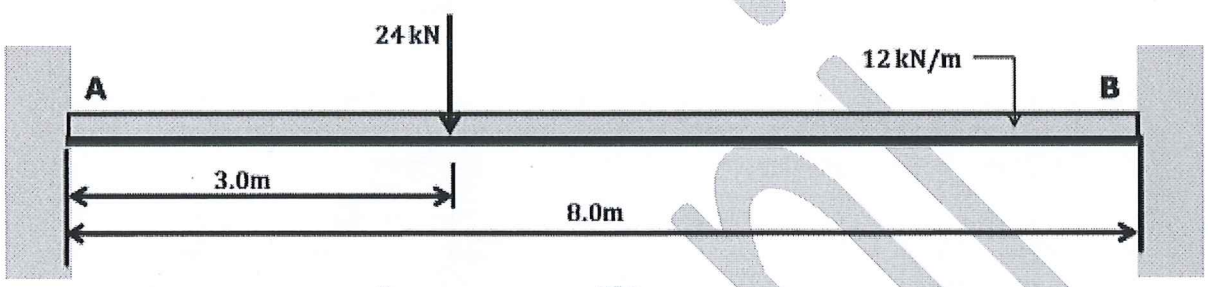


(10 Marks)

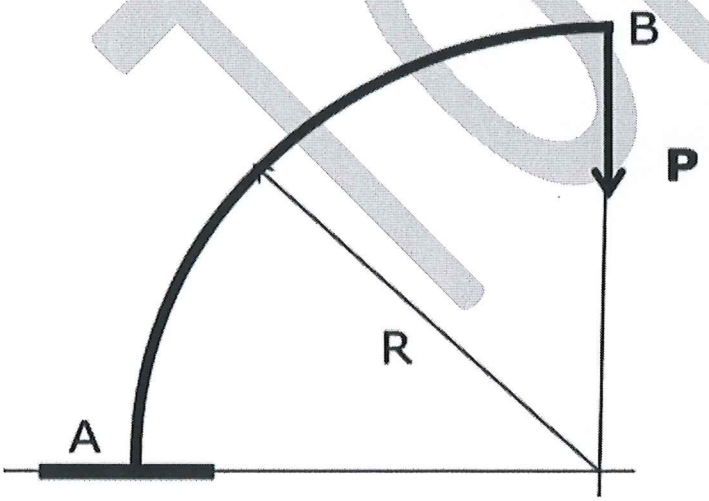
19. Consider a hinge supported beam with loads subjected on it as shown in the figure bellow. Using Area – Moment theorem calculate the slope of the beam at support points and deflection of the beam at the mid span of the beam and slope of the beam at supports (10 Marks)



20) Consider the Fixed - Fixed Beam with loads subjected on it as shown in the figure bellow. Calculate the Support reaction force and support reaction moment at both the fixed ends. Draw SFD and BMD. (10 Marks)



21) Thin bar AB, curved in the form of a quadrant of a circle, and is fixed on the ground at point A to hold the total arc in the vertical plane and end B is left free as shown in the figure bellow. A Vertical force in the plane of the arc of magnitude P Newton is applied at the point B. Obtain the vertical as well as horizontal displacement of the point B. (10 Marks)



22. Derive the expression for the Euler's Buckling load for the Strut supported by the hinged joints at the both ends. (4 Marks)

a) A steel column with length of 4.8 meter is fixed –Fixed connected with outside structure to take pure axial load. The cross section of the strut is hollow circular with outside diameter of 100 mm and inside diameter of

80 mm. Consider following material properties of the steel used in the construction of column:
Modulus of Elasticity = 200 GPa
Yield Stress in compression = 300 MPa
Rankine's Constant = 1/7500
Factor of Safety to be considered is 1.25
Calculate the maximum safe axial load using Rankine – Gordon Formula.
(6 Marks)