Graphic Era HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

End Term (Even) Semester Examination May-June 2025

Roll no.....

Name of the Program and semester: B.Tech-Civil Engineering & IV
Name of the Course: Structural Analysis
Course Code: TCE- 402
Time: 3 hour **Maximum Marks: 100**

Note:

i) All questions are compulsory
ii) Answer any two sub questions among a, b & c in each main question
iii) Total marks for each question is 20 (Twenty).
iv) Each question carries 10 marks.

Q1. **(2X10=20 Marks) CO1**

a. A simply supported beam AB of span 4m carries a point load of 100KN at its center C. The values of I for the left half is 1 $x10^8$ mm^4 and for the right half portion I is $2x10^8$ mm^4. Find the slopes at the two supports and deflection under the load using conjugate beam method. Take E=$2x10^5$ N/mm^2

b. A cantilever of length 2m carries a uniformly distributed load 2kN/m over a length of 1m from the free end, and a point load of 1kN at the free end. Find the slope and deflection at the free end if E=$2x10^5$ N/mm^2 and I= 6.667 $x10^7$ mm^4

c. A fixed beam with a span of L carries a central concentrated load P. Derive the expression for the fixed-end moments at both supports and determine their values for P=50kN and L=5m

Q2. **(2X10=20 Marks) CO2**

a. A cantilever of length L is carrying a point load of W KN at a distance of 'a' from the fixed end. Calculate Slope at the free end and deflection at the free end using Castigliano's method.

b. Determine the mid-span deflection in a simply supported beam of span 'L', when it is subjected to a udl throughout the span. Use Castigliano's method

c. The external diameter of a hollow shaft is twice the internal diameter. It is subjected to pure torque and it attains a maximum shear stress τ. Show that the strain energy stored per unit volume of the shaft is $\frac{5\tau^2}{16C}$. Such a shaft is required to transmit 5400kW at 110 r.p.m with uniform torque, the maximum stress not exceeding 84 MN/m^2. Determine:
i) The shaft diameters ii) The energy stored per m^3

Q3. **(2X10=20 Marks) CO3**

a. A continuous beam ABC covers two consecutive span AB and BC of lengths 4m and 6m, carrying uniformly distributed loads of 6kN/m and 10kN/m respectively. If the ends A and C are simply supported, find the support moments A, B and C. Draw also B.M. and S.F. diagrams.
b. A continuous beam ABC covers two consecutive span AB and BC of lengths 4m and 6m, carrying uniformly distributed loads of 6kN/m and 10kN/m respectively. If the ends A and C are simply supported, find the support moments A, B and C. Draw also B.M. and S.F. diagrams.

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c. A continuous beam ABC of uniform section, with span AB and BC as 6m each, is fixed at A and C and supported at B as shown in figure 1. Find the support moments and reactions. Draw B.M diagrams of the beam.

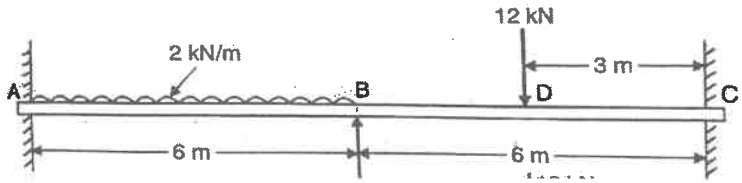

Figure 1

Q4. **(2X10=20 Marks)** **CO4**

a. A simply supported beam has a span of 15m. Uniformly distributed load of 40kN/m and 5m long crosses the girder from left to right. Draw the influence line diagram for shear force and bending moment at a section 6 m from left end. Use these diagrams to calculate the maximum shear force and bending moment at this section.

b. For point loads, 8,15,15 and 10 kN have centre spacing of 2 m between consecutive loads and they traverse a girder of 30 m span from left to right with 10kN load lending. Calculate the maximum bending moment and shear force at 8 m from the left support.

c. A train of wheel loads as shown in figure 2 crosses a girder of 25m span with 120 kN load leading. Determine the value of

i) Maximum bending moment at the section 8m from the left end of the girder
ii) Absolute maximum bending moment of the girder

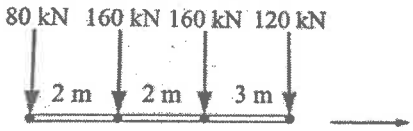

Figure 2

Q5. **(2X10=20 Marks)** **CO5**

a. A three hinged circular arch hinged at the springing and crown points has a span of 40m and a central rise of 8m. It carries a uniformly distributed load 20kN/m over the left half of the span together with a concentrated load of 100kN at the right quarter span point. Find the reactions at the supports, normal thrust and shear at a section 10m from left support.

b. A circular arch to span 25m with a central rise 5m is hinged at the crown and springing. It carries a point load of 100kN at 6m from the left support. Calculate
   i) The reactions at the supports
   ii) The reactions at crown
   iii) Moment at 5m from the left support
   iv)

c. A three hinged parabolic arch hinged at the supports and at the crown has a span of 24m and a central rise of 4m. It carries a concentrated load of 50kN at 18m from left support and a uniformly distributed load of 30kN/m over the left-half portion. Determine the moment, thrust and radial shear at a section 6m from the left support.