Q. No. CEE 610/ 37

B.TECH/EVEN
.REG/(22-23)

Even Semester Mid-term Examination, 2022-23

ADVANCED DESIGN OF CONCRETE STRUCTURES

CEE 610

Full Marks : 30 *Time* : 90 Minutes

The figures in the margin indicate full marks.

Answer only *one* question using suitable missing data.

Materials to be supplied:
IS: 456 - 2000. IS: 875 (III) and IS: 1893 (I) are allowed

Question No.	Body of the Question	Marks	Mapped CO

1. A 5 stored special R.C. moment resisting hospital building located at NIT Durgapur campus with following details:

   Bay width = 4 m c/c,

   Frame spacing = 3 m c/c,

   Height of ground floor = 4m,

   Height of other floors = 3.5 m,

   Floor thickness = 0.15 m,

   Outer columns = 250 mm x 300 mm, 2 nos,

   Inner columns = 250 mm x 400 mm, 3 nos,

   Girder below floor slab = 250 mm x 400 mm,

   Live load = 5 KN/m^2,

   Walls are in the frame and resting over hard soil.

Draw Shear force and bending moment diagram of the frame members due both earthquake and wind load.

25 CO1 & CO3

2. A drop and column head flat slab consists of 5.5 m x 6.5 m panels subjected to live load of 4.2 KN/m^2 along with a finishing load of 0.8 KNm^2. The diameter of column is 500 mm and clear height is 4.8 m with both ends fixed. Design one interior or exterior panel using Fe500 and M30. 25 CO1 & CO3

3. A 10x0.65x0.35 m^3 M25 grade of reinforced concrete simply supported beam of age 1year carries an all-inclusive load of 30 kN/m out of which 60 % is permanent. After designing the beam, it is found that 5nos and 3nos 25 mm tor-phi bars (HYSD-Fe500) are required at bottom and top respectively. Calculate the long term deflection at $1/4^{th}$ span of the beam after one year from the date of construction. Also, calculate the crack width of the beam at the following points in the $1/4^{th}$ span:

   (i) bottom corner and

   (ii) at the soffit below the central bar

   8+4+4+3+3+3 CO1&CO3

COURSE OUTCOMES

CO1: Acquire knowledge of engineering design of different Member

CO2: Ability to analyse the Utility Structures: Bunker, Silo, Water Tank, Shefl, etc.

CO3: Ability for understanding the need of future studies

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Q. No. CEE 611/ 31

B.TECH/EVEN
REG/(22-23)

Even Semester Mid-term Examination, 2022-23

ADVANCED STRUCTURAL ANALYSIS

CEE 611

Full Marks : 25 *Time* : 90 Minutes

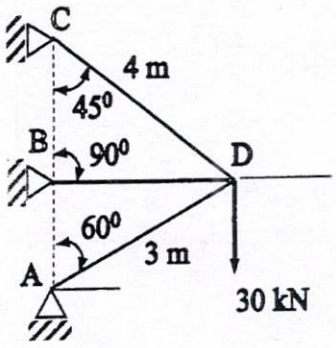
The figures in the margin indicate full marks.

Answer *all* the questions.

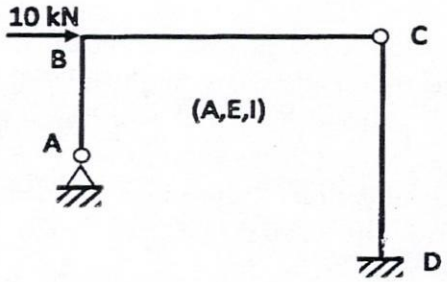
Question No.	Body of the Question	Marks	Mapped CO

1. The two-dimensional truss ABCD, shown in the figure below, is subjected to a force of magnitude 30 kN at joint D as indicated. Define the global coordinate system and determine the degrees of freedom of the truss. For each individual element define the local coordinate system and determine the transformation matrix and the connectivity array. Write down the member and global stiffness matrices of member AD and the load vector for the truss. For all the elements, take area = A, modulus of elasticity = E and area moment of inertia = I.

12 CO1, CO3, CO4



2. The two-dimensional portal frame ABCD shown in the figure is subjected to a concentrated force of magnitude 10 kN acting at joint B. Determine the degree of kinematic indeterminacy of the frame. Show the kinematic indeterminacies with the help of a diagram. Indicate the local coordinate system and write down the transformation matrix and the connectivity array for each element. Also determine the stiffness matrices in local coordinate system and the global coordinate system for element CD, and the load vector for the frame. Assume all members to be extensible. Take 2AB = BC = CD = L and A=10I. 13 CO1, CO3, CO4



Useful formula:

1. The transformation and stiffness matrices for a two-dimensional truss element:

$$[T]=\begin{bmatrix} l & m & 0 & 0 \\ 0 & 0 & l & m \end{bmatrix};\quad [K]=[T]^T \times \frac{AE}{L}\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \times [T]=\frac{AE}{L}\begin{bmatrix} l^2 & lm & -l^2 & -lm \\ lm & m^2 & -lm & -m^2 \\ -l^2 & -lm & l^2 & lm \\ -lm & -m^2 & lm & m^2 \end{bmatrix}$$

where, $l=\cos\theta, m=\sin\theta$

2. The transformation and stiffness matrices for a two-dimensional frame element:

(*Continued*)

$$[T] = \begin{bmatrix} l & m & 0 & 0 & 0 & 0 \\ -m & l & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & l & m & 0 \\ 0 & 0 & 0 & -m & l & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$$[K] = [T]^T \times \begin{bmatrix} \frac{AE}{L} & 0 & 0 & -\frac{AE}{L} & 0 & 0 \\ 0 & \frac{12EI}{L^3} & \frac{6EI}{L^2} & 0 & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ 0 & \frac{6EI}{L^2} & \frac{4EI}{L} & 0 & -\frac{6EI}{L^2} & \frac{2EI}{L} \\ -\frac{AE}{L} & 0 & 0 & \frac{AE}{L} & 0 & 0 \\ 0 & -\frac{12EI}{L^3} & -\frac{6EI}{L^2} & 0 & \frac{12EI}{L^3} & -\frac{6EI}{L^2} \\ 0 & \frac{6EI}{L^2} & \frac{2EI}{L} & 0 & \frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix} \times [T]$$

$$= \begin{bmatrix} c_1 & c_2 & -c_4 & -c_1 & -c_2 & -c_4 \\ c_2 & c_3 & c_5 & -c_2 & -c_3 & c_5 \\ -c_4 & c_5 & c_6 & c_4 & -c_5 & c_7 \\ -c_1 & -c_2 & c_4 & c_1 & c_2 & c_4 \\ -c_2 & -c_3 & -c_5 & c_2 & c_3 & -c_5 \\ -c_4 & c_5 & c_7 & c_4 & -c_5 & c_6 \end{bmatrix}$$

where, $c_1 = l^2\frac{AE}{L} + m^2\frac{12EI}{L^3}$, $c_2 = lm\left(\frac{AE}{L} - \frac{12EI}{L^3}\right)$

$c_3 = m^2\frac{AE}{L} + l^2\frac{12EI}{L^3}$, $c_4 = \frac{6EI}{L^2}m$, $c_5 = \frac{6EI}{L^2}l$, $c_6 = \frac{4EI}{L}$

$c_7 = \frac{2EI}{L}$

COURSE OUTCOMES

CO1: Develop basic understanding of the fundamental concepts and theorems of the advanced topics in analysis of structures

CO2: Model and analyze different structural systems by matrix method of analysis using clement approach of force/flexibility method

CO3: Model and analyze different structural systems by matrix method of analysis using element approach of displacement/ stiffness method

CO4: Understand the basic methodology adopted in developing computer programmes for structural analysis and thus, develop an overall understanding of the available structural analysis softwares

CO5: Write the governing equations for stability and carry out stability analysis of structures

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Q. No. CEE 613/ 28

B.TECH/EVEN
REG/(22-23)

Even Semester Mid-term Examination, 2022-23

MATERIAL TECHNOLOGY

CEE 613

Full Marks : 25 *Time* : 90 Minutes

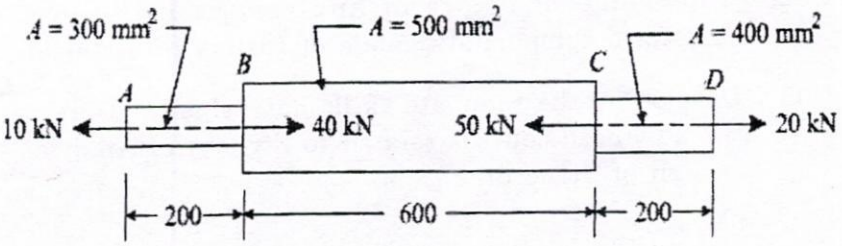
The figures in the margin indicate full marks.

Graph paper shall be supplied, if required.

Answer *all* the questions.

Question No.	Body of the Question	Marks	Mapped CO

1. A member *ABCD* is subjected to the axial loads as shown in the following figure. Determine the total change in length of the member. Consider E = 200 GPa. Length of the member is given in mm. 10 CO1



2. A load of *250kN* is carried by a short concrete column of *300 mm* x *300 mm*, which is reinforced with *8* bars of *16 mm* diameter. Find the stresses in concrete and steel if modulus of elasticity for steel is *18* times that of concrete.
If the stress in concrete is not to exceed 5 *MPa*, find the area of steel required so that the column can carry *600kN*. 6 CO1, CO3

3. Draw the generalized graphical representation of stress-strain behavior of the materials having following properties: 3 CO2

   (a) Low strength, high ductility and low toughness

   (b) High strength, high ductility and high toughness

4. Write a short note on the followings: 3×2=6 CO2

   (a) Poisson's ratio

   (b) Elastic strain recovery

   (c) Toughness of material

COURSE OUTCOMES

CO1: Development of skills for predicting structural behaviour of different materials under different loads

CO2: Knowledge of basics of analysis and design of structural components, made of variety of materials

CO3: Developing the requisite skill that helps in studying the advanced courses related to Structural Analysis, Design of Structures

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Q. No. CEE 621/ 28

B.TECH/EVEN
REG/(22-23)

Even Semester Mid-term Examination, 2022-23

FINITE ELEMENT METHODS

CEE 621

Full Marks : 25 *Time* : 90 Minutes

The figures in the margin indicate full marks.

Notations have their usual meanings if not mentioned otherwise.

Assume any relevant data.

Question No. Body of the Question Marks Mapped CO

GROUP A

Attempt any *one* question out of the following.

1. (a) Briefly describe the Finite Element Method and its importance in Civil Engineering. 3 CO1

   (b) Mention the basic and important steps in solving problems using FEM 2 CO1

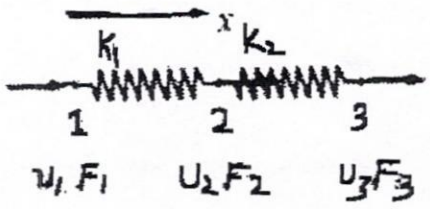
   (c) Mention important elements types with their domain of application used in FEM 3 CO1

   (d) Mention some important FEM softwares with their specific application areas. 2 CO4

   (e) What do you mean by 'discretization'? Discretize a chosen structure with standard *finite element and* and mention total number of elements, nodes and d.o.fs. 2.5 CO2

2. (a) Establish stiffness matrix for a bar element. Also specify some areas of application of barelement in Civil Engineering. 4 CO2

(b) A system of springs are subjected to nodal forces $F_2 = F_3 = -P$ and nodal displacement $u_1=0$. Establish equilibrium equation for the spring assembly as shown below. 4 CO2



(c) Explain the difference between FE method and exact method of analysis with the help of example. Also, mention why FEM is called approximate method. 4.5 CO1

GROUP B

Q No. 3 is compulsory,
Attempt any *one* from the rest.

3. (a) "FEM may be necessary for analysis of even simple structural components": comment with proper explanation/example(s). 2.5 CO1

(b) Refer to the beam element of Fig.Q3 where the length is *L*, cross section is *A* and flexural rigidity is *EI*, Define the stiffnesses k_{12} and k_{34}. Hence, derive the **first column** of the element stiffness matrix (ESM). 5 CO2

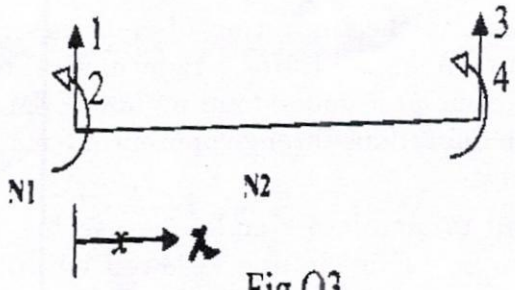


Fig.Q3

4. A cantilever beam, of length L and constant EI, is supporting a downward concentrated load P_0 at the free end.

   (a) Model this beam by FEM using the minimum number of element (s). Hence write down the governing equation in matrix form. 2.5 CO3

   (b) Hence, compute the unknown quantities when $\mathbf{P_0}$= **sum of the last two digits of your roll no.** 2.5 CO3

5. (a) Develop a flow chart, in context of writing a FE code, for finding out the solution of Q4 above when more than one element are used. 2.5 CO4

   (b) In case of a general beam problem, what is the relevance of interpolation functions? Hence, with respect to a beam element as in Fig. Q3, write the steps for finding out the relevant interpolation functions? 2.5 C02

COURSE OUTCOMES

- CO1: Realising the limitation of classical methods in solution of real life Structural Engineering problems and understanding how FEM addresses such limitations through appropriate modelling and analysis
- CO2: Skill to simulate simple engineering structures through FE modelling followed by analysis and interpretation of resulting data to ascertain their reliability and applicability in light of physical constraints of the system and common engineering sense.
- CO3: Skill to use computational tools for solving Structural Engineering problems
- CO4: Ability of using FE software packages and development of FE codes for modelling, analysis and investigation of engineering problems relevant to industry and research.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester Mid-term Examination, 2022-23

Course Code: CEE623 Full Marks: 25

Course Name: Remote Sensing & GIS Time: 90 Mins

Question Paper No.: NITDGP/CEE623/1 Date of Exam: 25/02/2023

Instructions: Answer **Q. 10 and any seven** questions.

Question No.	Body of the Question	Marks	Mapped CO
1	What is path radiance? What is its effect on the image quality? How can it affect the process of RS?	1+1+1	CO1
2	What are the advantages of using a satellite over an aircraft as a platform in RS?	3	CO1
3	What are the differences between NIR & thermal IR bands in RS?	3	CO1
4	What are the factors governing the scattering of EMR? Why non-selective scattering is named so?	2+1	CO1
5	What is an atmospheric window? Briefly explain with a neat sketch.	1+2	CO1
6	What is radiant flux? Write down the simple radiation budget equation & state the condition of its validity.	1+2	CO1
7	Draw the spectral reflectance curve of clear water & state how you will interpret it.	1+2	CO1
8	What are the two classes of variable about which information may be provided by RS? Explain each of them with examples.	1+2	CO1
9	What do you understand by PAN & multispectral images? Why is the spatial resolution of a PAN imagery better than a multispectral imagery?	2+1	CO1
10	What are the different stages of RS system?	4	CO1

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Course Outcomes

CO1: Learn about basic items, parameters & concepts related with remote sensing.
CO2: Apply techniques of visual image interpretation and digital image processing.
CO3: Use GIS and its components for basic applications in civil engineering.

Q. No. CEE 624/ 28

B.TECH/EVEN
REG/(22-23)

Even Semester Mid-term Examination, 2022-23

TRAFFIC ENGINEERING AND MANAGEMENT

CEE 624

Full Marks : 25 *Time* : 90 Minutes

The figures in the margin indicate full marks.

Programmable scientific calculators are not allowed.

Question No.	Body of the Question	Marks	Mapped CO

Answer *all* the question.

1. Inspection of an expressway data set reveals a free flow speed of 60 kmph, a jam density of 180 vehicles per km per lane, and an observed maximum flow of 2000 vehicles per hour. Determine the linear equation for velocity for these conditions, and determine the speed and density at maximum flow conditions. How do the theoretical and observed conditions compare?

5 CO1

2. Use linear speed-density relationship. Derive the relationship between speed and density in terms of free flow speed and jam density. Use necessary illustrations.

5 CO2

3. On a highway with a flow of 1600 vehicles per hour and free flow speed of 110 kmph, the following spot speeds were observed (in kmph): 52, 48, 58, 43, 58, 54, 62, 51,

58, 55, 59, 59, 53, 50, 54. Use linear speed-density relationship. What will be the Jam density, in vehicles per km? 5 CO3

4. Describe the traffic parameters i.e. Space headway and time headway. Which type of headway data collection is most suitable for Indian Traffic condition describe with a proper logic. 2 CO1

5. There is a two-way four-legged intersection with three lanes in each direction. The left-most, middle and the right-most lanes are used for left-turning, through and right turning movements only. Traffic is generated from the northern, eastern, southern and western sides respectively. The traffic volume in terms of vehicles per hour from North to West, South and East is 100, 200 and 300 respectively. The traffic volume in terms of vehicles per hour from East to North, West and South is 75, 180 and 100 respectively. The traffic volume in terms of vehicles per hour from South to North, East and West is 250, 125 and 115 respectively. The traffic volume in terms of vehicles per hour from West to South, North and East is 100, 100 and 300 respectively. Consider a four phase signal where, right- turn, through and left-turn movements from one direction takes place in a particular phase. The peak hour factor is 1 and the critical volume to capacity ratio is 0.9. The lost time per phase is 3 secs and the amber time for each cycle is 2 secs. Based on the above mentioned inputs, develop the phase plan for Green Red Yellow indication for each phase using appropriate illustrations. 8 CO3

COURSE OUTCOMES

CO1: Apply knowledge of traffic study & analysis for design solutions.

CO2: Understand basic design philosophy applicable to traffic flow & highway intersections.

CO3: Formulate, analyze, and design basic components of highway intersections

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