# University of Mumbai

## Examination 2022

Program: M.E. Civil Engineering (with Structural Engineering Sub)
Curriculum Scheme: Rev 2016
Examination: ME Semester II
Course Code: STR-C203 and Course Name: Advanced Design of Concrete Structures
Time: 2 hrs 30 min Max. Marks: 80

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**1T02212 / / M. E. (Civil with Structural Engineering) (Sem.-II) (Choice Based Credit and Grading System) (R-2016)**

| **Q1.** | **Choose the correct option for following questions.**<br>**All the Questions are compulsory and carry equal marks** |
|---|---|
| | |
| 1. | In an interior span (flat slab) the negative design moment is --------% of total design moment |
| Option A: | 35% |
| Option B: | 65% |
| Option C: | 50% |
| Option D: | 25 % |
| | |
| 2. | The distance between line of reaction to the supported load and the root of the corbel is -------mm if effective depth is 400mm |
| Option A: | 350 |
| Option B: | 450 |
| Option C: | 650 |
| Option D: | 550 |
| | |
| 3. | A bunker having capacity 300kN is to be used for coal storage. what is the volume bunker is needed |
| Option A: | 98.5m3 |
| Option B: | 74.2m3 |
| Option C: | 37.5m3 |
| Option D: | 96.5m3 |
| | |
| 4. | A simply supported circular slab of radius 3m and ultimate load of |

| | |
|---|---|
| | 10KN/m2.Ultimate moment from yield line theory |
| Option A: | 25kNm |
| Option B: | 15kNm |
| Option C: | 35kNm |
| Option D: | 45kNm |
| | |
| 5. | For simply supposed square slab having size 4mX4m and ultimate load of 20kN/m2, ultimate moment is |
| Option A: | *46.52kNm* |
| Option B: | *26.52kNm* |
| Option C: | *13.33kNm* |
| Option D: | *33.33kNm* |
| | |
| 6. | In case of hopper bottom the ultimate tensile force is 100kN and fy=415. The reinforcement required is ------- |
| Option A: | *277mm2* |
| Option B: | *358mm2* |
| Option C: | *152mm2* |
| Option D: | *459mm2* |
| | |
| 7. | Determine hoop tension for silo if ph is 20kN/m2 and diameter is 5m |
| Option A: | 20kN |
| Option B: | 30kN |
| Option C: | 60kN |
| Option D: | 50kN |
| | |
| 8. | In portal frame for beam critical section for shear is at a distance ------- from face of column |
| Option A: | 1.5d |
| Option B: | 1.0d |
| Option C: | 1.75d |
| Option D: | 0.5d |
| | |
| 9. | If far end is hinged, relative stiffness is |

| | |
|---|---|
| Option A: | I/L |
| Option B: | 2I/3L |
| Option C: | 3I/4L |
| Option D: | 4I/3L |
| | |
| 10. | Critical section for one way shear in the strip footing is at distance _____ from the face of the beam |
| Option A: | 1.5d |
| Option B: | 0.5d |
| Option C: | 1.0d |
| Option D: | 1.75d |
| | |

| **Q2.** | **Solve any ONE Question out of Two 20 marks** |
|---|---|
| A | Design a bunker to store 400 kN coal for the following data, unit wt. of coal 8 KN/$m^3$, angle of repose is 25 degrees, the stored coal is to be surcharged of its angle of repose provide square bunker of size 4m x 4m. Use M20/Fe415<br>Draw neat sketch showing reinforcement details. |
| B | A silo with internal diameter 5.5m, height of cylindrical portion 18m and central opening with 0.5m is to be built with a store wheat. Design the silo using M20 grade concrete and Fe 415 steel. Given:<br>Unit weight of wheat=8.5kN/m3<br>Angle of internal friction = 28º<br>Angle of wall friction = 0.75ϕ while filling<br>=0.60ϕ while emptying<br>Pressure ratio = K=0.5 while filling<br>Use Janssen's theory for pressure calculations. |

| Q3. | **Solve any ONE Question out of Two 20 marks** |
|---|---|
| A | Design a strip footing for a row of 4 columns of size 400 mm × 400 mm. Center to center to distance between the two adjacent columns is 4m. The two exterior columns carry a load of 1500 kN each and the two interior columns carry a load of 2000kN each. SBC of soil is 200kN/$m^2$. Use M20 and Fe 415 steel. Draw reinforcement details. |
| B | Design an interior panel of a flat slab with panel size 6 m × 6 m providing suitable drop and column head supported by columns of diameter 500mm. Take LL = 4 KN/m2. Use Fe415/M20. Draw reinforcement details. |

| Q4. | **Solve any TWO Questions out of THREE 10 marks each** |
|---|---|
| A | Q2) C) Analyze the portal frame and find design moments for following data. Height of column =4.5m. Distance between column center is 9m, total factor load acting on portal frame is 40kN/m. |
| B | Design Corbel to carry ultimate load of 500 kN at a distance of 300 mm from the face of column 500 mm × 500 mm. Use M25 / Fe415. Take bearing stress of concrete as 0.8fy. Draw reinforcement details. |
| C | Derive the expression relating yield line moment for the orthotopically reinforced simply supported rectangular slab subjected to udl over the entire surface. |

**University of Mumbai**
**Examination 2022**
Program: **M.E. (Civil) (CBCS)**

Examination: ME Semester II
Course Code: STR-DLO 2014 and Course Name: Health Monitoring System
Time: Time: 2-30 hour Max. Marks: 80
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| **Q1.** | **Choose the correct option for following questions.**<br>**All the Questions are compulsory and carry equal marks** |
|---|---|
| | |
| 1. | The longitudinal cracks in columns of RCC building are normally due to- |
| Option A: | Structural deficiency |
| Option B: | Excess cement content |
| Option C: | Corrosion of rebars |
| Option D: | Thermal expansion |
| | |
| 2. | Alkali Aggregate Reaction occurs when |
| Option A: | Soluble sulphates react with calcium hydroxide to form gypsum. |
| Option B: | Carbon dioxide from the air penetrates the concrete and reacts with hydroxides, such as calcium hydroxide, to form carbonates. |
| Option C: | Reactive silica, react with two alkalis contained in the cement, potassium and sodium. |
| Option D: | Material is repeatedly struck by particles from a harder body. |
| | |
| 3. | Which of the following is not a Deterioration caused by environmental Chemicals? |
| Option A: | Carbonation |
| Option B: | AAR |
| Option C: | Chloride Ingress |
| Option D: | Rebar Corrosion |
| | |
| 4. | Which of the following processes is not required in rehabilitation activity of RCC structures? |
| Option A: | Grouting |
| Option B: | Guniting |
| Option C: | Curing |
| Option D: | Detonating |
| | |
| 5. | Which of the following is not used as repair material ? |
| Option A: | Polymer |
| Option B: | Gypsum |
| Option C: | Epoxy |
| Option D: | Latex |
| | |

| | |
|---|---|
| 6. | If value of rebound hammer number is between 10 to 20, what does it indicate? |
| Option A: | Excellent strength of concrete |
| Option B: | Good strength of concrete |
| Option C: | Average strength of concrete |
| Option D: | Delaminated concrete surface |
| | |
| 7. | Which of the following test is used to determine possibility of rebar corrosion inside concrete? |
| Option A: | Half Cell Test |
| Option B: | UPV Test |
| Option C: | Carbonation Test |
| Option D: | RCPT Test |
| | |
| 8. | Which of the following is NOT directly responsible for corrosion? |
| Option A: | Chlorides |
| Option B: | Carbonation |
| Option C: | Low Temperature |
| Option D: | Humidity |
| | |
| 9. | Which of the following forms does not require the crane to move upwards, minimising crane use? |
| Option A: | Slip form |
| Option B: | Cantilever form |
| Option C: | Wooden form |
| Option D: | Steel form |
| | |
| 10. | What does the acronym OSHA stand for? |
| Option A: | Occupational Safety and Health Administration |
| Option B: | Occupational Safety and Hazards Administration |
| Option C: | Operational Safety and Health Authority |
| Option D: | Operational Safety and Hazards Authority |
| | |

| **Q2.** | **Solve any Two Questions out of Three 10 marks each** |
|---|---|
| A | Enlist the environmental factors responsible for deterioration of RCC structures. Explain each with its preventive measure. |
| B | What are the possible causes of cracks in longitudinal direction in RCC members. Also provide treatment procedure for the same. |
| C | Differentiate between repairs, rehabilitation and retrofitting of RCC structure. Explain each with respect to RCC Bridge over a river. |

| **Q3.** | **Solve any Two Questions out of Three 10 marks each** |
|---|---|
| A | A four-storey building collapsed in the Kurla area of Mumbai in the last week of June 2022. According to you what are the reasons of this accident? |
| B | Explain the process of corrosion of reinforcement in concrete and its effect on structural members like beams, columns and slabs. |
| C | What are various safety measures to be taken during rehabilitation of structure ? Explain significance of each. |

| Q4. | Solve any FOUR Questions out of SIX 5 marks each |
|---|---|
| A | How can we recycle the material removed from demolished RCC structure? |
| B | Discuss about outline of various demolition methods and their suitability of application. |
| C | Write a short note on 'Items in BOQ and their specifications' for rehabilitation of Columns in pilotis (stilt) area of buildings. |
| D | Compare Conventional formwork & Modular Formwork with merits and demerits of each. |
| E | Explain Structural Health Monitoring of RCC Structure. How different tests help in diagnosis of structure. |
| F | What are various parameters for assessment for restoration strategies? |

Program: **ME Civil Engineering** with **Structural Engineering Subjects**

Curriculum Scheme: Revised 2016

**Examination: SEM-II**

Paper Code: 33302 Course Name: Structural Dynamics(STR-C202)

Time: 2:30 hour Max. Marks: 80

| | |
|---|---|
| Q1. | The ratio of the maximum displacement of the forced vibration to the deflection due to the static force, is known as |
| Option A: | Damping factor |
| Option B: | Damping coefficient |
| Option C: | Logarithmic decrement |
| Option D: | Magnification factor |
| Q2. | Calculate logarithmic decrement if damping factor is 0.33 |
| Option A: | 0.36 |
| Option B: | 3.23 |
| Option C: | 5.16 |
| Option D: | 2.19 |
| Q3. | Calculate damped natural frequency, if a spring mass damper system is subjected to periodic disturbing force of 30 N. Damping coefficient is equal to 0.76 times of critical damping coefficient and undamped natural frequency is 5 rad/sec. |
| Option A: | 3.25 rad/sec |
| Option B: | 4.12 rad/sec |
| Option C: | 2.13 rad/sec |
| Option D: | 3.99 rad/sec |
| Q4. | Which of the following systems produce a vibration in the foundation? |
| Option A: | Unbalanced machine |
| Option B: | Balanced machine |
| Option C: | Coupled machine |
| Option D: | Uncoupled machine |
| Q5. | A soft story has inadequate _____ to resist the earthquake-induced building stresses |
| Option A: | shear resistance |
| Option B: | energy absorption capacity |
| Option C: | ductility |
| Option D: | stiffness |
| Q6. | The equivalent stiffness of three springs with stiffness 10kN/m, 15 kN/m and 12 kN/m, if connected in series and parallel is, |
| Option A: | 37 kN/m and 4 kN/m |
| Option B: | 0.25 kN/m and 37 kN/m |
| Option C: | 37 kN/m and 0.25 kN/m |
| Option D: | 4 kN/m and 37 kN/m |

| | |
|---|---|
| Q7. | Maximum dynamic magnification factor in a rectangular pulse loading is, |
| Option A: | 1 |
| Option B: | 2 |
| Option C: | 3 |
| Option D: | 4 |
| Q8. | A machine of 1250 kg mass supported on springs of total stiffness 1000 kN/m and has an unbalanced rotating element which results in a disturbing force of 450 N at a speed of 1400rpm with 15% damping, then transmissibility factor is |
| Option A: | 0.0714 |
| Option B: | 0.0614 |
| Option C: | 0.0741 |
| Option D: | 0.0641 |
| Q9. | Which of the following relation is correct for design horizontal seismic coefficient? |
| Option A: | A=(Z×R×Sa)/(2×I×g) |
| Option B: | A=(Z×I×Sa)/(2×R×g) |
| Option C: | A=(Z×R×I)/(2× Sa×g) |
| Option D: | A=(2×R×I)/(Z× Sa×g) |
| Q10. | A natural frequency for cantilever beam of span 'L' subjected to continuous distributed mass 'm' band flexural rigidity 'EI' Rayleigh's method is, |
| Option A: | 3.53/(L×L)×SQRT(EI/m) |
| Option B: | 3.35/(L×L)×SQRT(m/EI) |
| Option C: | 5.33/(L×L)×SQRT(EI/m) |
| Option D: | 5.33/(L×L)×SQRT(m/EI) |

**Qu. 2: Solve any Five;** **(20)**

a) Write a short note on Orthogonality principal

b) What do you mean by degree of freedom in the dynamic analysis of structure?

c) Explain zone factor and Importance factor.

d) What are the ductility provisions in building as per IS-13920?

e) What is damping? Explain the various types of damping.

f) Explain in short Zone factor and Influence Factor.

g) Explain Viscous damping and Coulomb damping.

**Qu. 3:Solve any One** **(20)**

a) A three storey single bay frame has storey height of 4m each. All columns are 300 mm x 600 mm and beams are very stiff. The lumped mass on the first and the second floor is 25 t & on the third floor is 10 t. Calculate natural frequencies and mode shapes. Also calculate normal mode shape coefficients and verify the Orthogonality Principle. E = $2x10^5$ Mpa.

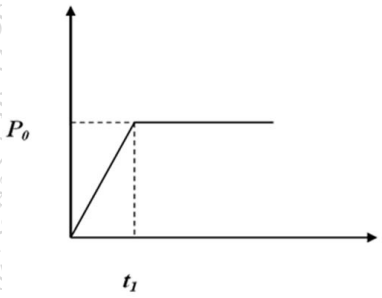
b) A three storey frame with free vibration characteristic is given below, is subjected to suddenly applied constant load of 30 kN at 2nd floor and 25 kN at 3rd floor level. Calculate maximum displacement at each storey by SRSS and ABS method.

| Storey No. | Storey height (m) | Mass No. | Mass (t) | ω(rad/sec) | Mode Shapes | | |
|---|---|---|---|---|---|---|---|
| | | | | | $\phi_{i1}$ | $\phi_{i2}$ | $\phi_{i3}$ |
| 1 | 3 | 1 | 50 | 4.92 | 0.336 | 0.759 | 1.0 |
| 2 | 3 | 2 | 25 | 13.45 | -2.46 | -0.749 | 1.0 |
| 3 | 3 | 3 | 25 | 18.7 | 1.58 | 1.157 | 2.58 |

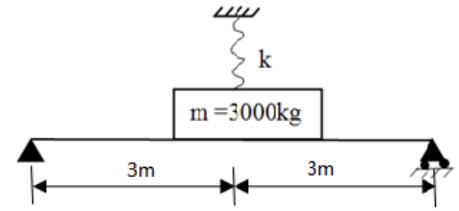
**Qu. 4:Solve any Two;** **(20)**

a) In a free vibration test a lateral force of 300 kN is applying to pull the model by 60mm. A cable is suddenly cut and resulting free vibration is recorded. At the end of 5 cycles the time is 6 seconds and the amplitude recorded was 32mm. Using this experimental data compute: i) damping ratio, ii) stiffness and iii) Number of cycles required for the displacement amplitude decrease to 20mm.

b) A SDOF system is subjected to dynamic load whose time history is given. Obtain the response.



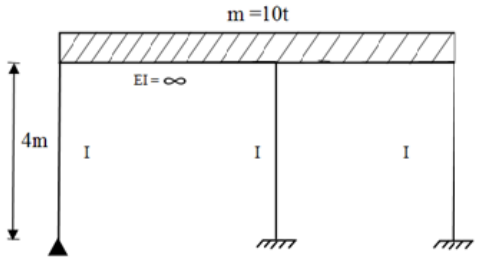

c) For the structural system shown in figure, compute the natural frequency of vibration.




k= 1000 kN/m

I= $8\times10^7$ mm$^4$

E= $2\times10^5$ N/mm$^2$




EI= $6\times10^4$ kN-m$^2$

# University of Mumbai

## Examination 2022 under cluster __(Lead College: _____)

Program: **M.E (Civil) Rev 2016 (Choice Based)**

Curriculum Scheme: Rev2016

Examination: M.E. Semester: II

Course Code: STR- C201 and Course Name: Finite Element Analysis

Time: 2-30 hour Max. Marks: 80

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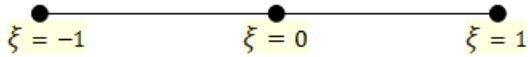
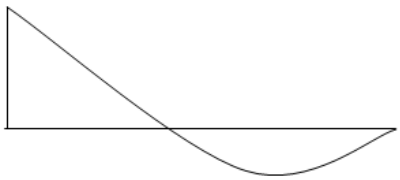
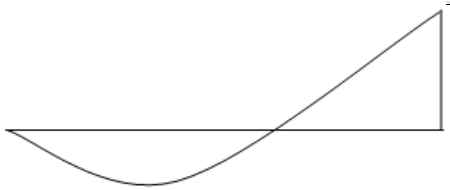
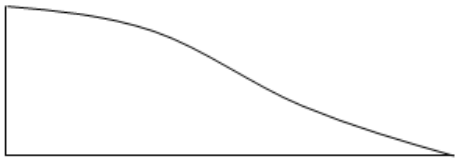
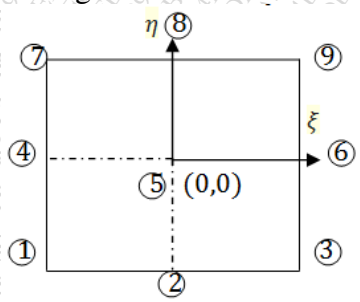
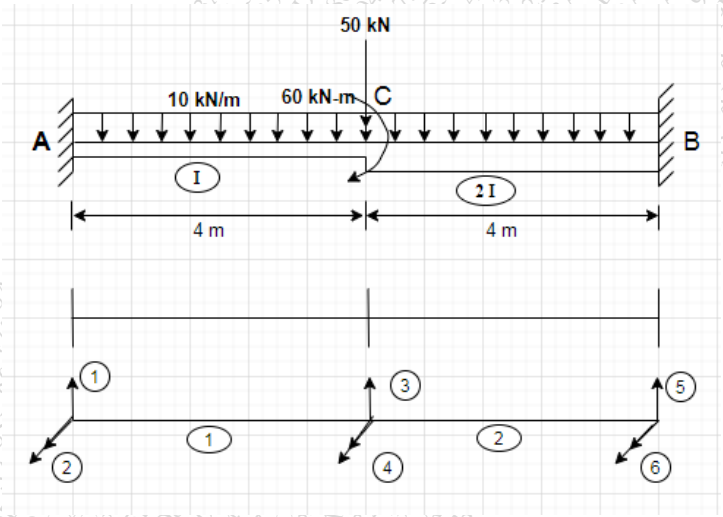
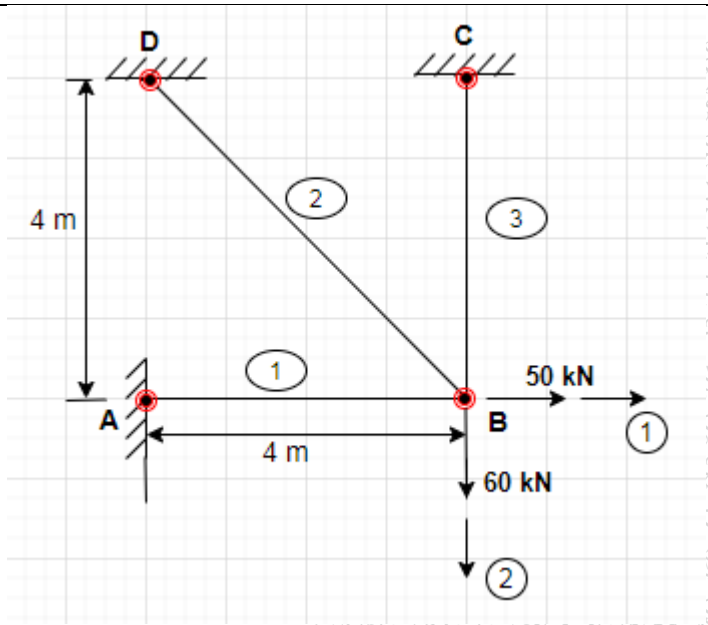
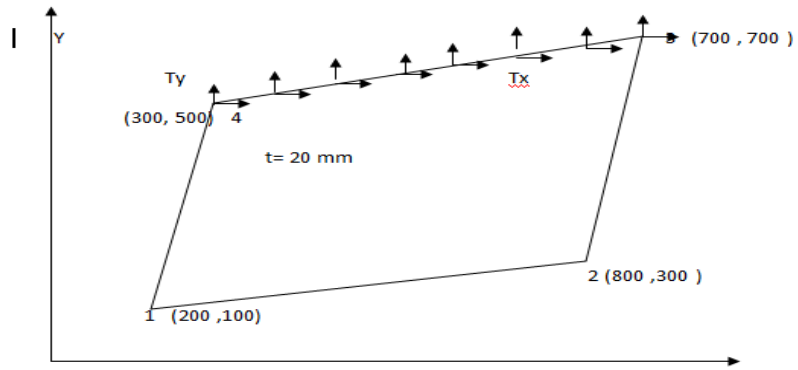
| **Q1.** | **Choose the correct option for following questions. All the Questions are compulsory and carry equal marks** |
|---|---|
| | |
| 1. | For 3-noded bar element with natural co-ordinate system<br>  <br><br>Obtain the variation of shape function for Node 1 ($N_1$) |
| Option A: |  |
| Option B: |  |
| Option C: |  |
| Option D: |  |
| | |
| 2. | Which one of the following is the shape function for the Node 7 in nine noded rectangular element in natural co-ordinate system using Langrange's function.<br>  <br> |
| Option A: | $N_7 = \frac{(\xi+1)\xi\eta(\eta-1)}{4}$ |

| | |
|---|---|
| Option B: | $N_7 = \frac{\xi(\xi-1)(\eta+1)\eta}{4}$ |
| Option C: | $N_7 = \frac{(\xi+1)(\eta+1)\xi\eta}{4}$ |
| Option D: | $N_7 = \frac{\xi(\xi-1)\eta(\eta-1)}{4}$ |
| | |
| 3. | In C° continuity element the only unknown is |
| Option A: | Slope |
| Option B: | Displacement |
| Option C: | Bending |
| Option D: | Reaction |
| | |
| 4. | Diagonal element of Mass stiffness matrix for two noded beam element is |
| Option A: | $m/420\ [\ 156\ ,4L^2\ ,156\ ,4L^2\ ]$ |
| Option B: | $m/420\ [\ 156\ ,4L^2\ ,156\ ,4L\ ]$ |
| Option C: | $m/420\ [\ 156\ ,4L\ ,156\ ,4L^2\ ]$ |
| Option D: | $m/420\ [\ 150\ ,4L^2\ ,156\ ,4L^2\ ]$ |
| | |
| 5. | Diagonal element of Geo-stiffness Matrix for two noded beam element is |
| Option A: | P/30 [ 36/L ,4L, 36/L, 4L ] |
| Option B: | P/30 [ 36/L ,4L, 30/L, 4L ] |
| Option C: | P/30 [ 36/L ,2L, 36/L, 4L ] |
| Option D: | P/30 [ 36/L ,4L, 36/L, 6L ] |
| | |
| 6. | Shape function function for two noded beam element is |
| Option A: | $N_1 = 1- 3x^2/L^2 + 2x^2/L^3 \quad N_2 = x - 2x^2/2 + x^3/L^2 \quad N_3 = 3x^2/L^2 - 2x^3 \quad N_4 = -x^2/L + x^3/L^2$ |
| Option B: | $N_1 = 1- 3x^2/L^2 + 2x^2/L^3 \quad N_2 = x - 2x^2/2 + x^3/L^2 \quad N_3 = 3x^2/L^2 - 2x^3 \quad N_4 = -x^2/L + x^3/L$ |
| Option C: | $N_1 = 1- 3x^2/L^2 + 2x^2/L \quad N_2 = x - 2x^2/2 + x^3/L^2 \quad N_3 = 3x^2/L^2 - 2x^3 \quad N_4 = -x^2/L + x^3/L^2$ |
| Option D: | $N_1 = 1- 3x^2/L^2 + 2x^2/L^3 \quad N_2 = x - 2x^2/2 + x^3/L \quad N_3 = 3x^2/L^2 - 2x^3 \quad N_4 = -x^2/L + x^3/L^2$ |
| | |
| 7. | Strain displacement matrix for two noded beam element is |
| Option A: | 1/L [-6+12x ,L(6x-4) ,6-12x , L(6x-2)] |
| Option B: | 1/L [-6+12x ,L(6x-4) ,6-10x , L(6x-2)] |
| Option C: | 1/L [-6+12x ,L(8x-4) ,6-12x , L(6x-2)] |
| Option D: | 1/L [-6+12x ,L(6x-4) ,6-12x , L(6x-4)] |
| | |
| 8. | Second degree complete polynominal for three dimensional polynomial shape function |
| Option A: | $u = \alpha_1 + \alpha_2 x + \alpha_3 y + \alpha_4 z + \alpha_5 x^2 + \alpha_6 xy + \alpha_7 y^2 + \alpha_8 yz + \alpha_9 z^2 + \alpha_{10} zx$ |
| Option B: | $u = \alpha_1 + \alpha_2 x + \alpha_3 xy + \alpha_4 z + \alpha_5 x^2 + \alpha_6 xy + \alpha_7 y^2 + \alpha_8 yz + \alpha_9 z^2 + \alpha_{10} zx$ |
| Option C: | $u = \alpha_1 + \alpha_2 x + \alpha_3 y + \alpha_4 z + \alpha_5 x^2 + \alpha_6 xy + \alpha_7 y^2 + \alpha_8 yz + \alpha_9 z^3 + \alpha_{10} zx$ |
| Option D: | $u = \alpha_1 + \alpha_2 x + \alpha_3 y + \alpha_4 z + \alpha_5 x^3 + \alpha_6 xy + \alpha_7 y^2 + \alpha_8 yz + \alpha_9 z^2 + \alpha_{10} zx$ |
| | |
| 9. | Material which exhibits symmetry with respect to plane within the body is called |
| Option A: | Anisotropic Material |

| | |
|---|---|
| Option B: | Orthotropic Material |
| Option C: | Isotropic Material |
| Option D: | None of the above |
| | |
| 10. | Thin plate subjected to forces in their plane is knows as |
| Option A: | Plane stress problem |
| Option B: | Plane strain problem |
| Option C: | Axisymmetric problem |
| Option D: | None of the above |
| | |

| | |
|---|---|
| **Q2** | **Solve any one out of two of 20 marks each** |
| A | Analyse the structure as shown in fig by using Finite Element Method ,draw shear force ,Bending Moment and elastic curve   |
| B | Analyse the pin jointed plane frame by finite element method, determine the nodal displacement and stress in each member. Find the support reactions E = $2 \times 10^5$ N/mm$^2$ ,Cross sectional area of all member is 20000 mm$^2$ |




| | |
|---|---|
| **Q3.** | **Solve any Two Questions out of Three 10 marks each** |
| A | The quadrilateral element shown in fig is 20mm thick and is subjected to surface forces Tx and Ty. Determine expression for its equivalent nodal forces. If Tx= 20 N /mm$^2$ and Ty= 25 N/mm$^2$, determine the numerical values of the nodal forces.   |
| B | A uniform fixed beam is modelad by two element, each of length 'L' Determine natural frequency of vibration in the first mode considering lumped mass matrix. |
| C | Starting with shape function relationship derive geometric stiffness matrix for a 2-noded beam element. |
| **Q4.** | **Solve any Two Questions out of Three 10 marks each** |
| A | Using polynominal functions (generalized coordinates ) determine shape function for a two noded beam element. |
| B | Explain the differences in geometric and material non-linearities |
| C | Determine the value of following integral using 2 x 2 and 3 x 3 Gauss quadrala |

| | |
|---|---|
| | rule<br>I = $\iint_{-1}^{1}$( 0.75 $(s-1)$^2 + 2.25 ( t - 1)$^2$) ds dt |