2014-2015
B.E. IV SEMESTER EXAMINATION
(CIVIL)
MATHEMATICS IV
(EAM – 212)

Max Marks: 60

Note:
(i) Answer all questions.
(ii) Programmable calculator is not allowed.

1. (a) Derive the iterative method based on Newton – Raphson method for finding \(N^{\frac{1}{3}}\), where \(N\) is a positive real number. Apply the method \(N = 18\) to obtain the result correct to three decimal places.

OR

(a') Determine \(p, q\) and \(r\) so that the order of the iterative method \(x_{n+1} = px_n + \frac{q}{x_n^2} + \frac{r}{x_n^3}\) for \(a^{\frac{1}{3}}\) becomes as high as possible.

(b) Solve the following system of equations by Gauss elimination method.

\[\begin{align*}
3.15x + 1.96y + 3.85z &= 12.95 \\
2.13x + 5.12y - 2.89z &= -8.61 \\
5.92x + 3.05y + 2.15z &= 6.88
\end{align*}\]

(c) Find a real root of the equation \(\cos x - 3x - 1\) correct to three places of decimal using iteration method.

2. (a) Using Newton's divided difference formula approximate a polynomial in \(x\) for the function \(f(x)\) given by the following table:

<table>
<thead>
<tr>
<th>(x)</th>
<th>-1</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>(y)</td>
<td>3</td>
<td>-6</td>
<td>39</td>
<td>822</td>
<td>1511</td>
</tr>
</tbody>
</table>

OR

(a') Apply Gauss's forward interpolation formula to find the value of \(f(x)\) at \(x = 2.75\) from the table.

<table>
<thead>
<tr>
<th>(x)</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>(f(x))</td>
<td>24.145</td>
<td>22.043</td>
<td>20.225</td>
<td>18.644</td>
<td>17.262</td>
<td>16.047</td>
</tr>
</tbody>
</table>

(b) A curve is drawn through the points given in the table:

<table>
<thead>
<tr>
<th>(x)</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>(y)</td>
<td>2.0</td>
<td>2.4</td>
<td>2.7</td>
<td>3.2</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Find:
(i) Value of \(x\) for which \(y\) is maximum.
(ii) Area bounded by the curve, the \(x\) – axis and the ordinates at \(x = 1.0,\ x = 3.0\) using Simpson's \(\frac{1}{3}\) rule.

Contd.....
3. (a) 

Drive two point Gauss formula \( \int_{-1}^{1} f(x) dx = \lambda_0 f(-x) + \lambda_1 f(x) \)

Hence evaluate \( \int_{0}^{\frac{\pi}{6}} \frac{dx}{\sqrt{3+4x}} \)

OR

(a') Solve the initial value problem \( \frac{dy}{dx} = x^2 + y \), \( y(0) = 1 \) for \( x = 0.02 \) using Euler's modified method. Take \( h = 0.01 \) and give two iterations at each step.

(b) Solve the boundary value problem \( y'' - y' + x \), \( y(0) - y(1) = 0 \) by finite difference method. Take \( h = \frac{1}{4} \).

4. (a) Evaluate any two of the following:

(i) \( L^{-1}[\cos(t)] \)  
(ii) \( L^{-1}\left[ \frac{1-e^{-t}}{t} \right] \)  
(iii) \( L^{-1}[\sin(2t) \cdot \sin(3t)] \)

(b) Evaluate any two of the following:

(i) \( L^{-1}\left[ \frac{2s-5}{9s^2-25} \right] \)  
(ii) \( L^{-1}\left[ \frac{1}{s(s+a)} \right] \)  
(iii) \( L^{-1}\left[ \frac{1}{9s^2+6s+1} \right] \)

(c) Using Laplace transformation, find the solution of the initial value problem \( y'' - 4y' + 4y = 64 \sin 2t \), \( y(0) = 0, y'(0) = 1 \).
2014-15
B. E. CIVIL ENGINEERING (WINTER SEMESTER) EXAMINATION
ECE 216
STRUCTURAL MECHANICS

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Question

1(a) A masonry dam of trapezoidal section, 1.5 m wide at top, 5.5 m at bottom and 10 m high with vertical face towards water, contains 7.5 m depth of water. Check the safety of the dam against overturning and calculate extreme stresses at base of dam. Assume unit wt. of masonry and water as 20 kN/m² and 10 kN/m² respectively.

[06]

1(b) A cylindrical shell 3.25 m long, 1 m in diameter, thickness of metal 10 mm is subjected to an internal pressure of 1 N/mm². Calculate the longitudinal and circumferential stress, change in the length, change in diameter assuming Young's modulus of elasticity \( E = 2 \times 10^5 \) N/mm² and Poisson's ratio \( \nu = 0.3 \).

OR

1* Analyse the pin jointed truss as shown in Fig. 1, to find forces in members CE, CF, BF and EF.

[12]

Fig. 1

2. (a) Following stress tensor is defined w.r.t \((x, y, z)\) axes. Transform this tensor w.r.t new axes \((x', y', z')\) obtained by rotating \((x, z)\) axes in their own plane in anticlockwise direction by 30°.

\[
\begin{bmatrix}
35 & -5 & 3
\end{bmatrix}
\]

[06]

(b) A steel shaft of hollow cross section with outer diameter 180 mm and inner diameter 100 mm is subjected to an axial load of 100 kN and a torque of 35 kNm at free end. Calculate principal stresses at critical cross section. Also, calculate the factor of safety against each of the following failure theories, if yield stress of the material is 150 N/mm² and \( \nu = 0.3 \).

(i) Maximum strain energy theory
(ii) Maximum principal strain theory
(iii) Total strain energy theory

[06]

3(a) A uniform beam of length 4L is simply and symmetrically supported over a span of 2L with an overhang of L on each support. It carries a load of \( W_2 \) at the mid span and a load of \( W_1 \) at each of the overhanging end. Find the ratio of \( W_1 \) and \( W_2 \) if the deflection at the mid span is equal to that at each end.

[06]

3(b) The middle half of a simply supported beam has a moment of inertia twice that of the end half.

[06]
the rest of the beam and is loaded as shown in Fig. 2. Determine the slope at the supports and the mid span deflection in the beam.

**Fig. 2**

**3'**
A simply supported beam AB 8 m long has a uniformly distributed load of 2\(\text{kN/m}\) over its entire length and a concentrated load of 40 kN at 3 m from the support A. Determine the maximum deflection in the beam. Also determine the slopes at ends A and B.

**4. (a)** A cantilever of 4 m span and 250x100 mm uniform cross section, carries a udl of 15 kN/m mm and a point load of 10 kN at free end. Calculate strain energy due to bending and shear separately. Use E = 2x10^5 N/mm\(^2\) and v = 0.3.

**4. (b)** A solid rod of steel, dia. 20 cm is freely held vertical from a fixed support and carries an axial load of 5 kN in addition to its self weight. Calculate strain energy due to applied loads. Assume unit weight of material as 7.8 gm/cc and E = 200 GPa.

**4'** Calculate deflection at D and slope at A for a simply supported beam as shown in Fig. 3. Assume E=2x10^4 N/mm\(^2\), I= 1x10^6 mm\(^4\).

**5(a)** An alloy tube 5 m long elongates 6.4 mm under a tensile load of 60 kN. Calculate the Euler's buckling load for the tube when used as a strut with pin jointed ends. The tube internal and external diameters are 25 and 40 mm respectively.

**5(b)** Determine the ratio of the buckling strengths of a solid steel column to that of a hollow column of the same material and having the same cross sectional area. The internal diameter of the hollow column is \(\frac{3}{4}\) of its external diameter. Both the columns are of same length and are pinned at both ends.
Q. No.  

1. Explain in detail the factors affecting in the planning of a residential building.  

OR  

1'. (a) Explain the byc laws of building and its requirements.  
(b) What do you understand by orientation of building? Explain with neat sketch.  

2. Draw a neat sketch showing all important component of a building in a wall section and define every component up to the D.P.C level.  

3(a) Find out the earth work excavation for the following single line plan of a building. The depth and width of the foundation is 1m and 0.9m respectively. 

[Diagram showing floor plan of a building with dimensions and labels.]

(All dimensions are in m)
3(b) Define shoring. Write down the different types of shoring. Explain raking shores?
OR

3'(a) Write down the construction procedure of bitumen road with neat sketch.
3'(b) Describe in detail any two of the following:
   (i) Scaffolding
   (ii) Cofferdam
   (iii) Underpinning

4 (a) Write down the defects caused by dampness. Also draw the neat sketch of different types of damp proof course.
(b) How pre and post construction anti-termite is carried out in a building? Explain in detail.
OR

(b) Draw the neat sketch of section of a dog-legged stair case and explain the following terms:
   Baluster; Landing; Hand rail; Newel post; Soffit; Tread and Riser

5(a) Describe the important consideration in the fire protection of a residential building?
5(b) Explain the characteristics of fire resisting materials and discuss the fire resisting properties of any two of the following materials:
   (i) Timber
   (ii) Bricks
   (iii) Concrete
   (iv) Steel
Maximum Marks: 60
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Answer all the questions.
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Q.No.          Questions                                           M.M.
1 (a)          What is chaining? Differentiate between Gunter's chain and Revenue chain. [04]
1 (b)          A 30 m steel tape was standardized on the flat ground and was found to be exactly 30 m under no pull at 66°F. It was used in 3-bay method to measure a base of 5 bays. The temperature during measurement was 92°F and the pull exerted during measurement was 10 kg. The area of cross section of the tape was 0.08 sq. cm. The specific weight of the steel is 7.86 g/cm³. Take α = 6.3 × 10⁻⁵ per °F and β = 2.1 × 10⁻⁸ kg/cm². Find the true length of the line. [08]

OR

1' (a)         Discuss the procedure to solve 3-point problem by Tracing paper method. [04]
1' (b)         The following bearings were observed with a prismatic compass at a place where local attraction was suspected.

<table>
<thead>
<tr>
<th>Line</th>
<th>Observed Bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fore bearing</td>
</tr>
<tr>
<td>AB</td>
<td>124° 30'</td>
</tr>
<tr>
<td>BC</td>
<td>68° 15'</td>
</tr>
<tr>
<td>CD</td>
<td>310° 30'</td>
</tr>
<tr>
<td>DA</td>
<td>200° 15'</td>
</tr>
</tbody>
</table>

At what stations do you suspect local attraction? Find the correct bearings of the lines and the included angles. [08]

2 (a)         Briefly describe barometric levelling? [04]
2 (b)         The following consecutive readings were taken with a dumpy level and a 4 m levelling staff on a continuously sloping ground at 30 m intervals.
0.680, 1.455, 1.855, 2.330, 2.885, 3.380; 1.055, 1.860, 2.265, 3.540; 0.945, 1.530 and 2.250.

Enter the readings on a level page and determine the R. L.'s of various stations by collimation method. Apply usual checks. [08]

3 (a)         How do you determine the intervisibility of triangulation stations? [04]
3 (b)         The altitudes of two proposed stations A and B, 80 km apart are respectively 225 m [08]

contd...
and 550 m. The intervening obstruction situated at C, 40 km from A has an elevation of 285 m. Ascertain if A and B are inter-visible, and if necessary, find by how much B should be raised so that the line of sight must not be less than 3 m above the surface of the ground.

OR

3’ From a satellite station S, 5.8 m from the main triangulation station A, the following directions were observed.

<table>
<thead>
<tr>
<th>Observed station</th>
<th>Bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0° 00' 00&quot;</td>
</tr>
<tr>
<td>B</td>
<td>132° 18' 30&quot;</td>
</tr>
<tr>
<td>C</td>
<td>232° 24' 06&quot;</td>
</tr>
<tr>
<td>D</td>
<td>296° 06' 11&quot;</td>
</tr>
</tbody>
</table>

The lengths AB, AC and AD were computed to be 3265.5 m, 4022.2 m and 3086.4 m respectively. Determine the directions of AB, AC and AD.

4 (a) Describe the procedure of setting out a simple circular curve by Rankine’s method of deflection angles.

4 (b) Two straights T1V and VT2 of a road curve meet at an angle of 80°. Find the radius of curve which will pass through a point P, 30 metres from the point of intersection (V), the angle T1VP being 30°.

OR

4’ (a) What are the essential requirements of a transition curve

4’ (b) Two straights AT1 and CT2 meet at V. It is proposed to introduce a reverse curve of radius R having T1 and T2 as tangent points. The angles AT1T2 and V T2T1 measured at T1 and T2 are 45° 30' and 25° 30' respectively. The distance T1T2 is equal to 800 m. Determine the common radius and central angle for two arcs.

5 A four sided traverse ABCD has the following lengths and bearings:

<table>
<thead>
<tr>
<th>Side</th>
<th>Length (m)</th>
<th>Bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>560</td>
<td>Roughly cast</td>
</tr>
<tr>
<td>BC</td>
<td>245</td>
<td>168° 00'</td>
</tr>
<tr>
<td>CD</td>
<td>7</td>
<td>270° 00'</td>
</tr>
<tr>
<td>DA</td>
<td>216</td>
<td>10°</td>
</tr>
</tbody>
</table>

Find the exact bearing of the side AB and length of side CD?

OR

5’ Determine the gradient of the line AB from the following observations:

<table>
<thead>
<tr>
<th>Instrument station</th>
<th>Point sighted</th>
<th>Horizontal angle</th>
<th>Vertical angle</th>
<th>Stadia wire readings (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Upper</td>
</tr>
<tr>
<td>O</td>
<td>A</td>
<td>0° 00' 00&quot;</td>
<td>10° 05' 20&quot;</td>
<td>2.585</td>
</tr>
<tr>
<td>O</td>
<td>B</td>
<td>40° 10' 30&quot;</td>
<td>0° 00' 00&quot;</td>
<td>3.100</td>
</tr>
</tbody>
</table>

Take constants of tacheometer as 100 and 0.