Maximum Marks: 60  Duration: Two Hours

Answer all questions

1.(a) A sphere of density \( \rho \) and radius \( r \) sinks in water to depth \( x \) given by
\[ x^3 - 3\gamma x^2 + 4\gamma^3 \rho = 0. \]
Solve this equation by general iteration method correct to three decimals for \( \gamma = 1, \ \rho = 0.72 \).

OR

(a') Establish an iterative formula to find the reciprocal of natural number \( N \)
and hence find the value of \( \frac{1}{19} \) correct to five decimal.

(b) Solve the following system of equations by Gauss-Seidel method:
\[ 83x + 11y - 4z = 95, \]
\[ 7x + 52y + 13z = 104, \]
\[ 3x + 8y + 29z = 71. \]
Use three iterations.

2.(a) (i) Find the lowest degree polynomial that will fit the following data:

<table>
<thead>
<tr>
<th>( x )</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y = f(x) )</td>
<td>5</td>
<td>9</td>
<td>61</td>
<td>209</td>
<td>501</td>
</tr>
</tbody>
</table>

(ii) Estimate the missing value in the following table

<table>
<thead>
<tr>
<th>( x )</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y = f(x) )</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>-</td>
<td>32</td>
<td>64</td>
<td>128</td>
</tr>
</tbody>
</table>

(b) Using the following table find \( f(x) \) as a polynomial in \( x \), by Newton's divided difference formula

<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 = f(x) )</td>
<td>3</td>
<td>-6</td>
<td>39</td>
<td>822</td>
<td>1210</td>
</tr>
</tbody>
</table>

Hence find \( f(2) \) and \( f'(4) \).

OR

(b') Derive the Simpson's \( \frac{1}{3} \) formula from the general quadrature formula and use it to find an approximate value of \( \pi \) from the formula
\[ \frac{\pi}{4} = \int_0^1 \frac{dx}{1+x^2} \] with \( h = \frac{1}{4} \).

(7+8)
3.(a) Use Taylor's series method to find a series expansion upto $x^5$ for the initial value problem:
\[
\frac{dy}{dx} = y \sin x + \cos x, \quad y(0) = 0, \quad \text{Also find } y(0.2)
\]

(b) Apply fourth order Runge-Kutta method to solve
\[
\frac{dy}{dx} = \frac{(y-x)}{(y+x)} \quad y(0) = 1 \quad \text{for } x = 1 \text{ with } h = 0.5
\]

OR

(b) Solve the boundary value problem
\[
y'' - 64y + 10 = 0
\]
with $y(0) = y(1) = 0$ and $h = \frac{1}{4}$, by finite difference method. (8+7)

4.(a) Evaluate the following transforms:
(i) $L \left[ t^2 e^{-t} \sin 4t + \left( \frac{\cos at - \cos bt}{t} \right) \right]$
(ii) $L^{-1} \left[ \frac{s}{(s^4 + 4s^2)} + \frac{1}{s(s+a)} \right]$ Co-4

(b) Apply convolution theorem to evaluate $L^{-1} \left\{ \frac{1}{s(s^2 - a^2)} \right\}$ Co-4

OR

(b') Using Laplace transform method, solve the following equation
\[
\frac{d^2 y}{dt^2} + 9y = \cos 2t \quad ; \quad y(0) = 1, \quad y \left( \frac{\pi}{2} \right) = -1.
\]
# B.TECH. (WINTER SEMESTER) EXAMINATION
## CIVIL ENGINEERING
### CE 214
#### WATER SUPPLY AND TREATMENT

**Maximum Marks:** 60  
**Credits:** 04  
**Duration:** Two Hours

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

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Differentiate between the water quality of groundwater and surface water.</td>
<td>03</td>
</tr>
<tr>
<td>1(b)</td>
<td>Calculate the concentration of 0.85mM (millimole/liter) solution of calcium in units of mg/L, meq/L, mg/L as CaCO₃</td>
<td>03</td>
</tr>
</tbody>
</table>

OR

<table>
<thead>
<tr>
<th>(b')</th>
<th>Define the pathogens. Name any two pathogenic bacteria, two viruses and one protozoan sometimes found in water supplies.</th>
<th>03</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(c)</td>
<td>What is the carbon monoxide concentration (expressed in µg/m³) of a 10 L gas mixture which contains 1 mole of CO?</td>
<td>03</td>
</tr>
<tr>
<td>1(d)</td>
<td>The solubility product for the dissociation of Mg(OH)₂ is 9x10⁻¹². Determine the concentration of Mg²⁺ and OH⁻ at equilibrium, expressed as milligrams per liter of CaCO₃.</td>
<td>03</td>
</tr>
</tbody>
</table>

OR

<table>
<thead>
<tr>
<th>(d')</th>
<th>One litre of water is analysed found to contain 5.0 mg trichloroethylene (TCE) is diluted with 15 L distilled water. What is the TCE concentration in mg/l and ppb?</th>
<th>03</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(e)</td>
<td>What are the sources of temperature increases in water bodies? What are the impacts of elevated temperatures?</td>
<td>03</td>
</tr>
</tbody>
</table>
2(a) What are the important considerations, which govern the selection of site of an intake structures?

OR

2(a') What are the basic requirements of water distribution system? Explain advantages and disadvantages any two pipe networks system with diagram.

2(b) How the fire demand is calculated by various formulae? Calculate the fire demand for a population of 15 lacs.

2(c) What are the various methods of predicting population of a city? Discuss any three methods?

3(a) Draw the typical water treatment scheme for surface water source. Discuss each unit in brief.

3(b) An industrial wastewater treatment plant discharges 1.5 m³/s of effluent having an ultimate BOD of 30.0 mg/L into a river flowing at 20.0 m³/s just upstream from the discharge point the stream has an ultimate BOD of 2.0 mg/L. Using Streeter – Phelps equation calculate the DO concentration in the stream after a time of travel of 3 days and 9 days. Assume stream temperature 20°C, stream reaccretion rate constant as 0.55/day, saturation DO as 8.5 mg/L and initial deficit as 2 mg/L, deoxygenation constant k_d is estimated at 0.22/day. Also calculate the time and distance and ultimate BOD at which maximum deficit will occur.

4(a) Explain the working of gravity flow filter with the help of diagram. What is the relationship between effective pore size of different types of membrane units and typical size of water contaminant?

4(b) Briefly explain the ion exchange process for calcium and magnesium hardness removal in ground water.

OR

4(b') Discuss the various disinfection process for water treatment. Explain the pH and temperature dependence in chlorination process.
2017-18
B.TECH. EXAMINATION
IVth SEMESTER
CIVIL ENGINEERING
STRUCTURAL MECHANICS
CE 216
Credits: 04

Maximum Marks: 60
Duration: Two Hours

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

Q.No. Question M.M.
1(a) A load $P$ is applied at an eccentricity $e$ from the axis of the column. The details of the column are as follows: 
  - Effective length $l_e$
  - Modulus of elasticity $E$
  - Area of cross-section $A$
  - Section modulus $Z$
  - Maximum compressive stress $\sigma_{\text{max}}$
  Prove:
  \[ \sigma_{\text{max}} = \frac{p}{A} + \frac{Pe \sec \frac{l_e}{Z}\sqrt{E}}{Z} \]

[07]

1(b) Find the greatest length for which a mild steel strut of T-shaped cross-section may be used with one end fixed and the other entirely free to carry a working load of 70 MN/m$^2$ of the section. The working load is one-fourth of the crippling load. The area of cross-section of the strut is 30 cm$^2$ and the least moment of inertia is 240 cm$^4$. Take Rankine's Constant $a = 1/7500$ and $\sigma_c = 330$ MN/m$^2$

[08]

OR

1(b') A masonry chimney of uniform hollow circular section 2.5m outer dia., 1.5m inner dia. is 12m high. The chimney is to carry a wind pressure of 1.5 kN/m$^2$. Calculate the extreme stresses developed at base and check its stability against overturning. Assume unit weight of masonry as 19 kN/m$^3$ and shape factor for the chimney as 0.7.

[08]

2(a) A beam is shown in Fig.1. Determine the displacement at $A$. Assume $B$ is a roller support. Take $E = 200$ GPa and $I = 80 \times 10^6$ mm$^4$. Use moment-area theorems.

[7]
2(a') A beam is shown in Fig. 2. Determine the displacement at C and slope at B. Take $EI$ as constant. Use moment-area theorems.

2(b) A simply supported beam is shown in Fig. 3. Determine the value of $a$ so that the slope at A is equal to zero. Take $EI$ as constant. Use Conjugate beam method.

3. (a) Write equations for stress-strain relation in (x, y) system of axes for homogeneous and isotropic material.

(b) Generalised stresses at a point are given with respect to x-y-z axes as;

\[
\sigma = \begin{bmatrix}
40 & 10 & 0 \\
10 & 30 & 5 \\
0 & 5 & -10
\end{bmatrix}
\]

Transform the stress tensor if X-Y axes are rotated in their own plane about Z-axis in anti-clock wise direction by 30°.
3' (a) The principal stresses at a point are $\sigma$ and $-\sigma$. Using Mohr's circle diagram, find the magnitude of maximum shear stress and orientation of planes of maximum shear.

(b) The planer stresses at a point in some material are given as below:

$\sigma_x = 25 \text{ N/mm}^2$, $\sigma_y = -10 \text{ N/mm}^2$ and $\tau_{xy} = 4 \text{ N/mm}^2$. Check the safety of material against following failure theories.

(i) Maximum Principal Stress theory
(ii) Maximum Shear Stress theory
(iii) Total Strain Energy theory

Also calculate factor of safety in each case. Assume yield stress for the material as 50 N/mm$^2$ and Poisson’s ratio as 0.3.

4(a) A cantilever beam of rectangular cross section 200mm x 300mm and 1.5m long is fixed at one end, kept horizontal and subjected to vertical load of 20 kN at free end. Calculate total strain energy absorbed due to bending, including its self weight of 1.5 kN/m. Assume $E = 200\text{ GPa}$.

4(b) Using Castigliano’s theorem, calculate vertical deflection at free end for the cantilever frame as shown below. Assume $I = 2 \times 10^9 \text{ mm}^4$ and $E = 2 \times 10^4 \text{ N/mm}^2$. 

![Cantilever Beam Diagram](image)
Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q. No. | Question | M. M.
--- | --- | ---
1 (a) | Differentiate between Gunter’s chain and Revenue chain. | [02]
(b) | State advantages and disadvantages of plane table survey. | [03]
(c) | A chain line ABC crosses a river. Points B and C being on the near and distant banks respectively. The respective bearings of C and A taken at D, a point 60m measured at right angles to AB from B are 280º and 190º, AB being 32m. Find the width of the river. | [10]

OR

1'(a) | Differentiate between magnetic meridian and true meridian. | [02]
(b) | Describe the method of orientation of plane table by back sighting method. | [03]

The following bearings were observed in running a closed traverse with a compass. | [10]

<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>76º 05'</td>
</tr>
<tr>
<td>BC</td>
<td>114º 20'</td>
</tr>
<tr>
<td>CD</td>
<td>165º 35'</td>
</tr>
<tr>
<td>DE</td>
<td>224º 50'</td>
</tr>
<tr>
<td>EA</td>
<td>304º 50'</td>
</tr>
</tbody>
</table>

At what station (s) do you suspect local attractions? Determine the correct magnetic bearings. If the magnetic declination was 5º 10' W, what is the true bearing of line EA?

2 (a) | Define sensitiveness of bubble tube. If the bubble tube of a level has a sensitiveness of 30 seconds per 2 mm division, find the error in staff reading on a vertically held staff at a distance of 150 m, caused by a bubble 2 divisions out of the centre. | [03]
(b) | What do you mean by permanent adjustment of level? Describe adjustment of cross hair ring of a dumpy level. | [04]
The following notes refer to the reciprocal levels taken with one level:

<table>
<thead>
<tr>
<th>Instrument at</th>
<th>Staff reading on</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>1.156</td>
<td>2.597</td>
</tr>
<tr>
<td>B</td>
<td>0.987</td>
<td>2.418</td>
</tr>
</tbody>
</table>

Find (a) the true reduced level of B (b) the combined correction for curvature and refraction and (c) the error in the collimation adjustment of the instrument.

3 (a) Differentiate between equilibrium and deficient cant.

(b) What do you mean by a vertical curve? Classify various types of vertical curves with suitable sketches.

(c) A road bend which deflects 85° is to be designed for maximum speed of 80 Km/h with a curve consisting of a circular arc combined with two cubic spirals. If the maximum centrifugal ratio is ¼ and the maximum rate of change of radial acceleration is 0.3 m/s²/s, calculate (a) Radius of the circular curve (b) Length of the transition curve (c) Total length of the combined curve and (d) Chainages of the salient points, if the chainage of point of intersection is 1550.40 m.

OR

3'(a) Define centrifugal ratio. How the design speed and minimum radius are related to each other for highway and railway curves?

3' (b) Explain the method of layout of simple circular curve by Rankine’s method of tangential angles.

4 (a) Briefly describe the objectives of theodolite traversing.

OR

4'(a) Explain reduction to centre in triangulation survey.

(b) For the following traverse, compute the length of CD so that A, D and E may be in one straight line.

<table>
<thead>
<tr>
<th>Line</th>
<th>Length (m)</th>
<th>Bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>110</td>
<td>83° 12' 00&quot;</td>
</tr>
<tr>
<td>BC</td>
<td>165</td>
<td>30° 42' 00&quot;</td>
</tr>
<tr>
<td>CD</td>
<td>?</td>
<td>346° 06' 00&quot;</td>
</tr>
<tr>
<td>DE</td>
<td>212</td>
<td>16° 18' 00&quot;</td>
</tr>
</tbody>
</table>
Q.No.          Question                                                                                                   M.M.  
1(a)          Explain the application of hydrology in water resources engineering. What are the essential requirements for precipitation to occur? [05]  
1(b)          Explain in detail the tipping bucket type recording raingauge. The annual rainfall of station X, and the average annual rainfall of 10 surrounding base stations in cm are given below for a period of 30 years starting from 1945. Check the consistency of data of station X. If data is found inconsistent, then correct the inconsistent data. [10]  

<table>
<thead>
<tr>
<th>Year</th>
<th>Rainfall at X (cm)</th>
<th>Average rainfall of base stations (cm)</th>
<th>Year</th>
<th>Rainfall at X (cm)</th>
<th>Average rainfall of base stations (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1945</td>
<td>126</td>
<td>123</td>
<td>1960</td>
<td>95</td>
<td>142</td>
</tr>
<tr>
<td>1946</td>
<td>120</td>
<td>90</td>
<td>1961</td>
<td>106</td>
<td>92</td>
</tr>
<tr>
<td>1947</td>
<td>153</td>
<td>138</td>
<td>1962</td>
<td>81</td>
<td>91</td>
</tr>
<tr>
<td>1948</td>
<td>172</td>
<td>119</td>
<td>1963</td>
<td>116</td>
<td>131</td>
</tr>
<tr>
<td>1949</td>
<td>127</td>
<td>108</td>
<td>1964</td>
<td>112</td>
<td>104</td>
</tr>
<tr>
<td>1950</td>
<td>108</td>
<td>107</td>
<td>1965</td>
<td>80</td>
<td>97</td>
</tr>
<tr>
<td>1951</td>
<td>126</td>
<td>111</td>
<td>1966</td>
<td>88</td>
<td>111</td>
</tr>
<tr>
<td>1952</td>
<td>190</td>
<td>142</td>
<td>1967</td>
<td>85</td>
<td>114</td>
</tr>
<tr>
<td>1953</td>
<td>112</td>
<td>112</td>
<td>1968</td>
<td>90</td>
<td>92</td>
</tr>
<tr>
<td>1954</td>
<td>97</td>
<td>99</td>
<td>1969</td>
<td>120</td>
<td>146</td>
</tr>
<tr>
<td>1955</td>
<td>86</td>
<td>93</td>
<td>1970</td>
<td>72</td>
<td>93</td>
</tr>
<tr>
<td>1956</td>
<td>111</td>
<td>131</td>
<td>1971</td>
<td>113</td>
<td>138</td>
</tr>
<tr>
<td>1957</td>
<td>68</td>
<td>92</td>
<td>1972</td>
<td>82</td>
<td>112</td>
</tr>
<tr>
<td>1958</td>
<td>88</td>
<td>142</td>
<td>1973</td>
<td>116</td>
<td>117</td>
</tr>
<tr>
<td>1959</td>
<td>112</td>
<td>123</td>
<td>1974</td>
<td>122</td>
<td>152</td>
</tr>
</tbody>
</table>

OR

1'(b) Describe the procedure for finding average depth of rainfall through Isohyetal method. A semi circle of diameter 20 Km with an equilateral triangle of side 20 Km below its diameter is a close approximation to a river basin. The position coordinates of 5 rain gauge stations...
A, B, C, D and E located within the basin with respect to a coordinate axes system whose X-axis and origin are coincident with diameter and centre of the circle are (5,5), (-5,5), (-5,-5), (5,-5) and (0,0) Km respectively. If the rainfall recorded at these rain gauges are 85, 90, 75, 80, and 105 mm respectively, determine the average depth of rainfall using Thiessen polygon method.

2(a) List the various methods available to estimate evaporation losses from surfaces of large water bodies. Describe the Lysimeter used to estimate the evapotranspiration.

2(b) What do you mean by infiltration. The initial infiltration capacity of a watershed is estimated as 4.0 cm/hr, and the Horton's time constant taken to be 0.35/hr. The equilibrium capacity is estimated as 0.5 cm/hr. (a) Plot an infiltration capacity versus time curve. (a) What are the values of \( t \) at 10 min, 30 min, 1 hr, 6 hr, and 8 hr, and (b) what is the total volume of infiltration over the 6 hour time period?

3(a) Give step-wise procedure of developing a flow duration curve and also discuss its significance.

3(b) The ordinates of a 2-h unit hydrograph are given below:

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>20</th>
<th>22</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-h UH ordinates (m³/s)</td>
<td>0</td>
<td>10</td>
<td>45</td>
<td>75</td>
<td>68</td>
<td>56</td>
<td>41</td>
<td>28</td>
<td>15</td>
<td>11</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Derive the ordinates of a 4 hour unit hydrograph using S-curve technique. Also compute the ordinate of resulting flood hydrograph, if a rainfall excess of 3 cm occurs in 4 hours in the same catchment. A constant base flow of 5 m³/s may be assumed.

OR

3'(b) Discuss the factors, which affect the rising limb of hydrograph. Give step-wise procedure for developing a Synthetic unit hydrograph for an ungauged catchment.

4(a) Differentiate between aquitard and aquifer. Derive the equation for steady state discharge through a well in an unconfined aquifer.

OR

4'(a) What is the significance of flood routing? Differentiate between reservoir and channel routing.

4(b) Differentiate between specific yield and specific retention. A 20 cm diameter tubewell taps an artesian aquifer. Find the yield for a drawdown of 3.0 m at the well. The length of strainer is 30 m and coefficient of permeability of aquifer is 30 m/day. Assume the radius of influence of the well as 300 m.

If, all other conditions remain same, find the percentage change in the yield under following cases.

(a) The diameter of well is 40 cm (b) The drawdown is 6.0 m