Maximum Marks: 60

Duration: Two Hours

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

Q.No. Question M. M
1(a) Explain surface & body forces with the help of examples [05]
1(b) Prove that \( G = \frac{E}{2(1+v)} \) [05]
1(c) The intensity of body force fields on a cubical mass of size 10 cm, in the three directions are given as:
\[
X = \rho g y + \rho g z
\]
\[
Y = \frac{1}{2} \rho g x + \rho g z
\]
\[
Z = -\rho g
\]
If \( \rho = 7.5 \text{ g/cm}^3 \), find the body force in three directions and their resultants. [05]
2(a) Investigate what problem is solved by this stress function
\[
\phi = -\frac{F}{d^3} xy^2(3d - 2y)
\]
Applied to the region included in y=0, y=d, x=0, on the side x positive. [05]
2(b) Derive the equation of equilibrium for 2D-element in polar coordinate system. [10]

OR

2'(a) If a bar is stretched in such a manner that all the lateral strains are prevented. Find the modified value of Modulus of Elasticity. [05]
2'(b) For a cantilever subjected to concentrated load at the free end, obtain all the three stress components [10]

3(a) Explain what do mean by Lames Stress Ellipsoid. What are its geometrical properties? [07]
3(b) The bending moment \( M \) applied to a solid shaft carries a maximum direct stress \( f_y \) at elastic failure. Determine the numerical relationship between \( M \) and twisting moment \( T \) which, acting alone on the shaft, will produce elastic failure according to different theories of failure. [07]

....Cont 2
3(c) Write short notes on any two of the following
i. Tangent and Plastic Modulus
ii. Friction Block model with relation to plasticity
iii. Difference between Plastic and Visco-elastic materials

4 The terms $\varepsilon_{ij}$ represents a given stress tensor as shown. If another strain
tensor $\varepsilon_{ni}$ is formed by rotating x,y,z axes about z-axis, through 30 °,
find the $\varepsilon_{ni}$ and invariants of both the tensors. Show that they are equal, i.e
$J_1,J_2,J_3$ for $\varepsilon_{ij}$ are equal to $J'_1,J'_2,J'_3$ for $\varepsilon_{ni}$.

\[
\varepsilon_{ij} = \begin{bmatrix}
0.01 & 0 & 0 \\
0 & 0.02 & 0.02 \\
0 & 0.02 & 0.01 \\
\end{bmatrix}
\quad a_{ni} = \begin{bmatrix}
\sqrt{3}/2 & 1/2 & 0 \\
-1/2 & \sqrt{3}/2 & 0 \\
0 & 0 & 1 \\
\end{bmatrix}
\]

OR

4' The state of strains at a point is given by a strain tensor $\varepsilon_{ij}$. If the axes are rotated about y-axis so that $a'_{x'y'} = 0.6$ and $a'_{x''} = 1$, find all the components of the $\varepsilon_{ni}$ and the invariants of $\varepsilon_{ij}$ and $\varepsilon_{ni}$.

\[
\varepsilon_{ij} = \begin{bmatrix}
0.01 & -0.02 & 0 \\
-0.02 & 0.03 & -0.01 \\
0 & -0.01 & 0 \\
\end{bmatrix}
\quad a_{ni} = \begin{bmatrix}
0.6 & 0 & -0.8 \\
0 & 1 & 0 \\
0.8 & 0 & 0.6 \\
\end{bmatrix}
\]
Maximum Marks: 60  
Credits: 04  
Duration: Two Hours

Note: Answer all the questions.  
Assume suitable data, if required.  
Notations used have their usual meaning.  
Programmable calculators (with extra memory storage) are not permitted.

Q. No.  
Questions  
M. M.

1(a) Derive expressions for the curvature and twist of a plate, and represent on Mohr’s circle.  
1(b) What do you understand by principal bending moments and principal curvatures of a plate?  

1' A rectangular plate \( a \times 2a \), simply supported on all four edges, is subjected to 
loading \( q, \sin^\frac{na}{a} \sin^\frac{ny}{a} \). Using Navier method, find the central deflexion of the plate, 
the maximum bending moment per unit length, the distribution of reactive forces 
along the edges, and the concentrated forces needed at the corners to prevent the 
corners from rising.  

2 A rectangular plate \( a \times b \) is simply supported at \( x = 0 \) and \( x = a \), and firmly built at 
\( y = 0 \) and \( y = b \). The intensity of load increases linearly from zero as \( y \) increases. 
Whereas, along \( x \) – direction, load remains non-varying. Using Levy’s method, find 
the general equation and its solution \( w \).

OR

SHELL STRUCTURES

3(a) Explain the different types of shell surfaces used in the construction of shell structures.  

3(a) Plot the distribution of membrane forces in a simply supported circular cylindrical 
shell subjected to uniform snow load.  

3(b) A reinforced concrete shell having semi-circular directrix is freely supported between 
the traverses separated by a distance of 3.5m. If the radius and thickness of the shell 
are 10m and 60mm respectively, calculate the membrane forces at the crown and 
edges due to its self weight and a snow load of 1.25 kN/m². Analyse the shell for 
maximum stress. Also determine the maximum bending moment and maximum tensile 
force developéd in the edge member.
4(a) Derive Donnell’s equation in terms of $w$ using Flugge’s differential equation for a thin cylindrical shell. Obtain DKJ’s characteristic equation and find its roots. [12]

4'(a) Using Fourier series, derive expressions for stress resultants for a simply supported thin circular shell subjected to snow load. [12]

4(b) State boundary conditions for an end shell with asymmetric support conditions at $\phi = 0^\circ$. [03]
2016-17  
M.TECH. AUTUMN (I SEMESTER) EXAMINATION  
CIVIL ENGINEERING  
(STRUCTURAL ENGINEERING)  
ADVANCED STRUCTURAL ANALYSIS  
(CE-604)

Maximum Marks: 60  
Duration: Two Hours

Answer all questions.  
Assume suitable data, if missing.  
Notations used have their usual meanings.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A continuous beam ABC is shown in Fig. 1. Find the redundant forces using force method. Take EI constant. OR</td>
<td>[15]</td>
</tr>
<tr>
<td>1'</td>
<td>Analyse the pin jointed plane truss shown in Fig. 2. using force method. The number in parentheses are the cross-sectional areas of the members in cm². Take ( E = 2 \times 10^3 ) N/mm².</td>
<td>[15]</td>
</tr>
<tr>
<td>2</td>
<td>A frame is shown in Fig. 3. Find the redundant forces using flexibility method. Take EI constant</td>
<td>[15]</td>
</tr>
<tr>
<td>3</td>
<td>Analyse the portal frame shown in Fig. 4 by using stiffness method and plot the bending moment diagram. OR</td>
<td>[15]</td>
</tr>
<tr>
<td>3'</td>
<td>Derive the elements of stiffness matrix for the portal frame with inclined legs.</td>
<td>[15]</td>
</tr>
<tr>
<td>4</td>
<td>Find out the forces in the members of the pin jointed plane truss shown in Fig. 5 by using stiffness method if the hinge support D settles down by 0.50mm. The cross sectional area of each member is 20 cm². Take ( E = 200)kN/mm².</td>
<td>[15]</td>
</tr>
</tbody>
</table>

contd...2.
Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.  Question  M.M.
1 (a)  Write the advantages of pre-stress concrete construction over the other forms of construction.  [05]
1 (b)  Explain creep of concrete and steel. Also mention factors affecting them.  [05]
1 (c)  A pre-stressed concrete beam 150 mm x 300 mm supports a live load 18 kN/m over an effective span of 12 m. The tendons are housed in a duct at a distance of 100 mm from the soffit of the beam. Determine increase in the stress is steel due to loading if:
   (i) Duct is un-grouted
   (ii) Duct is grouted
   (Take $E_s=200 \text{ GPa}$ and $E_c=35 \text{ GPa}$)
   [05]

OR

1' (a)  With the help of an example, prove that variation in stresses obtained by considering nominal and equivalent cross section in a pre-tensioned concrete beam is almost insignificant.  [05]
1' (b)  Design a pre-stressed concrete beam to support a live load 20 kN/m over a span of 12 m, if overall loss of pre-stress is 20%.  [10]
2 (a)  Explain, how the ultimate shear resistance capacity of a pre-stressed concrete beam is determined?  [05]
2 (b)  A pre-stressed concrete beam 250 mm x 450 mm is required to support a live load of 15 kN/m over a span of 10 m in addition to a central concentrated load of 55 kN. The compressive pre-stress at the centroidal axis is 5.5 MPa. Design suitable shear reinforcement for the beam.  [10]

Contd... 2.
3. (a) Discuss ‘Tension Stiffening Effect’ in RC flexural members. How the effective curvature is determined, based on concept of tension stiffening as adopted by new version of British code.

3. (b) A reinforced concrete beam of cross section 300mm x 450mm is simply supported over 5 m span, and reinforced with 5#.20Ø in tension and 2#.20Ø in compression zones. The beam is subjected to a permanent DL of 3.75 kN/m and LL of 15 kN/m over its complete span. Calculate deflection due to creep for 28 days of loading age. Assume M25 mix concrete, Fe415 steel.

OR

3. (b’) Calculate probable crack width in a one-way RC slab, simply supported over a span of 4.5 m 200 mm thick and reinforced with 10mm dia. Deformed steel bars (Fe 415 steel) @ 125 mm c/c with a clear cover of 30 mm. The slab carries a uniformly distributed DL of 5 kN/m² and a LL of 4 kN/m², out which 2 kN/m² is a permanent LL.
Assume modular ratio as 11, E=200 GPa, allowable stress in steel as 230 MPa. Use IS code method or Gergely Lutz method.

4. (a) Discuss assumptions in yield line theory and comment on their validity

4. (b) A square RC slab 5mx5m in plan and 160 mm thick, supported on four columns of size 400 mm x 400 mm, one on each corner, without edge beams, is isotropically reinforced and subjected to u.d.l. of w kN/m² over its complete area. Using Yield Line method of analysis, determine the correct Yield line pattern and determine ultimate moment of resistance.
M.TECH. (AUTUM SEMESTER) EXAMINATION  
(CIVIL ENGINEERING)  
(HYDRAULIC STRUCTURES)  
DESIGN OF IRRIGATION WORKS  
(CE-611)

Maximum Marks: 60  
Credits: 04  
Duration: Two Hours

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

Q.No.  Question  M.M.
1  Differentiate between meter and non-meter straight glacis fall. Design the crest of a straight glacis flumed meter fall for the data given below:  [15]
   Full supply discharge of the canal = 750 cumec
   Upstream bed level of canal = 360.0 m
   Downstream bed level of canal = 358.50 m
   Upstream full supply level of canal = 362.0 m
   Downstream full supply level of canal = 360.5 m
   Bed width of canal u/s and d/s = 40.0 m
   Safe exit gradient for canal material = 1/6
   Drop = 1.50 m

OR

1' Differentiate between sub-critical and super-critical flow transitions.  [15]
A rectangular channel carries a flow with a Froude number of 6.0 in a 5.0 m wide channel with a depth of flow 0.75 m. It is required to reduce the width to 2.5 m. Design a contraction and determine all the elements of the transition. Also, determine the energy loss in the transition. Curves required in the design are attached.

2 Design Expansion transition by Vittal and Chiranjeevi's method for the following data  [15]
   Full supply discharge of the canal = 300.0 cumec
   Normal bed width of canal = 24.0 m
   Flumed bed width of canal = 16.0 m
   Side slope M0=bed level of canal = 270.0 m

cont'd on 2.
Depth of flow in canal = 6.70m

OR

2' Design Hinds’s contraction transitions for the following data collected from the site of a cross drainage work. Assume that the flumed width is half of the normal bed width of canal and consider suitable splay for contraction transition.

High flood discharge = 260.0 cumec
High flood level = 246.0 m
High flood depth = 2.40 m
Full supply discharge = 42.0 cumec
Normal bed width of canal = 20.0 m
Full supply depth = 1.50 m
Full supply level = 250.0 m

3 Show the hydraulic jump calculations for the following data pertaining to the other barrage portion;
(i) Maximum discharge intensity on weir crest = 15 cumec/m
(ii) Level of u/s TEL = 225.16 m
(iii) Level of d/s TEL after retrogression = 224.62 m
(iv) Crest level = 222.45 m
(v) Anticipated d/s water level at pond level conditions = 221.35 m
(vi) Pond level = 224 m
Make suitable assumptions wherever necessary

4 Design Bell’s Guide bund using the following data:
Maximum discharge = 8000 cumec
Highest flood level = 254.0 m
River bed level = 251.5 m
Average diameter of river bed material = 0.30 mm.

OR

4' Design the longest tunnel of sediment excluder for the data given below:
Canal discharge = 280 cumec
Width of under sluices span of the barrage, where canal regulator to be provided With an excluder = 15.0 m
River bed slope = 1/3900
Average sediment diameter = 0.30 mm
Head available for design = 0.8 m
Manning’s rugosity coefficient = 0.016
ENERGY OF FLOW CURVES

Brench curves
Curve A

$F_3 = 1$

Variation of $\theta$ in contraction (Ref. 7)

$E_3/E_1$

$\theta$ in degrees

Third parameter = $F_1$

Variation $\beta_s$ in an oblique shock

$$\tan \theta = \frac{\tan \beta_s (\sqrt{3} + \sqrt{1 + 8F_1^2 \sin^2 \beta_s})}{2 \tan^2 \beta_s - 1 + \sqrt{1 + 8F_1^2 \sin^2 \beta_s}}$$
2016-17
M. TECH. (I) SEMESTER EXAMINATION
(CIVIL ENGINEERING)
HYDRAULIC STRUCTURES
RESERVOIR ENGINEERING
(CE-612)
Maximum Marks: 60
Credits: 04
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) | Describe various zones in a reservoir with a neat sketch. | [05]
1(b) | An expression for the area-elevation at a proposed reservoir is given below. A = \(0.460E^2 - 88.36E + 4447\) Where A is the area in hectare and E is the elevation in m. Compute the storage capacity for each elevation in the range of 100m – 150m with an interval of 10m using Simpson rule. | [10]

OR

1’ | The annual yields of a basin in Mm\(^3\) observed for a period of 19 years from 1971 to 1989 are recorded as 832, 672, 488, 1632, 608, 1128, 960, 560, 880, 984, 640, 832, 696, 632, 896, 464, 688, 432 and 1440 respectively. Determine (i) 75% dependable yield, (ii) 50% dependable yield and (iii) dependability of 1300 Mm\(^3\). | [15]

2(a) | Explain Sequent Peak Algorithm for the estimation of reservoir capacity for given demand. | [03]

2(b) | Determine the storage of the reservoir to meet demands with the following data: | [12]

<table>
<thead>
<tr>
<th>Month</th>
<th>Average monthly runoff (m(^3)/s)</th>
<th>Rainfall (mm)</th>
<th>Monthly demand (Mm(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>22.60</td>
<td>20.00</td>
<td>28.50</td>
</tr>
<tr>
<td>Feb</td>
<td>18.50</td>
<td>25.00</td>
<td>32.00</td>
</tr>
<tr>
<td>March</td>
<td>13.20</td>
<td>10.00</td>
<td>34.00</td>
</tr>
<tr>
<td>April</td>
<td>9.00</td>
<td>7.00</td>
<td>39.00</td>
</tr>
<tr>
<td>May</td>
<td>7.20</td>
<td>4.00</td>
<td>35.00</td>
</tr>
<tr>
<td>June</td>
<td>22.80</td>
<td>130.00</td>
<td>37.70</td>
</tr>
<tr>
<td>July</td>
<td>90.00</td>
<td>225.00</td>
<td>29.00</td>
</tr>
<tr>
<td>August</td>
<td>97.50</td>
<td>190.00</td>
<td>32.00</td>
</tr>
<tr>
<td>Sept</td>
<td>72.00</td>
<td>205.00</td>
<td>27.00</td>
</tr>
<tr>
<td>Oct</td>
<td>36.00</td>
<td>10.00</td>
<td>25.00</td>
</tr>
<tr>
<td>Nov</td>
<td>31.70</td>
<td>40.00</td>
<td>23.20</td>
</tr>
<tr>
<td>Dec</td>
<td>26.40</td>
<td>35.00</td>
<td>27.00</td>
</tr>
</tbody>
</table>

Remarks:
- Downstream riparian rights require the release of natural flow or 20 Mm\(^3\) in each month whichever is less.
- Submergence area = 60 sq. Km
- Runoff Coefficient = 0.55
3 Distribute pattern of sediment in the reservoir at project site with the following data:

<table>
<thead>
<tr>
<th>Elevation (m)</th>
<th>Original Area (Ha)</th>
<th>Original Capacity (Mm³)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>272.50</td>
<td>13562.00</td>
<td>1875.00</td>
<td>Rate of Silt load = 9 Ha.m / 100 sq. Km / year</td>
</tr>
<tr>
<td>270.00</td>
<td>11512.00</td>
<td>1561.44</td>
<td>Reservoir Life = 50 years</td>
</tr>
<tr>
<td>266.00</td>
<td>9579.00</td>
<td>1134.95</td>
<td>Catchment Area = 8200 sq. Km.</td>
</tr>
<tr>
<td>262.00</td>
<td>7780.00</td>
<td>736.00</td>
<td>Method : Area Increment method</td>
</tr>
<tr>
<td>258.00</td>
<td>5622.00</td>
<td>532.42</td>
<td></td>
</tr>
<tr>
<td>254.00</td>
<td>4246.00</td>
<td>332.81</td>
<td></td>
</tr>
<tr>
<td>250.00</td>
<td>2957.00</td>
<td>188.98</td>
<td></td>
</tr>
<tr>
<td>246.00</td>
<td>1904.00</td>
<td>95.11</td>
<td></td>
</tr>
<tr>
<td>242.00</td>
<td>1085.00</td>
<td>38.00</td>
<td></td>
</tr>
<tr>
<td>238.00</td>
<td>306.00</td>
<td>6.81</td>
<td></td>
</tr>
<tr>
<td>234.00</td>
<td>39.00</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>230.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
</tbody>
</table>

OR

3' Explain silt sampling method for the silt load estimation and estimate the sediment load at project site using various approaches with the following data:
- Catchment area = 1830 sq. Km.
- Width of reservoir at FRL = 560.0 m
- River slope = 0.006

<table>
<thead>
<tr>
<th>Year</th>
<th>82</th>
<th>83</th>
<th>84</th>
<th>85</th>
<th>86</th>
<th>87</th>
<th>88</th>
<th>89</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow (Mm³)</td>
<td>2210</td>
<td>1290</td>
<td>1640</td>
<td>1780</td>
<td>2150</td>
<td>1980</td>
<td>2540</td>
<td>1285</td>
<td>1620</td>
</tr>
</tbody>
</table>

4(a) Explain the concept of risk and reliability. Discuss criteria for the selection of design return period

4(b) The annual peak discharge of a river follows the Gumbel's extreme value distribution with a mean of 11000 m³/s and a standard deviation of 15500 m³/s. What is the probability that the annual peak discharge is more than 15000 m³/s? What is the magnitude of the peak discharge with an exceedance probability of 0.1

OR

4' A reservoir has the following elevation (m), outflow (m³/s) and storage (Mm³) relationship.

<table>
<thead>
<tr>
<th>Elevation</th>
<th>100.00</th>
<th>100.50</th>
<th>101.00</th>
<th>101.50</th>
<th>102.00</th>
<th>102.50</th>
<th>103.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outflow</td>
<td>0</td>
<td>10</td>
<td>26</td>
<td>46</td>
<td>72</td>
<td>100</td>
<td>116</td>
</tr>
</tbody>
</table>

When the reservoir level was at 100.5m, the following hydrograph enters the reservoir

<table>
<thead>
<tr>
<th>Time (hour)</th>
<th>0</th>
<th>6</th>
<th>12</th>
<th>18</th>
<th>24</th>
<th>30</th>
<th>36</th>
<th>42</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge (m³/s)</td>
<td>11</td>
<td>21</td>
<td>56</td>
<td>80</td>
<td>73</td>
<td>58</td>
<td>47</td>
<td>37</td>
</tr>
</tbody>
</table>

Route the flood by I.S.D. method and obtain outflow hydrograph.
Maximum Marks: 60

Credits: 04

Duration: Two Hours

Q.No.

Question

M.M.

[15]

1. Write short notes on:
   
   (a) Properties of an individual sedimentary particle
   
   (b) Sediment erosion and its control
   
   (c) Meander formation theories

OR

1'(a) What are the assumptions made in Stokes' law? A sediment particle has a diameter of 1.5 mm and specific gravity 2.65. Find the terminal fall velocity of sediment particle in water at 20°C.

[06]

1'(b) Comment on practical significance of incipient motion condition of sediment transport in alluvial channels.

A wide stream has a sediment bed of median size 0.30 mm and the slope of the channel is 1.6x10⁻⁴. If the depth of flow in the channel is 0.25 m, examine whether the bed particles will be in motion or not? (Use Shields curve).

[09]

2 (a) Discuss resistance to flow in alluvial channels. An alluvial stream (d = 0.60 mm) has a bed slope of 3x10⁻⁴. Find the mean velocity of flow using Einstein & Barbarossa method when the hydraulic radius is 1.45 m.

[07]

2 (b) An irrigation canal has to be designed for hydraulic radius = 2.50 m and slope = 1.5 x10⁻⁴. If the sediment on the bed has a median size of 0.25 mm, find (i) the bed condition that may be expected (ii) the height and spacing of undulations and (iii)

Contd...
the advance velocity of bed forms. Assume depth of flow and mean velocity of flow to be 2.80 m and 0.95 m/s respectively.

OR

2'(a) Write a note on characteristics frequency curve of sediment sample. [05]

2'(b) The cumulative size distribution of bed material in the river Yamuna is given below [10]

<table>
<thead>
<tr>
<th>Particle diameter (mm)</th>
<th>0.01</th>
<th>0.025</th>
<th>0.05</th>
<th>0.10</th>
<th>0.25</th>
<th>0.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative (% finer)</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>40</td>
<td>70</td>
<td>100</td>
</tr>
</tbody>
</table>

Determine the Geometric Mean Size, Geometric Standard Deviation, Quartile Geometric Skewness and Sorting Coefficient of the bed material.

3(a) Design a stable channel in alluvium to carry a discharge of 32 cumec with sediment load concentration of 40 ppm by weight. The average grain size of the bed material is 0.22 mm. Assume the cross section of the channel as trapezoidal with side slopes 1 (H) : 1(V). [07]

3(b) An alluvial channel has a median size of 0.28 mm, velocity of flow of 1.32 m/s, longitudinal slope of $1.67 \times 10^{-4}$ and depth of flow 0.65 m. Compute the total bed material load using Engelund and Hansen method. [08]

4(a) Describe the modes of sediment transport in alluvial streams. Determine the bed load transport in an alluvial stream for the following conditions:
- Depth of flow = 2.8 m
- Velocity of flow = 1.4 m/s
- Average slope of water surface = $5 \times 10^{-4}$
- Mean size of sediment = 2.0 mm
- Specific gravity of sediment = 2.65

4(b) A wide alluvial channel has a bed slope of 1 in 4800 and a depth of flow 1.8 m. Suspended load sampling at a height of 0.35m above the bed revealed a concentration of 900 ppm by weight, consisting of sediment particles having a fall velocity of 0.06 m/s. Estimate and plot the suspended load concentration at levels 0.6 m, 0.9 m, 1.2 m and 1.8 m from the channel bed.
Predictor for Regimes of Flow in Alluvial Channels

Shields Curve for Incipient Motion Condition
Einstein and Barbarossa relation between $U/U_1$ and $\psi'$
3.(b) Analyse the cylindrical arch dam under the uniform loading with the following data:
\( \alpha = 60^\circ \), \( r_e = 36 \text{ m} \), \( t = 6.0 \text{ m} \), \( h = 30.0 \text{ m} \).
Modulus of elasticity, \( E_m = 2.11 \times 10^9 \text{ Kg/m}^2 \).
Temperature drop = 12 \(^\circ\) F.
Coefficient of thermal expansion, \( C_T = 6 \times 10^{-6}/\text{O}^\circ \text{F} \).
Shear factor \( n = 2.8 \).
Neglect foundation terms and factors.

4.(a) List the advantages of buttress dam as compared to the conventional gravity dam.

(b) A 100 m high flat deck type buttress dam has a buttress spacing of 20 m and U/S inclination 45\(^\circ\). Assume \( f_c = 450 \text{ t/m}^2 \), \( W_o = 2.4 \text{ t/m}^3 \), determine the shape of buttress and required concrete thickness. Minimum thickness of unit column is 2.0 m. Assume water is stored up to the top of the dam and frictionless joint of deck and buttress.
2016-2017
M.TECH. AUTUMN (I SEMESTER ) EXAMINATION
(CIVIL ENGINEERING)
(HYDRAULIC STRUCTURES)
RIGID DAM
(CE-614)

Maximum Marks: 60
Duration: Two Hours

Note: (i) Answer all questions
(ii) Assume suitable data if not given
(iii) All symbols have their usual meanings

1. Check the stability of a dam section 40 m high with U/S face vertical. D/S face vertical from top to a depth of 0.5 m and then a uniform slope of 0.8 H : 1V up to the base of the section. The top width of the section is 0.5 m. Assume reservoir full conditions with a free board of 2.0 m. Take earthquake acceleration coefficient, \( \alpha = 0.15 \). Assume \( C_m = 0.73 \), \( W_c = 2.4 \text{ t/m}^3 \), \( q = 14 \text{ Kg/cm}^2 \).

OR

1'(a) Design the first two zones of a non overflow section of a concrete gravity dam of height 80 m. Fetch of the reservoir is 20 Km and wind velocity is 80 Km/hour.

1'(b) Discuss the effect of horizontal and vertical acceleration due to earthquake in the design of concrete gravity dam.

2. Derive the relationship for shear stress distribution at the base of a concrete gravity dam.

(b) Determine the distribution of shear stress at the base of a dam of top width, \( T = 173.0 \text{m} \), for the following data:
   (i) Normal vertical stress at heel, \( \sigma_{zu} = 103 \text{ t/m}^2 \).
   (ii) Normal vertical stress at toe, \( \sigma_{zd} = 289.55 \text{ t/m}^2 \).
   (iii) Total water pressure at the u/s face, \( P_u = 206 \text{ t/m}^2 \).
   (iv) No tail water.
   (v) Total horizontal force, \( H = 27000.00 \text{ tonnes} \).
Slope at u/s, \( \tan \phi_u = 0.1 \) and slope at d/s, \( \tan \phi_D = 0.85 \).

3. Using elastic theory of design of an arch dam, derive the equations for crown deflections, neglect the foundation terms.

(b) write short note on site selection of an arch dam

OR

3'(a) Describe the step by step procedure of designing of an arch dam by Cain's method.
Q.No. Questions
1. Derive expressions for estimating the efficiency in controlling seepage in earth and rockfill dams using
   a) Impervious blanket of finite length and
   b) Impervious blanket of infinite length.
   OR
1'. For the dam section shown in Fig.1 determine (i) suitable length of blanket, (ii) head lost up to the end of blanket, (iii) percentage reduction in seepage due to the provision of blanket and (iv) draw uplift pressure diagram. The permeability of foundation and blanket materials are $5 \times 10^{-3} \text{cm/s}$ and $1 \times 10^{-3} \text{cm/s}$ respectively.

2. Discuss the various causes of cracking of embankment dams. Suggest the preventive and remedial measures to control the cracking problems. Also discuss the influence of types of soil in distinguishing the longitudinal and transverse cracking patterns in earth and rockfill dams.

3(a). Discuss various methods of drainage facilities provided in embankment dams accomplished by one or a combination of other methods.

3(b). Describe anyone piezometer used in monitoring the safety of an earthen dam.

4(a). Discuss location of core in dam sections with clear sketches as well as the relative advantages and disadvantages of vertical and sloping cores.

4(b). Discuss the use of geotextiles as filter material in embankment dams. Also discuss its use in bank stabilisation, slope protection and foundation treatment as per global practice.
   OR
4'(a). Explain the components of single-stage as well as two-stage river diversion works with neat sketches.

4'(b). Enumerate some important embankment dams indicating their heights and reservoir capacity. Discuss the criteria of safe design of an embankment dam.
2016-2017

M. TECH. (1-SEMESTER) EXAMINATION
CIVIL ENGINEERING
Water Reclamation and Reuse
(CE- 621 N)

Maximum Marks: 60
Duration: Two Hours

Instructions:
Attempt FOUR questions, question no ONE is compulsory
Assume suitable data if required

1. Attempt any TEN parts;

1. Which of the following pathogens may be present in raw sewage?
   a. *Salmonella typhi* (bacterium responsible for typhoid fever)
   b. *Vibrio cholerae* (bacterium responsible for cholera)
   c. *Giardia intestinalis* (protozoan responsible for giardiasis)
   d. *poliovirus* (responsible for poliomyelitis)
   e. all of the above

2. What should be maximum velocity in the sewer when running full?
   a. 0.3 m/s
   b. 0.9 m/s
   c. 1.2 m/s
   d. 3.0 m/s

3. Which is the correct expression among the following?
   a. \( V = \frac{1}{n} \cdot R^{2/3} \cdot S^{1/6} \)
   b. \( Q = \frac{1}{n} \cdot R^{2/3} \cdot S^{1/6} \)
   c. \( V = n \cdot R^{2/3} \cdot S^{1/6} \)
   d. \( V = \frac{1}{n} \cdot R^{1/3} \cdot S^{3/2} \)

4. Pretreatment may not include
   a. Bar screens
   b. Comminuters
   c. Digesters
   d. Grit channels

5. Which type of pump is used for pumping dewatered sludge?
   a. Centrifugal open impeller
   b. Centrifugal closed impeller
   c. Progressive cavity
   d. Diaphragm

---

*contd... 2*
6 If the supernatant from an anaerobic digester containing high BOD joins aeration tank, how will it most likely affect the ASP aeration basin?
   a. Increases the DO level.
   b. Increases the SRT.
   c. Increases the F/M ratio.
   d. Increases the removal efficiency.

7 The BOD Areal loading to the pond with 10 Hectare area treating 10000 m³/day of sewage with incoming BOD of 200 mg/L will be:
   a. 300 Kg BOD/ha.day
   b. 20g BOD/m³.day
   c. 100 Kg BOD/m³.day
   d. 50 Kg BOD/ha.day

8 Which of the following formula for Sludge Age, Solids Retention Time (SRT) or MCRT (mean cell residence time) is:
   a. Solids in aeration tank (kg)/Solids wasted (kg/day)
   b. Solids wasted (kg/day)/Solids in Aeration Tank (kg)
   c. Volume of Aeration Tank (m³)/Flow (m³/day)
   d. Flow (m³/day)/Volume of Aeration Tank (m³)

9 The DO concentration in the ASP aeration tank should be around
   a. 0.2-0.5 mg/L
   b. 0.5-1.0 mg/L
   c. 1.0-1.5 mg/L
   d. 1.5-2.0 mg/L

10 Drawback of UASB treatment system:
   a. large land requirement
   b. high electricity requirement
   c. required post treatment of treated effluent
   d. required skilled manpower

11 The upflow velocity in the UASB reactor with 50 m Length, 20 m Width and 5 m Height treating 1000 m³/day sewage is:
   a. 0.5 m/day
   b. 1.0 m/day
   c. 1.5 m/day
   d. 2.0 m/day

contd...
12 Which of the following is not correct regarding chlorine gas
   a. Excessive amount is fatal
   b. lighter than air
   c. Pungent smell
   d. Vulnerable to respiratory system

13. Sludge Drying Beds and Centrifuges are generally used for:
   a. Thickening of Sludge
   b. Digestion of Sludge
   c. Drying of Sludge
   d. Dewatering of Sludge

14. The required chlorine dose for disinfection of the treated effluent of STP
    is around:
   a. 30 - 100 mg/L
   b. 5 - 10  mg/L
   c. 1 - 3  mg/L
   d. 0.1 - 0.5 mg/L

15 Oxygen requirement (Kg O$_2$/d) in activated sludge process can be
    calculated by the following formula;
   a. $1.42 (mass$ of BOD$_3$ removed, kg/d) - $1.42 (mass$ of sludge wasted, kg/d)
   b. $1.42 (mass$ of organisms wasted, kg/d) - $1.42 (mass$ of BOD$_3$ removed, 
      kg/d)
   c. (mass of BOD$_3$ removed, kg/d) - (mass of organisms wasted, kg/d)
   d. (mass of organisms wasted, kg/d) - (mass of BOD$_3$ removed, kg/d)

2. a) Calculate all form of solids for the following set of data.

<table>
<thead>
<tr>
<th></th>
<th>SAMPLE</th>
<th>FILTERATE</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Sample volume =100 mL</td>
<td>Sample volume =100 mL</td>
</tr>
<tr>
<td>Wt. of empty dry crucible</td>
<td>50.26gm</td>
<td>50.10gm</td>
</tr>
<tr>
<td>Wt. of oven dry crucible</td>
<td>52.90gm</td>
<td>51.05gm</td>
</tr>
<tr>
<td>Wt. of furnace dry crucible</td>
<td>50.88gm</td>
<td>50.49gm</td>
</tr>
</tbody>
</table>

b) Design criteria of spiral wound membranes in terms of Flux Packing Density,
   Recovery, Salt Rejection and, Pressure
3. Design a RO Water Treatment Plant for the following conditions:
   Plant capacity: 20000 m$^3$/d
   TDS in Raw water: 1000 mg/L
   Type of Membrane: 8040
   Recovery: 80%
   Salt Rejection: 95%
   Pressure: 1000 kN/m$^2$ = 10 atm
   No of module/pressure vessel = 6
   Pump efficiency: 90%
   Motor efficiency: 80%
   If required TDS in finished water is < 300 mg/L, calculate blending flow, permeate flow, reject flow, reject concentration, no of membranes, no of pressure vessels and, actual power requirement.

4. a) An ion exchange softener is required for 15m$^3$/h flow, to remove 85 mg/L as CaCO$_3$ hardness from an industrial process water. The selected ion exchange resin has an absorptive capacity of 75 kg hardness /m$^3$ at the exchange rate of 0.4m$^3$/min. calculate the quantity of resin required and the area for the exchanges process.
   b) List various oxidizing agents with reference to EOP (V) and EOP (Cl$_2$)
   c) List ozone based and non-ozone based advance oxidation processes.

5. a) Explain Langelier and Ryznar Saturation indices in water desalination process.
   b) What is the role of SAR, give mathematical expressions with explanation?

6. a) Determine contact time for a log inactivation value of 99% at different concentration of free chlorine dose on the given below survival data of E.coli.

<table>
<thead>
<tr>
<th>Free Chlorine dose (mg/L)</th>
<th>Percent Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contact time (min)</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>0.1</td>
<td>97</td>
</tr>
<tr>
<td>0.15</td>
<td>93</td>
</tr>
<tr>
<td>0.3</td>
<td>67</td>
</tr>
</tbody>
</table>

b) Give mathematical expressions of Freundlich Isotherm, Langmuir Isotherm and BET Isotherm
Answer all the questions. Assume suitable data if missing. Notations used have their usual meaning.

Q.No. | Question | M.M.
--- | --- | ---
1(a) | Express the following in terms of meq/L and moles/L 10 g/L of K₂Cr₂O₇, 15 g/L of Mg(OH)₂, 20 mg/L of Ca₃(PO₄)₂, and 20 g/L of Na₂SO₄ | 04
1(b) | Briefly explain the significance of half reactions used in water and wastewater treatment. Balance the following half reactions: Oxidation of Mn⁴⁺ to MnO₂ and reduction of O₂ to H₂O Oxidation of S₂O₃²⁻ to SO₄²⁻ and reduction of Cl₂ to Cl⁻. | 06
1(c) | Explain the significance of proton balance in solution of acid base equilibrium. | 02
1(d) | Briefly comment on the activity of ion and its significance. | 03
1'(a) | Describe in detail the procedure used for the determination of Total Phenols in wastewater. | 10
1'(b) | Briefly describe the different ways of expressing the strength of a solution. | 05
2(a) | Draw the concentration diagram for 0.1 M phosphoric acid and 0.2M oxalic acids. pK₁ = 1.25 and pK₂ = 4.28 for oxalic acid | 06
2(b) | Calculate the pH of a buffer solution containing 12.50 g/L of KH₂PO₄ and 13.5 g/L of K₂HPO₄ under following conditions: (i) Initially (ii) After addition of 0.001 M of HCl (iii) After addition of 0.001 M of NaOH Briefly describe the effect of molar concentration on the performance of the buffer. | 06
2(c) | Briefly explain the significance of chemical precipitation in water and wastewater treatment. | 03
3 | Draw the concentration diagrams for the various possible hydroxides species of cadmium. The values of formation constants are as follow: Find the optimum pH and the possible minimum soluble concentrating of cadmium. Take Kₕ for Cd(OH)₂ = 2 x 10⁻¹⁴ Log K₁ = 6.08, Log K₂ = 2.62, Log K₃ = -0.32 and Log K₄= 0.04 | 15
4(a) | What do you understand by electrochemical treatment of wastewater? Briefly explain how it can be optimised? | 05
4(b) | Describe the process of water stabilization. Explain its significance and write the various chemical equations involved. | 05
4(c) | Draw the structures of different Cresols, nitrophenols and chlorophenols and comment on their biodegradability. OR | 05
4'(c) | What are surfactants? Briefly explain their significance in environmental engineering in water and wastewater treatment. | 05
M.TECH. (AUTUMN SEMESTER) EXAMINATION
CIVIL (ENVIRONMENTAL)
ECOLOGY AND ENVIRONMENTAL MICROBIOLOGY
CE-623

Maximum Marks: 60
Credits: 04
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). Discuss the concept of flow of energy and matter in ecosystem. [7.5]
1(b). Write short note any two of the following
(a) Lake and ocean ecosystem
(b) River and Pond ecosystem
(c) Concept of productivity

2(a). Briefly discuss the concept of heterotrophic organism growth curve. Derive an [7.5] expression when substrate is unlimited during initial period of aerobic batch reactor.

2(b). What are nucleotides? What are DNA and RNA and why they are called [7.5] informational biopolymers?

OR

2'(b). Explain briefly about anaerobic metabolism. What is the difference between [7.5] conventional nitrification, denitrification and ANAMMOX process of nitrogen removal?

3. What are the different stages of aerobic metabolism? Explain briefly about the [15] glycolysis process. How many moles of ATPs are formed during the conversion process?

OR

3'. What is the concept of Biotransformation and Mineralization in biodegradation of [15] organic waste? Describe TCA cycle. Name the different coenzymes and explain their function in TCA cycle. Draw the structure of NAD and ATP.

4. Briefly answer any Five of following questions: [5x3 = 15]
   i) Draw the structure of Eucaryotic cell and Procaryotic cell
   ii) Write down the catabolic energy reactions for methanogenesis of acetate.
   iii) What are Amylose and Amylopectin?
   iv) Draw the structure of Lactose and Maltose
   v) What is Van't Hoff rule for enzymatic reaction?
   vi) What is (A), (G), (C) and (T) in DNA double helix structure?
Q2 (a) A flocculating suspension is placed in a test column and samples are withdrawn periodically from different depths. Following data are obtained for the percentage of solids removed for each sample:

<table>
<thead>
<tr>
<th>Settling time (min)</th>
<th>% suspended solids removed at 0.6m</th>
<th>% suspended solids removed at 1.2m</th>
<th>% suspended solids removed at 1.8m</th>
</tr>
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<tbody>
<tr>
<td>10</td>
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<tr>
<td>80</td>
<td>74</td>
<td>68</td>
<td>60</td>
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</tbody>
</table>

Estimate the percentage removal of solids at a retention time of 60 minutes. (7)

Q2 (b) What are the basic components of dissolved air flotation system? Draw the flowsheets for dissolved air flotation system with and without recycle (4)

Q2 (c) A wastewater has a flow of 60 m³/hr and oil concentration of 250 mg/L. For dissolved air flotation process, compute:
   (i) recycled flow rate
   (ii) surface area of the tank
   The surface loading rate is 0.081 m/min and operating pressure is 4.4 atm.
   Assume $s_a = 18.6$ mg/L and $f = 0.6$ (4)

Q3 (a) If there is a mixed media filter formed of garnet, anthracite and sand, what will their configuration be in the filter bed and why? (5)

Q3 (b) Calculate the backwash velocity and the volume of water for backwashing a sand filter. The grains have a settling velocity of 20 m/min and a porosity of 0.42. The backwash time is 5 minutes and the filter has the dimensions of 50mx 40m. (5)

OR

Q3 (b') A laboratory scale sand filter consists of a 10mm diameter tube with 900mm deep bed of uniform 0.5mm diameter spherical sand ($\psi = 1$), porosity 40 percent. Determine the head loss using Rose's formula and Carman-Kozeny formula when filtering at a rate of 140 m³/m²d. The measured settling velocity of the sand particles was 100cm/s. Determine the bed expansion when the filter is washed at a rate of 10mm/s. (5)
2016-2017
M.Tech. I (Autumn Semester) Examination
CIVIL ENGINEERING
(Environmental Engineering)
PHYSICAL-CHEMICAL PROCESSES
CE-624N

Maximum Marks: 60
Duration: Two Hours

Answer all questions.
Assume suitable data where necessary.

Q1 (a) Discuss the significance of the following from drinking water quality point of view.
coliform bacteria, iron, nitrate, fluoride and sulphate

Q1 (b) Describe the double boundary layer theory of colloidal particles in suspension. Why
does tapered flocculation improve the performance of a flocculator?
OR

Q1 (b') Sketch and explain two film theory of gas transfer. What are the objectives of gas
transfer in water and wastewater treatment?

Q1 (c) An aeration tank is 3m deep with diffused air introduced at the bottom. The tank
volume is 180 m$^3$ and bubbles are 2mm in size. Oxygen is transferred at the rate of
10 kg/hr with a dissolved oxygen deficit of 7 mg/L. How many bubbles are in the
tank at a given time? Assume bubble rise 0.3 m/s and $D_L = 150$ cm/hr.

OR

Q1 (c') A water sample with 15 mg/L alkalinity requires 40 mg/L alum for coagulation.
Calculate the quantity of Ca(OH)$_2$ required to leave a finished water with 25 mg/L
alkalinity. How much Na$_2$CO$_3$ would be needed if it were used in place of lime?

Contd...
Q3 (c) Draw schematic relationships for the following:
(i) Air/solid ratio and effluent suspended solids in a flotation tank
(ii) Filter bed depth and head loss during filtration
(iii) residual chlorine and chlorine dose for water containing ammonia compounds
(iv) relative amounts of HOCl and OCl in water at different pH values
(v) DO conc. and time when a supersaturated solution is stirred in an open container

Q4 (a) Compute the contact times necessary to give E-coli kills of 99.99 percent in water with:
(a) free chlorine residual of 0.2 mg/L and
(b) combined chlorine residual of 1 mg/L
The values of reaction constant (k) are $10^{-2}$/s and $10^{-5}$/s respectively.

Q4 (a') A contact time of 30 minutes with a free chlorine concentration of 10 mg/L achieves a 90 percent kill of pathogenic bacteria. How long it will take for 99 percent removal of pathogens at 8 mg/L concentration? Assume $n = 2$.

Q4 (b) Determine the quantity of lime and soda ash required to reduce the hardness of water of given composition to lowest possible level.
$Ca^{++} \ 53 \ mg/L, \ Mg^{++} \ 20 \ mg/L, \ Na^{+} \ 15 \ mg/L, \ HCO_3^- \ 135 \ mg/L, \ SO_4^{-2} \ 100 \ mg/L, \ Cl^- \ 70 \ mg/L$ and $CO_2 \ 16.8 \ mg/L$

Q4 (c) Explain or write notes on any two:
(i) Iron and manganese removal
(ii) Ion exchange
(iii) Chemical precipitation
(iv) Declining rate filtration
Q.1(a) What are the common types of indoor air pollutants? Discuss their sources in brief. 5

Q.1(b) How the concentration of respirable suspended particulate matter (RSPM) in ambient air is determined. Discuss sampling location and size of the sampling points in brief. 10

OR

Q.1(b) Discuss the importance of ambient air pollution monitoring techniques and write the instruments used for monitoring the various air pollutants. 10

Q.2(a) Explain the role of Meteorological elements in the dispersion of pollutants in the atmosphere. 7.5

Q.2(b) A coal burning electric generating plant emits 1.5 kg/min of SO$_2$ from a stack with an effective height of 65m. On a thinly overcast evening with a wind speed of 5.0 m/s, what will be the ground level concentration of SO$_2$ 500 m directly downwind from the stack? 7.5

OR

Q.2'(a) A power plant burns 6.38 tonnes of coal per hour and discharges the combustion products through a stack that has an effective height of 81 m. The coal has a sulfur content of 4.5 %, and the wind velocity at the top of the stack is 6.0 m/s. The atmospheric conditions are moderately to slightly unstable. Determine the maximum ground level concentration of SO$_2$ and the distance from the stack at which the maximum occurs. 7.5

Q.2'(b) Determine the ground level concentrations from above data at a distance 3.0 km downwind at the centerline of the plume and at a crosswind distance of 0.6km on either side of the center. 7.5
Q.3(a) Discuss the latest air pollution control technologies which reflect the physical and/or chemical processes used to separate pollutants from the carrier gases.

Q.3(b) A plate type ESP used in a cement plant for removing dust particles consists of 12 equal channels. The spacing between the plates is 20 cm and the plates are 3 m high and 3 m long. The unit handles 20,000 m³/h of gas.

I) What is the efficiency of collection plates?

II) What is the collection rate of particles having density 9.2 gm/m³?

III) What should be the length of the plate for achieving efficiency of 99% keeping other parameter same?

OR

Q.3(b)' An air stream with a flow rate of 12 m³/sec is passed through a cyclone of standard proportions. The diameter of the cyclone is 2.5 m and the gas viscosity is 2.1 x 10⁻⁵ kg/m.s. Determine the diameter of the particle with 50 percent efficiency with a density of 2.0 g/cm.

Q.4 Discuss any three of the following:

I) Global warming
II) Acid rain
III) Ozone layer depletion
IV) Photochemical smog

Contd...


KEY TO STABILITY CATEGORIES

<table>
<thead>
<tr>
<th>SURFACE WIND SPEED AT 10 m (m/s)</th>
<th>DAY</th>
<th>NIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(m/s)</td>
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<td>CLASS*</td>
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<td>C-D</td>
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<tr>
<td>&gt;6</td>
<td>C</td>
<td>D</td>
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</tbody>
</table>

*The neutral class, D, should be assumed for overcast conditions during day or night. Class A is the most unstable and class F is the most stable, with class B moderately unstable and class E slightly stable.
2016-17
M.TECH. (I SEMESTER) EXAMINATION
(GEOTECHNICAL ENGINEERING)
SOIL ENGINEERING
(CE-631)

Maximum Marks: 60
Credits: 04
Duration: Two Hours

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

Q. No.

1(a) Enumerate any five engineering properties, which are helpful in determining the bearing capacity of soil. Discuss briefly the index properties of soil. [07]

1(b) A core cutter 12.6 cm in height and 10.2 cm in diameter weighs 1075 gm when empty. It is used to determine the in-situ unit weight of an embankment. The weight of core cutter full of soil is 3000 gm. If the water content is 8%, what are the in-situ dry unit weight and porosity? If the embankment gets fully saturated due to heavy rains, what will be increase in water content and bulk unit weight, if no volume change occurs? The specific gravity of soil solids is 2.68. [08]

OR

1'(a) Discuss briefly the major properties of clayey soil which are affected in presence of moisture. [07]

1'(b) Cohesive soil yields a maximum dry density of 18 kN/m³ at on OMC of 20% during a standard Proctor test. If the value of specific gravity is 2.65, what is the degree of saturation? What is the maximum dry density it can be further compacted to? [08]

2(a) List the field tests used in subsurface investigations. Discuss any one of them in detail. [09]

2(b) The cone penetration resistance obtained in clayey soil was 65 kg/cm². Determine the undrained strength of the clayey soil. The total overburden pressure at the depth was 150 kN/m². [06]
2(b') Discuss in detail about the electrical resistivity method for exploring the soil at site.

3(a) Enlist various soil sampling techniques. Discuss any one of them in detail.

3(b) Determine the area ratios for split barrel and core cutter having OD=50 mm, ID=35 mm and OD=160 mm, ID=150 mm respectively. Also comment on the nature of samples obtained in each of the samplers.

4(a) Discuss the concept and importance of site characterization of soil at site

4(b) In a site investigation for the design of foundations of a multi-storied building structure, what kind of detailed information do you set out to obtain?
2016-17
I YEAR M. TECH. I SEMESTER EXAMINATION
CIVIL ENGINEERING (GEOTECHNICAL ENGINEERING)
FOUNDATION DESIGN-I
CE-632

Maximum Marks: 60

Duration: Two Hours

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

Q. No. Question

1(a) Draw failure envelop for layered soil when a weak stratum is situated over the strong stratum.

For a layered saturated clay profile, given:
$L = 1.83, B = 1.22m, D_f = 0.91, H = 0.61m, \gamma_1 = 17.29 kN/m^3, \phi_1 = 0, c_1 = 57.5 kN/m^2, \gamma_2 = 19.65kN/m^3, \phi_2 = 0, c_2 = 119.79 kN/m^2$, and $N_c = 5.14$. Determine the ultimate bearing capacity of the foundation.

OR

1'(a) Draw failure envelop for layered soil when a strong stratum is situated over the weak stratum.

Determine the gross allowable bearing capacity for a shallow continuous foundation in clay deposit as shown in Fig. 1. Use the following data: $B = 1.2m; D_f = 1.2m; b = 0.6m, H = 6.2m, \beta = 45^\circ, \gamma = 18.5 kN/m^3, \phi = 0$, and $c = 50kN/m^2$. If necessary, use Fig. 2. (Take FS = 4).

2(a) Write short notes on the following:
(i) Components of settlement
(ii) Structure on fills

2(b) A saturated undisturbed sample, taken from a clayey stratum, has moisture content of 22.22% and specific gravity of 2.7. Calculate the consolidation settlement of the clay layer under a square footing of size 2m x 2m (neglecting its self-weight) with additional data shown in Fig. 3. Assume the stress distribution as $2V:1H$ from the edge of the footing.

3(a) Attempt any TWO of the following:
(i) Explain broad guidelines for the design of foundation
(ii) Differentiate between conventional and rational design methodologies
(iii) Discuss the detailed design procedure for footings

Contd...2.
3(b) Two columns of sizes 30 x 30 cm and 50 x 50 cm are founded on a trapezoidal footing at spacing of 6 m. The safe bearing capacity of soil is 400 kN/m². The load carried by bigger and smaller columns are 5000 kN and 3000 kN respectively. Design the dimensions of footing so that it does not extend beyond the outer faces of column.

4(a) Explain the concept of critical depth as related to the determination of point bearing and skin friction resistance in a pile?

4(b) Determine the allowable pile load capacity of the 40 cm diameter driven concrete pile shown in Fig. 4.

OR

4'(a) What is “negative skin friction”? What are the reasons that could lead to development of negative skin friction in a pile foundation?

4'(b) For a 3 x 3 pile group of 200 mm diameter each, as shown in Fig. 5, compute the settlement of a pile group, in a normally consolidated clay stratum having properties as shown in Fig. 5.

Figure 1

Figure 2

cont'd ...
Figure 3

Saturated Sand
$Y_{sat} = 20kN/m^3$

Stiff Clay
$C_c = 0.4$

Figure 4

GS

Loose Sand
$Y_s = 16kN/m^3$
$\phi' = 30^\circ; k = 1$

Soft clay
$Y_{sat} = 19kN/m^3$
$e_u = 15 kN/m^3; \alpha = 1$

Dense Sand
$Y_{sat} = 20kN/m^3$
$\phi' = 40^\circ$
$k = 2; N_q = 160$

Figure 5

GS

800kN

NC clay
$Y_{sat} = 20kN/m^3$
$k_s = 0.027; e_p = 1.1$

Hard Stratum

NC clay
$Y_{sat} = 20kN/m^3$
$k_s = 0.027; e_p = 1.1$

600mm
2016-17
M.TECH. GEOTECHNICAL ENGINEERING
END SEMESTER (AUTUMN) EXAMINATION
(CIVIL ENGINEERING)
DESIGN OF EARTH RETAINING STRUCTURES
(CE-633)

Maximum Marks: 60
Credits: 04
Duration: Two Hours

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

Q. No.                                      Questions                                      M.M.M.

1a What are the major differences between Rankine’s and Coulomb’s theories of earth pressure? Explain the procedure for estimating active earth pressure on retaining wall having uniform surcharge above the backfill. (06)

1b A 12.0 m high retaining wall has stratified backfill of cohesionless soils. The backfill of the wall has the following data:

1\text{st} Strata = 3.0 m thick, \( \phi = 30^\circ \) and \( \gamma = 16 \text{ kN/m}^3 \)

2\text{nd} Strata = 4.0 m thick, \( \phi = 25^\circ \) and \( \gamma = 18 \text{ kN/m}^3 \)

3\text{rd} Strata = 5.0 m thick, \( \phi = 20^\circ \) and \( \gamma = 20 \text{ kN/m}^3 \)

Determine total lateral earth pressure and its point of application if the retaining wall moves away from the backfill. (09)

(OR)

2a Derive a relation for passive earth pressure on a vertical and smooth retaining wall of height ‘H’ with backfill of cohesive soil having unit weight \( \gamma \), cohesion \( c \) and angle of shearing resistance \( \phi \). Give some examples, where the passive earth pressure is considered in the design of civil engineering structures. (06)

1a An expressway side retaining wall of 8.0 m height is subjected to lateral earth pressure. The uniformly distributed surcharge intensity on expressway due to moving vehicles is 100 kN/m\(^2\). The backfill of retaining wall has the following properties:

(i) Unit weight, \( \gamma = 17 \text{ kN/m}^3 \) (ii) Angle of shearing resistance, \( \phi = 30^\circ \) (iii) Unit cohesion, \( c = 15 \text{ kN/m}^2 \). Determine the total active earth pressure exerted on the retaining wall and its point of application from the base of the wall. (09)

2a Enumerate different theories of lateral earth pressure on retaining wall. Discuss which theory gives better results for cohesionless and cohesive soils. Briefly explain why the active earth pressure increases at the time of flood and decreases during earthquakes. (07)
2b What are the design aspects of earth retaining structure? Explain the procedure for checking the stability of a retaining wall.

3a Explain briefly any two of the following:
(i) Cantilever sheet pile wall  (ii) Continuous anchors  (iii) Diaphragm wall  (iv) Bored pile wall.

3b A 6.0 m high cantilever sheet pile wall is embedded in purely cohesive soil of cohesion of 60 kPa and unit weight of 19 kN/m³. The sheet pile is subjected to a pressure of sandy soil having angle of shearing resistance of 30° and unit weight of 16 kN/m³. Determine the minimum and safe depth of embedment of sheet pile wall.

(OR)

3'b Design the tie rods of anchored sheet pile wall by free earth support method for the following data:
(i) Height of sheeting = 5.0 m (ii) Depth of tie rod below pile top level = 1.0 m (iii) Unit weight of retained earth, \( \gamma = 17 \) kN/m³ (iv) Angle of shearing resistance, \( \phi = 25^\circ \) (v) The maximum permissible stress of the tie rod material = 100 N/mm².

4a Draw different types of apparent pressure diagrams used in the design of braced cut in sand and clay, also explain the various factors that affect the pressure distribution of bracings.

4b Write short notes on any two of the following:
(i) Arching in soils  (ii) Open cut in bracing  (iii) Recent advances in earth retaining structures.
2016-17
I YEAR M. TECH. I SEMESTER EXAMINATION
CIVIL ENGINEERING (GEOTECHNICAL ENGINEERING)
ADVANCED GROUND IMPROVEMENT TECHNIQUE
CE-634

Maximum Marks: 60
Duration: Two Hours

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

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Questions</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1a</td>
<td>Discuss vibroflotation and vibro-replacement techniques. Discuss the suitability of each technique for different types of soil. If underground clay lenses are encountered, which technique would be preferred?</td>
<td>[7]</td>
</tr>
<tr>
<td>Q1b</td>
<td>Discuss IS-15248-I method of design of stone columns. Derive the expressions for the design of stone columns and explain each parameter.</td>
<td>[8]</td>
</tr>
<tr>
<td>Q1b’</td>
<td>Do any FOUR of the following:</td>
<td>[8]</td>
</tr>
<tr>
<td></td>
<td>a. Mention the maximum percentage of silt and clay content for vibro compaction to be applicable? To what depth vibro-compaction is considered effective?</td>
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<tr>
<td></td>
<td>b. What is the influence area if stone columns are installed in square pattern?</td>
<td></td>
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<tr>
<td></td>
<td>c. Discuss the objective, outcomes, common applications, and applicable soils for vibro-replacement technique?</td>
<td></td>
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<td></td>
<td>d. Explain the function of granular blanket in case of stone columns. What is the minimum and preferable depth values of thickness of granular blanket.</td>
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<td></td>
<td>e. What should be the general spacing of stone columns? Discuss the criteria for spacing of stone columns?</td>
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</tr>
<tr>
<td>Q2a</td>
<td>State various ground improvement procedures adopted to accelerate consolidation.</td>
<td>[05]</td>
</tr>
<tr>
<td>Q2b</td>
<td>On a ground improvement project, sand drains were used to expedite consolidation. The clay at the site is normally consolidated and other parameters are as given: Clay: ( H_c = 5.0 \text{m (Two-way)} ), ( C_c = 0.31 ), ( e_o = 1.1 ), ( C_v = 110.15 \times 10^{-4} \text{m}^2/\text{day} ), Sand Drains: ( r_w = 0.091 ), ( d_c = 2.0 ), ( C_{vr} = 0.34 ). Effective overburden pressure at the middle of the clay layer = 55.92kN/m². A surcharge load is applied as shown in Figure-1. Assume this to be a no-smear case. Calculate the degree of consolidation and consolidation settlement after 90 days from the start of ramp loading.</td>
<td>[10]</td>
</tr>
<tr>
<td>Q3a</td>
<td>Discuss the wet mix method of soil-cement column and also draw the different pattern for providing the soil-cement column in field.</td>
<td>[08]</td>
</tr>
</tbody>
</table>
Q3b  Highlight the desirable soil properties for economic stabilization with cement?  

OR  

Q3b'  For stabilization of soil through lime, what are the different amounts required for different types of soil?  

Q4a  Describe the failure modes of soil-nailed wall.  

OR  

Q4a'  Discuss any case study of ground improvement through the use of soil-nails or micropiles or industrial waste.  

Q4b  Design micropiles for an embankment with top width of 4.0m and 2.0m high with 1:2 slope on both sides with unit weight of embankment fill of 17kN/m³ on a soft soil to improve the bearing capacity in a uniform deposit of medium clay with unconfined compressive strength of 100kN/m². Consider the diameter of micropile as 0.1m with a spacing of 0.3m centre to centre.

Surcharge (kN/m²)

\[ 95.84 \text{ kN/m}^2 = \Delta \sigma_{(p)} + \Delta \sigma_{(f)} \]

60 days = \( t_c \)

Figure-1
Maximum Marks: 60  Credits: 04  Duration: Two Hours

Answer all the questions. Assume suitable data if missing. Notation used are usual meaning.

Q.No.  Questions  M.M.
1(a) Give a short account of joints in rocks and their importance in engineering classification of rock masses.  08

OR

1(a') Briefly discuss important factors taken into consideration for engineering classification of rock mass.  08

1(b) Enumerate mechanical properties of rocks and list their IS codes.  07

2(a) A rock sample fails at 100 N in a Point Load Index test. Determine the compressive strength of the rock if diameter of the sample is 60 mm. Assume suitable value of the constant  08

OR

2 (a') Discuss the Griffith theory of failure of rock.  08
2 (b) Highlight the advantages and disadvantages of using a TBM in underground tunnel excavations.  07
3(a) What is the importance of support interaction curve? Discuss the concept of Stand-up time.  07
3(b) The horizontal and vertical stresses in a rock mass surrounding a tunnel are reported as 100 and 120 KN/m². The tunnel has a diameter of 5 m. Calculate the stresses at an element having polar coordinate 10, 30°. What will be the values of stresses under hydrostatic condition of 100 KN/m². Assume the centre of tunnel on origin.  08
4(a) Enumerate causes of stresses stored in rock masses and methods of their measurements.  08
4(b) Enumerate different methods of rock mass improvement.  07

OR

4(b') Give a short account of drilling and blasting method for open slope excavation.  07
Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q. No. | Questions |
---|---|
1a | Explain briefly any three of the following: | 06 |
   | i. Undisturbed sample | |
   | ii. Representative sample | |
   | iii. Area ratio | |
   | iv. Recovery ratio | |
   | v. Inside and outside clearance | |
1b | How is static cone penetration test different from standard penetration test? | 09 |
   | i. A SPT was conducted at a depth of 2m in a sand deposit with a unit weight of 20kN/m³. The water table at this site was 1m below ground surface. The N value was observed to be 5. What would be the corrected N value? | |
   | ii. At this site for the SPT conducted at 15m below ground surface, the N value observed was 21. What would be the corrected N value? | |
2a | What do you understand by raft cum pile foundations? Discuss the various conditions under which a raft foundation is considered suitable than isolated and combined footings? | 05 |
2b | Design a rectangular combined footing to support two columns as shown in Fig. 1. The edge column on the left has a section of 0.40m × 0.40m and carries dead and live load of 700kN. The interior column has a section of 0.50m × 0.50m and carries dead and live load of 1000kN. The allowable soil pressure is 120kN/m². Design the footing using conventional method, take grade of concrete, M20 and grade of steel, Fe 415. | 10 |
   (OR) |
2'b | Determine the amplitude of motion for a machine foundation from the following data: | 10 |
   | 1. Soil properties: (i) Dynamic shear modulus, G = 5×10^4 kN/m² (ii) Unit weight, γ = 20N/m³ and (iii) Poison's ratio, ν = 0.30 | |
   | 2. RCC foundation block: Size = 2.0m × 3.5m × 2.5m | |
3. Machine: (i) Weight = 50 kN, (ii) Operating frequency, \( \omega = 600 \) rpm and (iii) Constant exciting force, \( Q_o = 25 \) kN

Also check whether, the machine foundation is safe or unsafe if the value of amplitude given by manufacturer of machine is \( 5.5 \times 10^{-3} \) mm.

3a What are the different circumstances under which a pile foundation is used? Also explain why displacement piles are preferred for use in loose to medium sands and not in dense sand or clay.

3b Determine the allowable pile load capacity in compression of the 40 cm diameter driven concrete pile shown in Fig. 2.

(OR)

3'a Define group efficiency factor of a pile group. What are the reasons that could lead to the development of negative friction in a pile foundation?

3'b In a uniform deposit of medium clay (\( q_u = 100 \) kN/m\(^2\)), a foundation of column is made consisting of 200 mm diameter piles of 8 m length. The center to center spacing between the piles is 500 mm. There are nine piles in the ground arranged in a square pattern. Calculate the ultimate pile load capacity of the group. Assume adhesion factor = 0.9.

4a Differentiate between rigid and flexible earth retaining structures. Briefly explain why the active earth pressure increases at the time of flood and decreases during earthquakes.

4b An anchored sheet pile wall supports a soil mass up to a height of 10.5 m above the ground level with the horizontal surface. The anchor rods are 1.5 m below the top of sheet pile wall, unit weight of the soil \( \gamma = 17 \) kN/m\(^3\) and angle of shearing resistance of backfill, \( \phi = 30^\circ \). Determine the safe depth of pile and tensile force in anchor rod.

![Diagram of pile wall](image1.png)

Fig. 1
Loose Compressible Fill
\[ c = 10 \text{ kN/m}^3, \theta = 0^\circ, \gamma = 16 \text{ kN/m}^3, \alpha = 1 \]

Soft Clay
\[ c = 15 \text{ kN/m}^3, \gamma_{\text{sat}} = 18 \text{ kN/m}^3, \alpha = 1 \]

Silty Sand
\[ c = 0, \gamma_{\text{sat}} = 18 \text{ kN/m}^3, \theta = 28^\circ, K = 1, N_q = 20 \]

Dense Sand
\[ c = 0, \gamma_{\text{sat}} = 20 \text{ kN/m}^3, \theta = 40^\circ, K = 2, N_q = 60 \]
Question

1(a) How does an environmental impact study help in decision makers in the development of projects? [07]

1(b) List all the biophysical, social and economic environmental factors (indicators) which are considered in the environmental impact assessment. [08]

OR

1'(a) Discuss important surface water contaminants and their impact on environment. [07]

1'(b) Explain with the help of schematic diagram the conceptual approach for addressing air environment impacts. [08]

2. What is environmental setting? Discuss framework for environmental setting for any development project of your choice. [15]

3. Discuss in detail the various steps involved in the preparation of an EIA report of a thermal power plant project. [15]

4. Write short notes on any four of the following [15]
   (i) Toxicology
   (ii) Methodology of Matrices
   (iii) D.O. Sag Model
   (iv) Flora and Fauna
   (v) Environmental Legislations
   (vi) Sources of Air Pollutants