A thin cylindrical shell is simply supported on traverses. Show that the stress resultants are given by:
\[ N_\theta = -ZR \]
\[ N_{x\theta} = -Kx \]
\[ N_x = -\frac{1}{2} \left( \frac{I}{4} - x^2 \right) \frac{1}{R} \frac{dK}{d\theta} \]
where \( X, Y \) and \( Z \) are the components of the external load per unit area in the \( x, y \) and \( z \) directions respectively.
\( R \) is the radius of curvature and \( K = \left( \frac{1}{R} \frac{dN_\theta}{d\theta} + Y \right) \)

OR

1'(a) Derive the equilibrium equations and moment curvature relations for thin cylindrical shells using bending theory.

[12]

1'(b) State the boundary conditions for a single shell without edge beams at \( \phi = 0 \).

[03]

A single short cylindrical shell without edge beams has the following dimensions:
The span of the shell \( L = 12 \text{m} \)
The radius of curvature \( R = 25 \text{ m} \)
Thickness \( t = 75 \text{ mm} \)
Semi central angle \( \theta = 40^\circ \)
Dead Load = 120 N/m² of shell surface
Live Load = 70 N/m² of shell surface

(a) Find the membrane forces at \( \phi = 0, \phi/16, \phi/8, \phi/4, \phi/2, \) and \( \phi \).
Using D-K-J Theory, find the roots of the characteristic equation.

A rectangular plate a x b carries a uniformly varying load q₀ per unit area (q₀ is the intensity of load along the edge y = b). Two opposite edges are simply supported and two other edges are fixed. Use Levy's method, calculate the maximum deflection at the centre of the plate.

Derive the differential equation for bending of the circular plate carrying symmetrical load about the vertical axis through the centre of the plate and show that the deflection at any point for the simply supported case is

\[ m = \frac{q}{64D}(R_1^2 - r^2) \]

where, D = Stiffness of the plate
R₁ = Outer rim of the plate
r = radius at any point

If Mₓ and Mᵧ are the moments in x-y axis and Mₓ, Mᵧ, and Mₓᵧ are the moments in n-t axis inclined at an angle 'α'. Find the relationship in the moments of the two sets of axes.

Show that the differential equation for bending of rectangular plate carrying uniformly distributed load 'q' about the vertical axis is \( V^2\omega = \frac{q}{D} \).

Table 8-4. Coefficients B₁, B₂, B₃, and B₄ in the D-K-J Theory

<table>
<thead>
<tr>
<th>Quantity</th>
<th>B₁</th>
<th>B₂</th>
<th>B₃</th>
<th>B₄</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \delta N_{xy} )</td>
<td>( \delta _x )</td>
<td>( \delta _y )</td>
<td>( \delta _{xy} )</td>
<td>( \delta _{yxy} )</td>
</tr>
<tr>
<td>( \alpha _x )</td>
<td>( \alpha _y )</td>
<td>( \alpha _{xy} )</td>
<td>( \alpha _{yxy} )</td>
<td></td>
</tr>
<tr>
<td>( \alpha _{xy} )</td>
<td>( \alpha _{yxy} )</td>
<td>( \alpha _{xy} )</td>
<td>( \alpha _{yxy} )</td>
<td></td>
</tr>
</tbody>
</table>

* Here, the approximate relation \( \delta = (1/4)(\delta _x/\delta _y) \) has been used.
Maximum Marks: 60

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

Q.No. Question M.M.

1 Using force method, analyse the continuous beam ABCD shown in Fig. 1. The beam has an internal hinge at B [15]

1' 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 cm$^2$. Take $E = 2 \times 10^5$ N/mm$^2$. [15]

2 Analyse the bent shown in Fig. 3 using flexibility method and plot the bending moment diagram. [15]

3 Analyse the portal frame shown in Fig.4 by stiffness method and plot the bending moment diagram. [15]

3' Derive the elements of stiffness matrix for the portal frame with inclined legs and from them deduce the elements for a rectangular frame. [15]

4 Calculate the forces in the members of the pin jointed plane truss shown in Fig. 5 by stiffness method, if the hinge supports B and D settle vertically downward by 0.4mm and 0.2 mm respectively. The cross sectional area of each member is 20 cm$^2$. Take $E = 200$ kN/mm$^2$. [15]

FIGURES ENCLOSED

Contd......2
M. TECH. (WINTER SEMESTER) EXAMINATION
CIVIL ENGINEERING (Structural Engg.)
Advanced Concrete Design
CE 605

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q. No.  Question  M.M.

1. (a) Explain need of high strength steel and concrete in prestressed concrete construction.  [05]

(b) A post tensioned concrete beam of size 200 mm x 450mm, is prestressed with a steel cable of circular profile (area= 800 mm²) with zero eccentricity at ends and 150 mm at centre. The span of beam is 10 m. The cable is stressed from one end such that an initial stress of 1.0 GPa is available at unyielded end. Determine the stress in the cable at unyielded end and prestress loss in the wire, if µ = 0.6 and k = 0.003 per m.  [05]

(c) What do you mean by prestressed concrete? Give historical background behind the prestressed concrete construction.  [05]

1’ (a) Differentiate between bonded and unbonded prestressed concrete. Prove that the increase in stress in a tendon of bonded prestressed beam due to u.d.l. is almost two times the increase in stress in unbonded tendon, if cable’s profile is parabolic.  [8]

(b) Giving examples, prove that variation in stress obtained with nominal and equivalent cross section in pre-tensioned concrete members is almost insignificant.  [07]

2. (a) What do you mean by shrinkage and creep in concrete? How do they affect  [05]

Contd.......2
prestressed concrete members.

(b) Design a prestressed concrete beam to support a live load of 15 kN/m over a span of 12 m. The allowable stresses in concrete in compression and tension are 15 MPa and 2 MPa respectively and allowable

3. (a) Discuss in brief the various limit states considered in design of R.C. flexural members.

(b) A doubly reinforced concrete beam of cross section 300 mm x 600 mm is simply supported over a span of 10 m and reinforced with 25% 5 Nos. in tension 20% 4 Nos. in compression zones. The beam is subjected to a DL of 25 kN/m and LL of 30 kN/m over its complete span. Calculate short term deflection at midspan due to DL and LL separately, using IS code method. Assume M25 mix concrete and Fe415 steel.

OR

3'. (a) Discuss in brief the Indian code method of predicting crack width in R.C. flexural members.

(b) A singly reinforced one way slab, simply supported over a span of 4.5 m is 150 mm thick and reinforced with 12 mm dia. bars @125 c/c. The slab is subjected to DL of 5 kN/m² and a LL of 7 kN/m², out which 2 kN/m² is a permanent LL. Calculate deflection due to creep and shrinkage separately. Assume $\varepsilon_{cr}=0.003$, $\theta=1.6$, M20 mix concrete and Fe415 steel.

4. Using Yield Line theory, obtain correct collapse mechanism and collapse load for a rectangular slab of size 4 m x 5 m, orthotropically reinforced and simply supported along its two short and one long edges. The slab is subjected to uniformly distributed load over its complete area. Assume the ratio of moment of resistances in shorter to longer directions as 1.3.
2013-2014
M. TECH. (I) SEMESTER EXAMINATION
(CIVIL ENGINEERING)
HYDRAULIC STRUCTURES
RESERVOIR ENGINEERING (CE-612)

Maximum Marks: 60
Duration: Three Hours

(i) Attempt All questions. All questions carry equal marks
(ii) Assume suitable data if required
(iii) All symbols have their usual meanings.

1(a) Explain various zones in a reservoir with a neat sketch. Discuss criteria for allocation of storage space for various uses.

1(b) Data for the area-elevation at a proposed reservoir is given below. Compute storage capacity and draw its Area-Elevation and Capacity-Elevation curves.

<table>
<thead>
<tr>
<th>Elevation (m)</th>
<th>100</th>
<th>104</th>
<th>108</th>
<th>112</th>
<th>116</th>
<th>120</th>
<th>124</th>
<th>128</th>
<th>132</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (Hd)</td>
<td>0</td>
<td>40</td>
<td>250</td>
<td>930</td>
<td>1810</td>
<td>2780</td>
<td>4040</td>
<td>5760</td>
<td>7500</td>
</tr>
</tbody>
</table>

2 The following table gives the mean monthly flows (m$^3$/s) in a river during 1981. Calculate minimum storage required to maintain a demand rate of 40 cusecs based on Sequent Peak Algorithm.

<table>
<thead>
<tr>
<th>Month</th>
<th>J</th>
<th>F</th>
<th>M</th>
<th>A</th>
<th>M</th>
<th>J</th>
<th>A</th>
<th>S</th>
<th>O</th>
<th>N</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runoff</td>
<td>60</td>
<td>45</td>
<td>35</td>
<td>25</td>
<td>15</td>
<td>22</td>
<td>50</td>
<td>80</td>
<td>105</td>
<td>90</td>
<td>80</td>
</tr>
</tbody>
</table>

2' The two-year monthly runoff (Mm$^3$) of a river into a reservoir are given below:

<table>
<thead>
<tr>
<th>Month</th>
<th>J</th>
<th>F</th>
<th>M</th>
<th>A</th>
<th>M</th>
<th>J</th>
<th>J</th>
<th>A</th>
<th>S</th>
<th>O</th>
<th>N</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runoff (I Year)</td>
<td>58</td>
<td>66</td>
<td>29</td>
<td>33</td>
<td>37</td>
<td>25</td>
<td>10</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Runoff (II Year)</td>
<td>10</td>
<td>31</td>
<td>50</td>
<td>39</td>
<td>39</td>
<td>36</td>
<td>12</td>
<td>12</td>
<td>14</td>
<td>18</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Draw a mass curve and find the storage capacity of the reservoir to meet a uniform demand of 20 Mm$^3$ per month.

12

Contd......2
3 At a proposed site, the silt load is 9.0 Ha-m/year/100sq.km. Distribute 50 year sediment by Area increment method. Take drainage area as 5574 sq.km. The elevation-area-capacity information at the proposed site is given below:

<table>
<thead>
<tr>
<th>Elevation (m)</th>
<th>230</th>
<th>234</th>
<th>238</th>
<th>242</th>
<th>246</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Area (Ha)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Original Capacity (Mm³)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Elevation (m)</td>
<td>254</td>
<td>258</td>
<td>262</td>
<td>266</td>
<td>270</td>
<td>273</td>
</tr>
<tr>
<td>Original Area (Ha)</td>
<td>4246</td>
<td>5822</td>
<td>7780</td>
<td>9579</td>
<td>11512</td>
<td>13562</td>
</tr>
<tr>
<td>Original Capacity (Mm³)</td>
<td>332.81</td>
<td>532.42</td>
<td>736.00</td>
<td>1134.95</td>
<td>1561.44</td>
<td>1875.00</td>
</tr>
</tbody>
</table>

4(a) Discuss the merits and demerits of the various method of the flood peak estimation.

4(b) A culvert is proposed across a stream draining an area of 200 hectares. The catchment has a slope of 0.004 and length of travel for water is 1200 m. Estimate the 25 year flood, if the rainfall is given by

\[ I = \frac{1000T^{0.2}}{(t + 20)^{0.7}} \]

Where I is in mm/h, T is in years, t is in minutes. Assume a runoff coefficient of 0.35

OR

4'(a) Explain the concept of risk, reliability and safety factor.

4'(b) Annual flood data of a river for the period 1948 - 1979 yielded a mean and std. deviation of 29600 and 14860 m³/s respectively. For a proposed bridge on this river, it is decided to have an acceptable risk of 10% in its expected life of 50 years. Estimate the flood discharge by Gumbel's method.

If the actual flood value adopted in the design is 125,000 m³/s, what are the safety factor and safety margin relating to maximum flood discharge. Take \( y_n = 0.5380 \) and \( s_n = 1.1193 \)

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

<table>
<thead>
<tr>
<th>Elevation (m)</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>Storage (Mm³)</td>
<td>3.35</td>
<td>3.472</td>
<td>3.88</td>
<td>4.383</td>
<td>4.882</td>
<td>5.370</td>
<td>5.527</td>
</tr>
<tr>
<td>Outflow (m³/s)</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 100.60 m, 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>
<th>48</th>
<th>54</th>
<th>60</th>
<th>66</th>
<th>72</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge (m³/s)</td>
<td>10</td>
<td>20</td>
<td>55</td>
<td>80</td>
<td>73</td>
<td>58</td>
<td>46</td>
<td>36</td>
<td>25</td>
<td>20</td>
<td>15</td>
<td>13</td>
<td>11</td>
</tr>
</tbody>
</table>

Route the flood by I.S.D. method and obtain Attenuation and reservoir leg.
MTECH. (AUTUMN SEMESTER) EXAMINATION
CIVIL
Fluvial Hydraulics
CE-613

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q.No. Question M.M.
1 Write short notes on:

(a) Fundamental properties of individual sedimentary particle.
(b) Sediment samplers.
(c) Aggradation and degradation.

OR

1' What is Stokes' law? A sediment particle has a diameter of 1.4 mm and specific gravity 2.65. Find the terminal fall velocity of sediment particle in water at 20°C.

A wide stream has a sediment bed of median size 0.33 mm. The slope of the channel is 1.5x10⁻⁴. If the depth of flow in the channel is 0.25 m, examine whether the bed particles will be in motion or not? Shields curve is attached.

2(a) Comment on the practical significance of incipient motion condition in sediment transport in alluvial channels.

2(b) An unlined irrigation channel in an alluvium of median size 0.30 mm is of trapezoidal section with bed width =3.0 m, side slopes =1.5H:1 V and longitudinal slope =0.0004. If this channel carries a discharge of 1.5 cumec at a depth of 0.8 m, estimate the:
(i) Shear stress due to the grain roughness and
(ii) Shear stress due to bed forms.

Contd......
2'(a) Discuss regimes of flow in alluvial channels. Comment on the influence of bed forms on channel resistance

2'(b) A trapezoidal unlined irrigation channel carries a discharge of 2.0 cumec. Bed width of channel is 3.25 m, depth of flow is 0.85 m, longitudinal slope is 0.0036, side slopes are 1\(\frac{1}{2} \) (H) : 1(V), median size of sediment is 0.30 mm. Predict the nature of bed form in the channel and determine the length of the bed undulations.


The cumulative size distribution of bed material in the river Ganga is given below

<table>
<thead>
<tr>
<th>Particle diameter in 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>6</td>
<td>12</td>
<td>20</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
</tbody>
</table>

Determine standard deviation, geometric mean size, geometric standard deviation and sorting coefficient of the bed material.

Determine the bed load transport in an alluvial stream for the following conditions

OR

3' An alluvial channel has a median size of 0.30 mm, velocity of flow of 1.3 m/s, longitudinal slope of 1.7x10^{-4}, depth of flow 0.60 m. Compute the total bed material load using Engelund and Hansen method with the following given data:

Depth of flow = 2.5 m

Velocity of flow = 1.5 m/s

Average slope of water surface = 8x10^{-4}.

Mean size of sediment = 5.0 mm

Specific gravity of sediment = 2.65

4. What is meant by stable alluvial channel?

Design a stable channel in alluvium to carry a discharge of 30 cumec with sediment

Contd......3
load concentration of 60 ppm by weight. The average grain size of the bed material is 0.3mm. Assume the cross section of the channel as trapezoidal with side slopes $1\frac{1}{2} (H) : 1(V)$.

A wide alluvial channel has a slope of 1 in 4500 and a depth of flow 2.0 m. Suspended load sampling at a height of 0.4 m above the bed revealed a concentration of 800 ppm by weight, consisting of sediment particles having a fall velocity of 0.05 m/s. Estimate and plot the suspended load concentration at levels 0.6 m, 0.8 m and 2.0 m from the bed.
2013-2014
M.TECH. AUTUMN (I SEMESTER ) EXAMINATION
(CIVIL ENGINEERING)
(HYDRAULIC STRUCTURES)
RIGID DAM
(CE-614)

Maximum Marks: 60
Duration: Three Hours

"Students governed by the old ordinance will be examined out of 75 marks and their obtained marks shall be proportionately raised"

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

1.(a) Discuss the criteria for fixing the base width of an elementary profile of a concrete gravity dam and obtain the relation for it.

(b) Design the first two zones of a non-over flow section of a concrete gravity dam of height 70 m. Fetch of the reservoir is 15 Km and wind velocity is 85 Km/hour.

2.(a) Calculate the base width of an elementary profile of a gravity dam considering the earthquake force, hydrostatic pressure of water, uplift pressure and weight of dam.

(b) Distinguish clearly between low and high gravity dams. Derive the expressions used for such distinction. Determine the critical height of low gravity dam taking specific gravity of concrete as 2.40 and allowable compressive stress as 340.0 t/m².

(c) Explain the design criteria for the design of high gravity dam.

3.(a) 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 = 173.0m, for the following data:
   (i) Normal vertical stress at heel, σzu = 103 t/m².
   (ii) Normal vertical stress at toe, σzd = 289.55 t/m².
   (iii) Total water pressure at the u/s face, P_u = 206 t/m².
   (iv) No tail water.
   (v) Total horizontal force, H = 27000.00 tonnes.
   (vi) Slope at u/s, tan φ_u = 0.1 and slope at d/s, tan φ_D = 0.85.

Contd........2
4.(a) Analyse the cylindrical arch dam under the uniform loading with the following data:
\[ \alpha = 60^\circ, r_c = 36 \text{ m}, t = 6.0 \text{ m}, h = 30.0 \text{ m}. \]
Modulus of elasticity, \( E_m = 2.11 \times 10^9 \text{ Kg/m}^2 \).
Temperature drop = 12 \text{ } ^{\circ} \text{ F}.
Coefficient of thermal expansion, \( C_T = 6 \times 10^{-6}/^{\circ} \text{ F} \).
Shear factor, \( n = 2.8 \).
Neglect foundation terms and factors.
All symbols have their meanings.

(b) Write the short notes on the following.
(i) Elastic theory of design of an arch dam.
(ii) Thick cylinder theory of design of an arch dam.

5.(a) Briefly discuss the advantages and disadvantages of arch and buttress dam as compared to the conventional gravity dam.

(b) Determine the stresses in a thin constant angle arch dam at 35 m below maximum water level. The geometrical data are as follows:
(i) Constant angle = 120°
(ii) Centre line radius = 41.0 m
(iii) Thickness at crown = 6.0 m
(iv) Thickness at abutment = 6.3 m
Use Cain's method for analysis.
Assume, Coefficient of thrust at crown = 0.97
Coefficient of moment at crown = 0.0106
Coefficient of thrust at abutment = 0.9380
Shear coefficient at abutment = 0.0529
Coefficient of moment at abutment = 0.0178

6.(a) Derive the relations for the design of buttresses of a buttress dam by using concept of unit column theory.

(b) A 100 m high flat deck type buttress dam has a buttress spacing of 18 m and U/S inclination 45°. Assume \( f_c = 450 \text{ t/m}^2 \), \( W_c = 2.4 \text{ t/m}^3 \), 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.
2013-14
M.TECH. (AUTUMN SEMESTER) EXAMINATION
CIVIL ENGINEERING (HYDRAULIC STRUCTURES)
EARTH & ROCKFILL DAM
CE-615

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q.No. Question M.M.
1(a) Draw clear sketches showing single stage and two stage river diversion methods. [06]
1(b) Enumerate various factors affecting the design of river diversion works during construction of dam. [06]
2(a) For the dam section shown in Fig.1, determine the optimum length of horizontal drain needed to keep 2m thickness of downstream slope dry. [08]
2(b) What are various causes of cracking of earthen dams? [04]
3 For the dam section shown in Fig.2 design a suitable length of blanket of constant thickness of 1.8m and ascertain its effectiveness. Also plot the head lost and uplift pressure diagrams. The permeability of blanket material is $1 \times 10^{-5}$ cm/s while that of foundation material is $5 \times 10^{-3}$ cm/s. [12]
4(a) Derive the expression for the length $a'$ of seepage discharge face for $a < 30^\circ$. Also deduce the same relation for $a'$ by graphical method. [08]
4(b) Write short note on Chimney drain. [04]

OR

4'(a) Describe in brief the methods of controlling seepage through embankments. [08]
4'(b) Discuss mechanics of compaction of cohesionless and cohesive soils in embankment dams. [04]
5 An earthen dam with slope $\beta = 40^\circ$ is to be constructed with a soil that has $\phi' = 20^\circ$ and $c' = 24$ kN/m$^2$ and $\gamma = 18.9$ kN/m$^3$. [12]

Contd.........2
(a) Find the critical height of earthen dam.
(b) If the height of earthen dam is 20m, determine the factor of safety with respect to strength.

OR

5'(a) Discuss the criteria for safe design of earthen dam in detail. [04]
5'(b) Explain the method of slices for stability analysis of earthen dam. How can steady seepage be accounted for in this method? [08]
Fig: Taylor's stability number
2013-14
M.TECH. (AUTUMN SEMESTER) EXAMINATION
(CIVIL/PETRO CHEMICAL ENGINEERING)
(ENVIRONMENTAL ENGINEERING)
ENVIRONMENTAL CHEMISTRY
(CE 622 / PK- 620)

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q.No. Question M.M.
1(a) Using half reactions balance the following oxidation reduction reactions [04]
   (i) Oxidation of ammonium to nitrate and reduction of oxygen to water
   (ii) Oxidation of acetate to carbon dioxide and reduction of sulphate to hydrogen sulphide
1(b) Find the pH of a 0.05M acetic acid solution. What would be the pH of the solution if 10 mL of 0.01M NaOH solution is added to 500 mL of 0.05M acetic acid solution [08]
   OR
1' (a) Briefly explain the significance of alkalinity in water treatment processes. Calculate the hydroxide, carbonate and bicarbonate alkalinity using the following experimental results [06]
   Initial pH of sample = 11.2, volume of sample taken for titration = 100mL
   mL of 0.02 N H₂SO₄ used to reach phenolphthalein end point = 8.2
   mL of 0.02 N H₂SO₄ used to reach methyl orange end point = 8.4
1' (b) Briefly explain the different units used for expressing the strength of a solution [04]
1' (c) Define proton balance. Illustrate your definition with a suitable example. [02]
2 (a) Draw the logarithmic concentration diagrams for the following solutions on a graph paper. [04]
   (i) 0.01 M H₂CO₃ solution
   (ii) 0.02 M H₃PO₄ solution

Contd......
2 (b) With the help of concentration diagrams determine the pH of 0.01 M \( \text{Na}_2\text{CO}_3 \) solution and 0.02 M \( \text{H}_3\text{PO}_4 \) solution

2 (c) Calculate the activity of each ion in a solution containing 0.02 M \( \text{NaCl} \) and 0.01 M of \( \text{MgSO}_4 \)

OR

2' (a) Describe in detail the procedure adopted for the determination of fluoride ion in water

2' (b) Briefly describe common ion effect. Calculate the solubility of fluoride ion in a saturated solution of sodium fluoride if the sample has already 75 mg/L of \( \text{Ca}^{++} \).

3 (a) Define buffers and briefly explain their significance

3 (b) A buffer is made by combining monosodium oxalate (\( \text{NaC}_2\text{O}_4\cdot\text{H}_2\text{O} \)) and disodium oxalate (\( \text{Na}_2\text{C}_2\text{O}_4 \)) to give concentrations of 0.02 M (\( \text{NaC}_2\text{O}_4\cdot\text{H}_2\text{O} \)) and 0.03 (\( \text{Na}_2\text{C}_2\text{O}_4 \)). Take \( pK_1 = 1.25 \) and \( pK_2 = 4.28 \).

(i) What is the initial pH of the buffer?

(ii) What is its buffer index?

(iii) What is the pH of the buffer after addition of 0.001 M of HCl?

3 (c) Briefly explain the criteria of selection of weak acid system for the preparation of buffer solution.

3 (d) Briefly explain the significance of buffer index

4 Using logarithmic concentration diagrams determine the optimum pH and minimum soluble concentration of Cadmium in a wastewater solution treated with lime. Take the value \( K_{sp} \) for \( \text{Cd(OH)}_2 = 2 \times 10^{-14} \) and the values of formation constants for cadmium hydroxide complexes as follows:

\( \log K_1 = 6.08, \log K_2 = 2.62, \log K_3 = -0.32 \) and \( \log K_4 = 0.04 \)

5 Discuss any three of the following

(i) Different types of surfactants and their significance in environmental engineering

(ii) Different pesticides used in agricultural practices in India.

(iii) Chlorophenols and their structures

(iv) Pollutants found in Petroleum Refinery Wastewater
2013-2014
M.TECH. (AUTUMN SEMESTER) EXAMINATION
CIVIL (ENVIRONMENTAL)
ECOLOGY AND ENVIRONMENTAL MICROBIOLOGY
CE-623

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q.No.       Question                                                                                     M.M.
1(a)       What is environmental microbiology and briefly explain its applications in water       [06]
            reclamation and reuse?
1(b)       What are protists? How they are classified on the basis of source of energy and       [06]
            source of carbon?
2(a)       What are the different types of media used in bacteriological examination of water?     [06]
            How dilution and staining technique is performed in MPN test?
2(b)       What are disaccharides and polysaccharides and how they are formed? Draw their       [06]
            structures?

OR

2'(b)      What are amino acid, dipeptide and polypeptide? Describe in brief about the        [06]
            biological treatment of protein containing waste?
3(a)       Write down the catabolic energy reactions for aerobic oxidation of acetate,      [06]
            methanogenesis of glucose and methanogenesis of acetate.

OR

3'(a)      Explain briefly about anaerobic metabolism. What is ANAMMOX process of      [06]
            nitrogen removal?
3(b)       Discuss the concept of energy capture with suitable example.                        [06]
4(a)       A sample of bacterial culture was placed in an oven overnight at 150°C. The       [06]
            organic portion of residue remaining was then analysed after which the sample was

Contd......2
burned in muffle furnace to determine the amount of ash remaining. The composition of cells by weight was found to be 46.9% C, 7.2% H, 24.8 %O, 9.46% N. Remaining 9.2% ash. Prepare empirical formula for the cells taking c=1 and find out the COD per organic weight ratio of the cell.

4(b) Explain briefly about the conversion of glucose to pyruvic acid. How many moles of ATPs are formed during the conversion process?

OR

4'(b) Describe TCA cycle. Name the different coenzymes and explain their function in TCA cycle.

5(a) Discuss the concept of flow of energy and matter in ecosystem.

5(b) Write short note any two of the following
   (a) Lake and ocean ecosystem
   (b) River and Pond ecosystem
   (c) Concept of productivity.
2013-2014
M.Tech. Autumn (I Semester) Examination
CIVIL ENGINEERING
(Environmental Engineering)
PHYSICAL AND CHEMICAL PROCESSES OF WATER & WASTEWATER TREATMENT (CE-624)

Maximum Marks: 60

Answer all questions.
Assume suitable data where necessary.

Q1 (a) Name four inorganic ions whose presence may be of concern in drinking water. What parameter is used for determination of microbiological quality of drinking water? (05)

Q1 (b) Sketch and explain two film theory of gas transfer. OR (05)

Q1 (b') What are colloids? What do you understand by colloid destabilization? What can be the effect of overdosing of alum? (05)

Q1 (c) Estimate total dissolved salts in mg/L in water if \(Ca^{++} = 94, Mg^{++} = 28, Na^+ = 13, K^+ = 30, HCO_3^- = 160, SO_4^{--} = 130 \text{ mg/L} \). The water also contains Cl\(^-\) but the analyst did not measure it. (05)

Q2 (a) What are the basic components of dissolved air flotation system? Draw the flowsheets for dissolved air flotation system with and without recycle. (05)

Q2 (b) A wastewater has a flow of 60 m\(^3\)/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 \(s_a = 18.6 \text{ mg/L and } f = 0.6\). (05)

Q2 (c) Describe Chick-Watson law of disinfection. Ozone is to be used to obtain 99.9% kill of bacteria in water with a concentration of 0.5 mg/L. Determine the contact time required assuming \(K = 0.058 \text{ s}^{-1}\). (05)

Q3 (a) 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? (05)

Contd......2
Q3 (b) Tests on a flocculant suspension in a settling column with three sampling points gave the following results:

<table>
<thead>
<tr>
<th>Sample time (min)</th>
<th>% suspended solids removed at</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1m</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>20</td>
<td>60</td>
</tr>
<tr>
<td>30</td>
<td>62</td>
</tr>
<tr>
<td>40</td>
<td>70</td>
</tr>
<tr>
<td>60</td>
<td>73</td>
</tr>
</tbody>
</table>

Estimate the probable removal of solids from this suspension in a tank 3m deep with a retention time of 40 minutes. (10)

OR

Q3 (b') Derive an expression to find the settling velocity of a discrete particle in water. Also find the settling velocity for sand in water having particle diameters of 100 and 200 μm and a density of 2650 kg/m³. Assume \( \mu = 1.3 \times 10^{-3} \text{Ns/m}^2 \). (10)

Q4 (a) Determine the quantity of lime and soda ash required to reduce the hardness of water of given composition to lowest possible level. 
Ca\(^{2+}\) 53 mg/L, Mg\(^{2+}\) 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. (05)

OR

Q4 (a') A filter is backwashed at a rate of 10 L/m\(^2\)-s for 20 minutes after filtering 12000 m\(^3\)/d in 24 hour period. Calculate the average filtration rate, quantity and percentage of treated water used in backwashing the filter having a plan area of 5 m x 10 m. (05)

Q4 (b) 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 chlorination dose for water containing ammonia compounds
(iv) Relative amounts of HOCl and OCI\(^-\) in water at different pH values
(v) DO conc. and time when a supersaturated solution is stirred in an open container (10)

OR

Q4 (b') Derive the expression for calculating the head loss in a granular media filter. Sketch the cross sectional view of a rapid sand filter. Why a dual media filter considered being better than a mono media filter? (10)
2013-2014
M. TECH. AUTUMN (I SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
AIR POLLUTION AND CONTROL
(CE-625)

Maximum Marks : 60

Duration: Three Hours

Answer all the questions.
Assume any data judiciously, if required

Q.1(a) Why earth day is celebrated? Explain in brief. 5

Q.1(b) Discuss the significance of world environment day? 5
   OR

Q.1(b)' What are the sources and effects of volatile organic 5
      compounds.

Q.1(c) From which natural sources might be the following 5
       pollutants arise: Hydrocarbons, CO, H₂S, CH₄ and
       particulate matters. In what units of measurement might
       you expect to see the above pollutants.

Q.2(a) What is the major photochemical oxidant found in the 5
       atmosphere? What detrimental effects does this oxidant
       have on human and materials?
       OR

Q.2(a)' Explain the relationship between the adiabatic lapse rate 5
       of a rising plume of stack gas and the ambient lapse rate.

Q.2(b) Carbon dioxide is emitted at a rate of 145 g/s from a stack 10
       with an effective height of 63m. The wind speed at the
       stack height is 5.8 m/s, and the atmospheric stability class
       is D for the overcast day. Determine the ground level
       concentration long the centre line at a distance of 600 m
       from the stack, in microgram per cubic meter.
       OR

Q.2(b)' For the above question, determine the concentration 10
       crosswind at 50 m from the center line for the downwind
       distance of 600 m.

Contd......2
Q.3(a) With a neat sketch explain the principle, construction and working of a gravitational settling chamber. Suggest methods to improve its efficiency.

Q.3(b) A conventional cyclone with diameter 0.45 m handles 4.2 m$^3$/sec of standard air carrying particles with a density of 2500 kg/m$^3$. Determine the cut size of particle diameter. ($\mu_g=1.81 \times 10^{-5}$ Kg/m-s) and $p_g$ being negligible w.r.t. $p_p$. Take $Ne=6$, inlet width =0.25 m, inlet height =0.5 m.

OR

Q.3(b') An electrostatic precipitator must be designed to process 5 m$^3$/sec of stack gas. The drift velocity of the fly ash particles has been determined to be $w=1.5 \times 10^{-5}d_p$. Determine the plate area required to remove particles with diameters of 0.7μm with 95% efficiency.

Q.4(a) Discuss about the new emerging areas for air pollution control in India.

Q.4(b) Explain the objective of using control equipments.

Q.4(c) Discuss the sources and effects of noise pollution.

**FIGURES**

![Figure 8.11] Vertical diffusion coefficient $\sigma_v$ vs. downward distance from source. (From D)

![Figure 8.10] Lateral diffusion coefficient $\sigma_s$ vs. downward distance from source. (I)
M.TECH. (AUTUMN SEMESTER) EXAMINATION
ADVANCED SOIL MECHANICS AND FOUNDATION ENGINEERING
(CE – 641)

Maximum Marks: 60

Duration: Three Hours

Answer any five questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Questions M.M.
1(a) With the help of neat sketch discuss pile loading test in detail. [06]
1(b) Design the pile group for a column load of 3000 kN to be installed in deep cohesive soil having unconfined compressive strength of 200 kN/m². Assume other data suitably. [06]

2(a) Discuss the load carrying capacity of under reamed pile foundation in clay and sand by static formulae as per IS: 2911 Part-III. [06]
2(b) Explain in detail about settlement of pile group in clays. [06]
3(a) Enumerate various soil exploration methods. Discuss in detail about seismic refraction method. [06]
3(b) Compare the standard penetration test, static cone penetration test and dynamic cone penetration test. [06]

4(a) What are the various theories for estimating the magnitude of pressures on earth retaining structures? According to Coulomb’s theory the force due to earth pressure behind a retaining structure does not act horizontally but acts at an inclination, explain why. [04]
4(b) Using Rankine’s theory, draw pressure distribution diagram for the active pressure for a 12.0m high retaining wall constructed to hold back soil with the following profile:
   0.0m to 5.0 m : Sand with $\phi = 30^\circ$
   5.0m to 12.0m : Clay with unconfined compression strength of 20.0 kN/m² and $\phi$ of 24°. The unit weight for sand is 20 kN/m³ and that of clay 18 kN/m³. [08]

Contd.......2
5(a) List the various design criteria for machine foundation. Design of machine foundation is an iterative procedure. Explain.

5(b) Determine the amplitude of motion for a machine foundation system for the following data:
   (a) Soil properties: \( G = 50 \times 10^3 \text{ kN/m}^2 \), \( \gamma = 18 \text{ kN/m}^3 \) and \( v = 0.33 \).
   (b) RCC foundation block: \( 3 \text{m} \times 2 \text{m} \times 1.5 \text{m} \)
   (c) Machine: Weight = 50 kN, resonant frequency = 375 rad/sec and exciting force = 25 kN

6 What are the various types of combined footings? Design a rectangular footing to support two square columns of 300mm and 500mm sides respectively. Columns are 7.0m apart and the allowable bearing capacity of soil is 300 kN/m². The bigger column carries 3000 kN and smaller 2000 kN.

7(a) What are the basic principles of design of anchored sheet pile walls and cofferdams?

7(b) Briefly explain Malter and Teng procedure for the design of combined footing by finite difference method.