I III YEAR B.TECH. V SEMESTER EXAMINATION
CIVIL AND ARCHITECTURE
SOIL MECHANICS
CF-312

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) | Enumerate various soil classification systems. Discuss any one of them in detail | 06
(b) | A 10 cm diameter and 30 cm long soil sample extracted from ground weighs 4.125 kg. A moist specimen of the sample weighs 12.7g and after oven drying 9.2g. Specific gravity of solids is 2.65. Determine the bulk unit weight, voids ratio, degree of saturation and dry unit weight of soil sample. | 06
OR
1' (a) | List out various methods for determining the in-situ density of soil. Discuss any one of them in detail. | 06
(b) | A soil in its natural state has a voids ratio of 0.65 and a water content of 21%. Specific gravity of soil is 2.65. How many additional litres of water per cubic metre of soil is needed to make it a saturated soil with no change in voids ratio? | 06
2 (a) | Attempt any TWO of the following: | 06
i) Define seepage stress. Obtain expressions to compute the variation in vertical effective stress when the direction of seepage is upwards and downwards.
ii) Obtain the expression of critical hydraulic gradient. Discuss different kinds of failures due to upward seepage
iii) Derive the expression to determine coefficient of permeability using falling head permeability test

Contd. .... 2.
(b) A layer of saturated clay 4m thick is overlain by a layer of sand 5m deep, with
ground water table 3m below the ground surface. The saturated unit weights of the
clay and sand are 19 kN/m³ and 20 kN/m³ respectively. The unit weight of the sand
above the water table is 17 kN/m³. Draw the sectional elevation of this soil mass and
determine the values of total vertical stress and effective vertical stress at 3m, 5m,
and 9m depths below ground level, if sand is saturated with capillary water to a
height of 1 m above the water table.

3 (a) Precisely discuss the applications of Boussinesq vertical stress distribution equation.
(b) A rectangular area 5m × 4m is uniformly loaded with an intensity of 100 kN/m².
Calculate the vertical stresses at a point 5 m below one of its corners and centre of
the loaded area.

OR

3' (a) Derive the relationship for vertical stress distribution of uniformly distributed
circular area.
(b) Draw the isobars for 25% and 30% of point load (Q). Use Boussinesq method.

4 (a) With the help of neat sketch, discuss in detail about laboratory consolidation test.
(b) Over a saturated 7.5 m thick clay layer with drainage at top and bottom, the
effective pressure in increasing from 0.03 kg/cm² to 4.5 kg/cm². The coefficient of
consolidation of the clay layer is 1.65 × 10⁻⁶ cm²/s. Determine the degree of
consolidation at 60 days and 450 days.

5 (a) Do any TWO from the following:
   i) Based on drainage conditions, elaborate the three different kinds of tests
      performed in a triaxial testing system.
   ii) The critical state friction angle of a soil is 28°. Determine the critical state
      shear stress if the normal effective stress is 200 kPa.
   iii) Discuss Mohr-Coulomb’s failure criterion and its application to cohesive
       soils and cohesionless soils.
(b) Three samples of saturated clay were tested in a triaxial test under drained
conditions. The applied stresses are as shown below:

<table>
<thead>
<tr>
<th>Cell Pressure (kPa)</th>
<th>200</th>
<th>400</th>
<th>600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deviator Stress (kPa)</td>
<td>530</td>
<td>1091</td>
<td>1620</td>
</tr>
</tbody>
</table>

Draw Mohr’s circles and obtain the values of shear strength parameters
2015-16
B.TECH. (AUTUMN SEMESTER) EXAMINATION
CIVIL ENGINEERING
ENVIRONMENTAL ENGINEERING
CE 313 N

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions. Assume suitable data if missing. Notations used have their usual meaning. Use of Nomograph and partially flow diagram permitted.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Why it is essential to remove nutrients in wastewater treatment. Briefly describe nitrogenous oxygen demand.</td>
<td>[04]</td>
</tr>
<tr>
<td>(b)</td>
<td>Briefly explain the impact of discharge of wastewater in streams. A wastewater treatment plant discharges its effluent to a small stream. The characteristics of the wastewater and stream are as follows: Stream Wastewater Flow = 0.4 m³/s Flow = 10 MLD BOD = 2.0 mg/L D.O. = 0.0 mg/L D.O. = 8.0 mg/L Temperature = 21°C Temperature = 24°C ( k_1 = 0.23 \text{ d}^{-1} ) ( k_2 = 0.45 \text{ d}^{-1} ) Determine the maximum ( \text{BOD}_5 ) that can be discharged if a minimum of 4 mg/l of oxygen is to be maintained in the stream.</td>
<td>[08]</td>
</tr>
</tbody>
</table>

OR

| (a)   | Briefly explain why dilution of wastewater is done in laboratory determination of BOD. | [02] |
| (b)   | Compute \( L_0 \) and \( K \) values using method of least square for the following data. | [06] |
|       | Time (days) | 2 | 4 | 6 | 8 | 10 |
|       | \( y \) (mg/L) | 11 | 18 | 24 | 26 | 28 |
| (c)   | What are endocrine disruptors? Briefly explain their characteristics and effects on human health. | [04] |

Contd....2.
2 (a) Briefly describe the objective of population forecasting. Enumerate different methods of population forecasting and explain any two methods.

2 (b) Calculate the corrected discharges in each pipe for the following loop

```
80 l/s → 400 mm φ → 40 l/s
L = 500 m
L = 300 m
L = 300 m
300 mm φ
300 mm φ

L = 500 m
```

3 (a) Design a sedimentation tank for the treatment of 12 MLD of water assuming surface overflow rate as 25 m³/m².d. Your design should include both rectangular as well as circular sections.

3 (b) Water defined by the following analysis is to be softened by excess lime treatment.  
\[ \text{CO}_2 = 8.8 \text{ mg/L}, \quad \text{Ca}^{++} = 40 \text{ mg/L}, \quad \text{Mg}^{++} = 14.7 \text{ mg/L}, \quad \text{Na}^{+} = 13.7 \text{ mg/L} \]
\[ \text{HCO}_3^- = 135 \text{ mg/L}, \quad \text{SO}_4^{2-} = 29 \text{ mg/L}, \quad \text{Cl}^- = 17.8 \text{ mg/L} \]

(a) Sketch a meq/L bar diagram and list hypothetical combinations of chemical compounds in solution.

(b) Calculate the softening chemicals required expressing lime as CaO and soda as Na₂CO₃ for the treatment of 10 MLD of water assuming purity of lime as 70% and soda as 80%.

4 (a) Differentiate between coarse and fine screens.

4 (b) Briefly explain how only inorganic solids are removed in grit channel and not organic ones. Design a grit channel for the treatment of 10 MLD of wastewater assuming settling velocity as 0.02 m/s and horizontal velocity as 0.3 m/s.

4 (c) Briefly explain wastewater collection systems.

4 (d) Define mean cells residence time and F/M.

OR

4' (a) Draw microbial growth curve for limited substrate conditions and explain each phase.

4' (b) Design an activated sludge process for the treatment of 15 MLD of wastewater.
using the following data. Take influent BOD = 180 mg/L. It is desired to have effluent BOD as 30 mg/L.

\[ X = 2000 \, \text{mg/L}, \quad X_s = 10,000 \, \text{mg/L}, \quad Y = 0.45, \quad \Theta_c = 10 \, \text{d}, \quad k_d = 0.06 \, \text{d}^{-1} \]

| **5 (a)** | Describe the BOD removal mechanism in facultative ponds. | [04] |
| **5 (b)** | Briefly explain the suitability of providing septic tanks. Design a septic tank for 50 users assume wastewater contribution per person as 50 l/d and period of cleaning as two years. | [04] |
| **5 (c)** | What are the different methods of disposal of municipal solid waste? Explain the various components of a secured landfill. | [04] |

Contd....4.
(a) Define the following terms:
(i) Camera Axis (ii) Picture Plane (iii) Principal Point (iv) Tilted Photograph (v) Flying Height
(b) Two points A and B having elevations of 500 m and 300 m respectively above datum appear on the vertical photograph having focal length of 20 cm and flying altitude of 2500 m above datum. Their corrected photographic co-ordinates are as follows:

<table>
<thead>
<tr>
<th>Point</th>
<th>Photographic Co-ordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>x (cm)</td>
</tr>
<tr>
<td>a</td>
<td>+ 2.65</td>
</tr>
<tr>
<td>b</td>
<td>− 1.92</td>
</tr>
</tbody>
</table>

Determine the length of the ground line AB.

OR (for part "b" only)

(b') With the help of neat sketches, describe any two methods of locating the soundings.

2(a) What points will you keep in mind during selecting triangulation stations?
(b) In a triangulation survey, the altitudes of two proposed stations A and B, 100 km apart, are respectively 430 m and 710 m. The intervening obstruction is situated at C, 60 km from A and has an elevation of 440 m. Ascertain if A and B are intervisible, and if necessary, find how much B should be raised so that the line of sight nowhere be less than 3 m above the surface of the ground.

OR (for part "b" only)

(b') With the help of neat sketches, describe the various triangulation systems.

3(a) With the help of neat sketches, describe the following:
(i) Simple Circular Curve (ii) Compound Curve (iii) Reverse Curve (iv) Transition Curve
(b) Two tangents intersect at a chainage of 3450 m, the deflection angle being 50°. Calculate the necessary data for setting out a simple circular curve of 250 m radius to connect the two tangents by Rankine's method of tangential angles. Take peg interval as 20 m. The least count of the theodolite used for setting out is 20°.
OR (for part "b" only)

(b') Two straights AB and BC are intersected by a line PQ. The angles BPQ and BQP are 55° and 25° respectively. The radius of the first arc is 350 m and that of the second arc is 500 m. If the chainage of point of intersection is 8248.54 m, find the chainages of tangent points and point of compound curvature.

4(a) What do you mean by weight of an observation? Write down the various laws of weights.

(b) The following are the three angles α, β and γ observed at a station P closing the horizon, along with their probable errors of measurement. Determine their corrected values.

\[ \alpha = 78^\circ 12' 12'' \pm 2'' \]
\[ \beta = 136^\circ 48' 30'' \pm 4'' \]
\[ \gamma = 144^\circ 59' 08'' \pm 5'' \]

5(a) Define the following terms:
(i) Nadir (ii) Celestial Horizon (iii) Latitude (iv) Declination (v) Equinoctial Points

(b) The meridian altitude of a star was observed to be 65°40'18'' on a certain day, the star lying between the pole and the zenith. The declination of the star is 53°12'10'' N. Find the latitude of the place of observation.