## B.TECH. (WINTER SEMESTER) EXAMINATION
ARCHITECTURE/CIVIL ENGINEERING
CONSTRUCTION MANAGEMENT
CE - 410

Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

Answer all the questions.  
All questions carry equal marks.  
Answer all parts of a question.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Write down definition of 'Project' given by Project Management Institute USA and UNIDO.</td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>Explain the concept of Interest in detail and how Interest affects the indirect cost of the project.</td>
<td>[04]</td>
</tr>
<tr>
<td>(c)</td>
<td>Explain the concept of &quot;Ceiling&quot; limit with a suitable example.</td>
<td>[04]</td>
</tr>
<tr>
<td>2(a)</td>
<td>Write down objectives of purchasing in detail.</td>
<td>[06]</td>
</tr>
<tr>
<td>(b)</td>
<td>Define and discuss following types of estimates with suitable examples</td>
<td>[06]</td>
</tr>
<tr>
<td></td>
<td>(i) Approximate Estimate  (ii) Detailed Estimate</td>
<td></td>
</tr>
</tbody>
</table>

**OR**

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2'(a)</td>
<td>In what ways industrial purchasing different from household purchasing?</td>
<td>[04]</td>
</tr>
<tr>
<td>(b)</td>
<td>What are the various issues to be examined during the purchase of construction equipment?</td>
<td>[08]</td>
</tr>
<tr>
<td>3(a)</td>
<td>Explain the concept of wages and its classification in detail.</td>
<td>[06]</td>
</tr>
<tr>
<td>(b)</td>
<td>Discuss various types of achievements and corresponding rewards offered in industry.</td>
<td>[06]</td>
</tr>
</tbody>
</table>

**OR**

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3'(a)</td>
<td>Write down detailed account on the evaluation of Human Resource Management in India</td>
<td>[06]</td>
</tr>
<tr>
<td>(b)</td>
<td>Discuss various elements of Human Resource Planning (HRP)</td>
<td>[06]</td>
</tr>
<tr>
<td>4(a)</td>
<td>Draw network diagram of the following activities:</td>
<td>[05]</td>
</tr>
</tbody>
</table>
Activity
A – Locate the site where several buildings are available on rent
B – Select a building where the office can be accommodated
C – Engage the cleaners
D – Clean the office area
E – Decorate the interior
F – Advertise the opening of the new office
G – Prepare the list of invitees for the opening day
H – Send the invitations
I – Formally open the office

4(b) Draw the network diagram of the following activities and calculate Critical Path.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration in Days</th>
<th>Activity</th>
<th>Duration in Days</th>
<th>Activity</th>
<th>Duration in Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>10</td>
<td>3-9</td>
<td>17</td>
<td>7-10</td>
<td>14</td>
</tr>
<tr>
<td>1-6</td>
<td>12</td>
<td>4-6</td>
<td>0</td>
<td>8-10</td>
<td>20</td>
</tr>
<tr>
<td>1-3</td>
<td>18</td>
<td>4-7</td>
<td>15</td>
<td>8-9</td>
<td>27</td>
</tr>
<tr>
<td>2-4</td>
<td>13</td>
<td>5-9</td>
<td>10</td>
<td>8-11</td>
<td>17</td>
</tr>
<tr>
<td>2-6</td>
<td>16</td>
<td>6-7</td>
<td>18</td>
<td>9-12</td>
<td>21</td>
</tr>
<tr>
<td>3-6</td>
<td>8</td>
<td>6-8</td>
<td>22</td>
<td>10-11</td>
<td>22</td>
</tr>
<tr>
<td>3-5</td>
<td>19</td>
<td>7-8</td>
<td>12</td>
<td>11-12</td>
<td>18</td>
</tr>
</tbody>
</table>

OR

4’ Calculate EST, EFT, LFT, LST, Free Float, Total Float and Interfering Float of various activities of the following project.
Draw the network diagram of the following activities and calculate crash Cost and crash Time of the following project.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Normal Duration $T^N$ in days</th>
<th>Normal Cost $C^N$ in Rupees</th>
<th>Crash Duration $T^C$ in days</th>
<th>Crash Cost $C^C$ in Rupees</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1</td>
<td>10</td>
<td>200</td>
<td>10</td>
<td>200</td>
</tr>
<tr>
<td>1 - 2</td>
<td>20</td>
<td>200</td>
<td>20</td>
<td>200</td>
</tr>
<tr>
<td>1 - 3</td>
<td>40</td>
<td>1800</td>
<td>40</td>
<td>1800</td>
</tr>
<tr>
<td>1 - 6</td>
<td>28</td>
<td>500</td>
<td>20</td>
<td>580</td>
</tr>
<tr>
<td>2 - 4</td>
<td>8</td>
<td>150</td>
<td>8</td>
<td>150</td>
</tr>
<tr>
<td>3 - 5</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 - 6</td>
<td>10</td>
<td>100</td>
<td>6</td>
<td>260</td>
</tr>
<tr>
<td>4 - 5</td>
<td>30</td>
<td>3000</td>
<td>10</td>
<td>6600</td>
</tr>
<tr>
<td>5 - 6</td>
<td>20</td>
<td>2800</td>
<td>8</td>
<td>3400</td>
</tr>
<tr>
<td>5 - 7</td>
<td>24</td>
<td>1000</td>
<td>14</td>
<td>1650</td>
</tr>
<tr>
<td>6 - 8</td>
<td>10</td>
<td>200</td>
<td>6</td>
<td>520</td>
</tr>
<tr>
<td>7 - 8</td>
<td>12</td>
<td>400</td>
<td>8</td>
<td>520</td>
</tr>
<tr>
<td>8 - 9</td>
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<td>0</td>
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<tr>
<td>8 - 10</td>
<td>10</td>
<td>200</td>
<td>5</td>
<td>500</td>
</tr>
<tr>
<td>8 - 11</td>
<td>6</td>
<td>200</td>
<td>3</td>
<td>320</td>
</tr>
<tr>
<td>9 - 10</td>
<td>6</td>
<td>150</td>
<td>4</td>
<td>290</td>
</tr>
<tr>
<td>10 - 11</td>
<td>4</td>
<td>300</td>
<td>4</td>
<td>300</td>
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<tr>
<td>11 - 12</td>
<td>4</td>
<td>100</td>
<td>2</td>
<td>180</td>
</tr>
</tbody>
</table>
1(a) Classify the following open channel flow situations:
   (i) Flow in main irrigation canal.
   (ii) Flow in a river during flood.
   (iii) Breaking of a dam
   (iv) Flow over a side weir.  

1(b) Water flows in a 3 m wide rectangular channel at a velocity of 2.5 m/s and at a depth of 1.8 m. If at a section there is a smooth vertical step of 0.08 m, what bed width is needed at that section to enable the critical flow to occur on the hump without any change in the upstream depth.

1(c) Calculate the bottom width of a trapezoidal channel required to carry a discharge of 15 m$^3$/s as a critical flow at a depth of 1.2 m. Take side slope as 1.5H:1V.

1(c) A circular culvert 2.0 m diameter is running half full and the flow is in critical stage. Estimate the discharge and specific energy.

2(a) Show that maximum discharge in a circular channel occurs when \[ \frac{y}{D} = 0.938 \] where \( y \) = depth of flow and \( D \) = diameter of the circular channel.

2(b) A trapezoidal channel carrying a discharge of 20 m$^3$/s is to have a longitudinal slope of 0.0005. Analyse the proportions of (i) an efficient trapezoidal channel section having a side slope of 1.5 H : 1 V (ii) the most efficient channel section of trapezoidal shape.
3(a) A rectangular channel 3 m wide and laid on a slope of $5 \times 10^{-3}$ carries a flow at a normal depth of 1.2 m. A sharp crested rectangular suppressed weir ($C_d = 0.62$) is located with its crest at 2.0 m above the channel bottom at the downstream end of the channel. Compute water surface profile. Assume $n = 0.002$.

3(b) Show that for a wide rectangular channel, the critical slope is given by

$$S_{cr} = \frac{n^2 g}{y_c^n}$$

OR

3(a) An over flow spillway has its crest at an elevation of 125.40 m and a horizontal apron at an elevation of 95.00 m on the downstream side. Find the tail water elevation required to form a hydraulic jump when the elevation of energy line is 127.90 m. The $C_d$ for the flow can be assumed as 0.735. The energy loss for flow over the spillway face can be neglected.

3(b) Sketch the possible GVF profiles in the following serial arrangement of channels and controls. The flow is from left to right.

(i) Mild — milder — steep — steeper
(ii) Intake — steep — mild — sluice gate — mild — sudden drop
(iii) Sluice gate — horizontal — sudden drop.

4(a) Classify waves on the basis of motivating force and mass transport.

4(b) What is meant by complete similitude in model studies? Is it possible to obtain complete similitude in modelling a stretch of a river? Support your answer with reasons.

4(c) A 2 m wide rectangular channel 2 km long carries a steady flow of 4.6 m$^3$/s at a depth of 1.15 m. The sides of the channel are 2m high. If the flow is suddenly stopped by the closure of gate at the downstream end, will the water spill over the sides of the channel? If there is no spillage, what minimum time interval must elapse before the arrival of the surge at the upstream end?

OR

4'(c) A 10 km stretch of the river is to be modelled to study the passage of flood wave. During the normal discharge of 500 m$^3$/s, the river flow section is 100 m wide and 5 m deep, with roughness estimated as 0.025. The maximum flood discharge is 1500 m$^3$/s. The length available in lab is 36 m. Determine different scale ratios, and water supply needed. Check for the turbulence in the model. If the flood peak requires 1.8 minute in travelling a distance of 30 m in the model, what would be the travel time for the corresponding distance in the actual river?
Question

1(a) Discuss sprinkler method of irrigation with its suitability conditions. What are the advantages of sprinkler irrigation?

1(b) What are requirements of a good canal outlet?

A semi-modular pipe outlet of diameter 15 cm is to be installed on a distributary with its bed level and full supply level at 101.15 m and 101.5 m. Set the outlet for maximum discharge and calculate the same. The discharge coefficients C may be taken as 0.62. Is the setting proportional, sub proportional or hyper-proportional?

OR

1*(a) Enlist various factors on which water requirement of crops depend.

A watercourse commands an irrigation area of 800 hectares. The intensity of irrigation of rice in this area is 50%. The transplantation of rice crop takes 15 days and total depth of water required by the crop is 60 cm on the field during the transplantation. Assuming losses of water to be 20% in the watercourse, calculate the discharge required in the watercourse. Take the value of time factor as 0.75.

1*(b) What is meant by frequency of irrigation?

Compute the depth and frequency of irrigation required for a certain crop with data given below:
Root zone depth = 100 cm
Field capacity = 22%
Permanent wilting point = 12%
Apparent specific gravity of soil = 1.50
Consumptive use = 25 mm/day
2(a) Define irrigation efficiency. 

10 cumecs of water is delivered into a farm distribution to a 32 hectare field, for 4 hours. Soil probing after the irrigation indicates that 0.3 meter of water has been stored in the root zone. Compute the water application efficiency.

2(b) Define field capacity of soil? 

Find the field capacity of a soil with following data: 

Dry density of soil = 1.5 g/cm³ 
Depth of root zone = 1.5 m 
Existing water content = 6.0 % 
Water applied to the soil = 500 m³ 
Loss of water in evaporation = 10 % 
Area of field = 1000 m²

OR

2'(a) What are the points to be considered while selecting the type of lining? 

Design a lined canal to carry a discharge of 40 cumecs. Assume bed slope as 1 in 5000, N=0.0225 and side slope 1.25:1.

2'(b) Comment on the importance of water losses in canals. Discuss the measures to control evaporation and seepage losses through canal.

3(a) Compare Kennedy’s and Lacey’s silt theories. Why is Lacey’s conception superior to that of Kennedy’s?

3(b) Differentiate between initial and final regimes.

Design an irrigation canal using Lacey’s method. 

Full supply discharge = 30 cumec 
Side slopes = ½(H):1(V) 
Average size of silt particle = 0.3 mm

OR

Contd…..3
3' (a) Define critical velocity ratio.

Design a channel section by Kennedy's theory for data given below:
Discharge = 30 cusecs
Kutter's N = 0.0225
Critical velocity ratio = 1
Side slope = ½:1
B/D ratio = 8

3'(b) Differentiate between Bed load and Suspended load.

Write notes on the following:
(i) Dowla (ii) Spoil bank (iii) Spoil bank (iv) Berm (v) Borrow pit

4 (a) Comment on the causes of failure of hydraulic structures due to uplift pressure.

Various dimensions and levels are shown on the profile of hydraulic structure shown in the figure given below. Compute the corrected uplift pressures at the key points of the sheet piers.

4(b) Draw the neat sketch of diversion headwork showing its different component parts on it and explain the function of silt excluder.

OR

4'(a) What is river training? What are objectives of river training?

Discuss types of river training.

4' (b) With neat sketches explain the following:

(i) Guide bund (ii) marginal bund (iii) pitched island
and (iv) Artificial cut-off

Contd.... 4
5(a) What is a cross drainage work?

Design drainage waterway and expansion canal transition of an aqueduct with the following data

**Canal Data**
- Discharge = 30 cumecs
- Bed width = 20 m
- Depth of water = 1.50 m
- r.S.L. = 251.50 m

**Drain Data**
- High flood discharge = 250 cumecs
- High flood level = 247.50 m
- High flood dept = 2.50 m

5(b) Comment on the necessity of a fall on a canal. Design the crest of Sarda fall. The relevant data for the design are given below.

- Full supply discharge = 10 cumec
- Full supply level u.s/d.s = 301.2/300.0m
- Full supply depth u.s/d.s = 1.2/1.2m
- Bed width of canal = 12 m
- Side slopes of canal = 1(H):1(V)
- Bligh’s coefficient = 8

[Figure Enclosed]
Khosla's Curves For Q. No. 4(a)
2012-2013
B. TECH. (WINTER SEMESTER) EXAMINATION
BRANCH
ADVANCED HYDROLOGY
CE-425
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 meant by PMP (Probable Maximum Precipitation)? Describe the statistical [05]
    approach for the estimation of PMP.
1(b) From the data given below, Draw the intensity duration curve for 15, 30, 45 and 90 [10]
    minute interval.

<table>
<thead>
<tr>
<th>Time</th>
<th>Cumulative rainfall in (mm)</th>
<th>Time</th>
<th>Cumulative rainfall in (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.00</td>
<td>0</td>
<td>9.45</td>
<td>84.00</td>
</tr>
<tr>
<td>8.15</td>
<td>9.5</td>
<td>10.0</td>
<td>95.00</td>
</tr>
<tr>
<td>8.30</td>
<td>18.5</td>
<td>10.15</td>
<td>103.25</td>
</tr>
<tr>
<td>8.45</td>
<td>27.5</td>
<td>10.30</td>
<td>111.00</td>
</tr>
<tr>
<td>9.00</td>
<td>40.5</td>
<td>10.45</td>
<td>113.00</td>
</tr>
<tr>
<td>9.15</td>
<td>49.00</td>
<td>11.00</td>
<td>113.00</td>
</tr>
<tr>
<td>9.30</td>
<td>62.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OR

1' The following are the data of the monthly ground water table fluctuation (D), [15]
precipitation (P) and ground water pumping (Q) in Kavcry Delta in Tamilnadu. Obtain
the regression line connecting the Ground water table fluctuation with the
precipitation and pumping.

<table>
<thead>
<tr>
<th>Month</th>
<th>GWT &quot;P&quot;(m)</th>
<th>Precipitation &quot;P&quot;(mm)</th>
<th>GW &quot;Q&quot;(Mm) pumping</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>3.60</td>
<td>30</td>
<td>14.0</td>
</tr>
<tr>
<td>February</td>
<td>4.05</td>
<td>52</td>
<td>23.4</td>
</tr>
<tr>
<td>March</td>
<td>4.12</td>
<td>95</td>
<td>23.4</td>
</tr>
<tr>
<td>April</td>
<td>4.57</td>
<td>90</td>
<td>51.2</td>
</tr>
<tr>
<td>May</td>
<td>4.80</td>
<td>200</td>
<td>62.3</td>
</tr>
<tr>
<td>June</td>
<td>4.95</td>
<td>280</td>
<td>79.5</td>
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<tr>
<td>July</td>
<td>5.02</td>
<td>168</td>
<td>61.4</td>
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<td>August</td>
<td>4.80</td>
<td>51</td>
<td>47.4</td>
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<td>September</td>
<td>4.42</td>
<td>18</td>
<td>34.4</td>
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<td>October</td>
<td>4.20</td>
<td>27</td>
<td>18.9</td>
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<td>November</td>
<td>3.90</td>
<td>52</td>
<td>1.8</td>
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<tr>
<td>December</td>
<td>3.30</td>
<td>57</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Contd... 2
2(a) What do you mean by flood routing?

2(b) The topographic survey at a proposed site yielded the following data:

<table>
<thead>
<tr>
<th>Contour Elevation (m)</th>
<th>Contour Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>219</td>
</tr>
<tr>
<td>472</td>
<td>227</td>
</tr>
<tr>
<td>474</td>
<td>240</td>
</tr>
<tr>
<td>476</td>
<td>257</td>
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<td>478</td>
<td>278</td>
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<tr>
<td>480</td>
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<td>482</td>
<td>330</td>
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<td>484</td>
<td>362</td>
</tr>
<tr>
<td>486</td>
<td>396</td>
</tr>
</tbody>
</table>

There are two circular sluices with a diameter of 2.5m and with their centers at an elevation of 470m. A spillway with an effective crest length of 20 m is also provided with its sill level at 480m.

The $C_d$ for the sluices may be taken as 0.78 and for spillway $C=2.15$. Prepare the elevation-storage and elevation-discharge curve.

OR


3(a) Analysis of data on maximum one-day rainfall depth at a place indicates that a depth of 280mm had a return period of 50 years. Determine the probability of a one day rainfall depth equal to or greater than 280mm at the same place, ones in 20 successive years and two times in 15 successive years.

3(b) A cofferdam is designed for a 25 year flood, if it took 5 years to complete the construction of the main dam. What is the risk if the cofferdam fails before the end of the construction of main dam? What return period can reduce the risk to 10%?

4(a) Explain the convolution integral with a neat sketch.

4(b) Explain the Nash's conceptual model for IUH and derive the equation for instantaneous unit hydrograph.

OR
4'(a) Explain the Bernard's distribution graph.

4'(b) Characteristics of two catchments M and N measured from a map are given below.

<table>
<thead>
<tr>
<th>Item</th>
<th>Catchment M</th>
<th>Catchment N</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L_{ca}$</td>
<td>76 km</td>
<td>52 km</td>
</tr>
<tr>
<td>L</td>
<td>148 km</td>
<td>106 km</td>
</tr>
<tr>
<td>$\Lambda$</td>
<td>2718 km$^2$</td>
<td>1400 km$^2$</td>
</tr>
</tbody>
</table>

For the 6-h unit hydrograph in catchment M, the peak discharge is at 200.00 m$^3$/s and occurs at 37 hour from the start of the rainfall excess. Assuming the catchments M and N are meteorologically similar; determine the elements of the 6-h synthetic unit hydrograph for catchment N by using Synder's method.
Q.No. Question M.M.

1. Discuss affect of weathering on rock mass. How different engineering classes of weathering can help to determine the state and uses of rock mass? (12)

2. Define and classify shear zones. How shear zones affect strength of rock mass. What are the remedial measures? (12)

OR

2'. Write short account of deformation of rocks. Enumerate different deformation structures with their significance in engineering aspect of rock masses. (12)

3. Discuss different mechanical properties of rocks used as rock material. (12)

4. What do you understand by engineering classification of rock mass? List five important classification schemes with their significance. (12)

OR

4'. Discuss about Rock Mass Rating System (‘RMR’) and its applications in civil engineering. (12)

5. Write short notes on any two of the followings:
   a. Stresses in rock mass (06)
   b. Rock Slope Stabilization (06)
   c. Grouting (06)
   d. Geo-engineering investigations (06)
2012-13
B. TECH. (WINTER SEMESTER) EXAMINATION
CIVIL ENGINEERING
STRUCTURAL ANALYSIS II
CE 430

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. 1. Analyze the frame shown in Fig. 1 using Kani's method taking advantage of the symmetry of frame geometry and loading. Also draw the BMD for the frame.

![Frame Diagram](image)

Fig. 1

OR

Q. No. 2. Analyze the continuous beam shown in Fig. 2 using Kani's method. Also draw the BMD for the beam.

![Continuous Beam Diagram](image)

Fig. 2

Contd.......2
2. Use stiffness method to analyse the frame shown in Fig. 3. Neglect degree of freedom at C. Flexural rigidity, EI, of the members is constant throughout. Also draw SFD and BMD.

3. Use flexibility method to analyse the frame shown in Fig. 4. Neglect degree of freedom at C. Flexural rigidity, EI, of the members is constant throughout. Also draw SFD and BMD.

4. For the continuous beam with internal hinges at C and D as shown in Fig. 5, draw the influence line diagram (I.L.D.) for reactions at the supports A and B; shear force and bending moment at both the sections G and H.
For the simply supported beam shown in Fig. 6, find the shear force and bending moment at section X using the influence line diagrams.

The wheel load system shown in Fig. 5 can move on a girder of span 5 m. Find the maximum positive and negative shear force for the girder. Find the maximum values of shear force and bending moment at a section 7.5 m from the left end in a simply supported beam of span 20 m when a load system as shown in Fig. 7 crosses the beam from right to left.

Calculate maximum shear force and bending moment at a section 6 m from the left hand hinge support of a three hinged parabolic arch whose span is 16 m with a central rise of 4 m, due to a 80 kN point load rolling over the arch from left to right.
B.TECH. (WINTER SEMESTER) EXAMINATION
CIVIL ENGINEERING
BRIDGE ENGINEERING
CE 434

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 standard table, relevant codes and charts is permitted

Q.No.

1(a) List the loads, forces and stresses to be considered for designing the road bridges. [05]

1(b) Show that for an economical span of a bridge, cost of superstructure of one span should be equal to the cost of substructure of the same span. State the assumptions made in its derivation. [10]

OR

1' Design the deck slab of one span of a T-beam bridge to be built on a rural section of a State Highway. [15]

Data:
Span of bridge = 5 @ 14.5m
Effective span of T-beam with overall depth of 1575mm = 14.5m
Clear roadway = 7.5m
Three T-beams spaced at 2.5m intervals
Five cross beams 250mm thick and 1.275m deep inclusive of deck slab thickness at 3.625m intervals
Thickness of slab supported on beams on four sides by beams = 215mm
Thickness of wearing course = 75mm
Span of deck slab in transverse direction = 2.6m
Width of the rib of the beams = 300mm
Clear cover to steel = 40mm
Assume concrete grade as M25 and steel as Fe415
Impact factor fraction = 25%
Size of kerb = 475mm × 275mm
Size of fillet = 300mm × 150mm
Cantilever portion for footpath = 1.725m from centre of end T-beam
Check whether the provision of total depth of 215mm of deck slab is safe?

2 Design the top and bottom lateral bracings of a deck type plate girder railway bridge using the following data:
- Effective span = 25 m
- Wind pressure = - 1.5 kN/m²
- Net height of the train = 3.8 m and
- Depth of girder, track etc = 2.4 m

3 Design the stringer of a through type single lane truss bridge for BGML loading. The effective span of bridge is 33 m. Spacing of the trusses is 5.5 m c/c. The truss is standard Warren type with six panels @5.5m each.

OR

3' Design the floor beam of the truss bridge given in Question 2. Take dead load of stringer and track as 2 kN/m and 2.7 kN/m respectively. Depth of girder of stringer is 750 mm. Also design the connection between the stringer and the cross girder.

4 Design the intermediate cross beam for the data given in Q. No. 1'

Tables Enclosed
TABLE 16-2 (Cont.):

<table>
<thead>
<tr>
<th>Permissible Stresses</th>
<th>( \sigma_{per} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel &amp; Mild Steel</td>
<td>100 N/mm²</td>
</tr>
<tr>
<td>( \sigma_{per} )</td>
<td>128 N/mm²</td>
</tr>
<tr>
<td>Mild Steel &amp; High Tensile Steel</td>
<td>150 N/mm²</td>
</tr>
</tbody>
</table>

Note: Values valid for bolts up to 22 mm in diameter. For bolts over 22 mm in diameter, consult manufacturer's data.
Q.

1. Using the finite element concept, show that the stiffness matrix of a prismatic bar using formal approach method is

\[ k = \int_{V} (B^T B) \, dV \]

2. For the spring system shown in Fig. 1, \( k_1 = 150 \text{ N/mm}, k_2 = 200 \text{ N/mm}, k_3 = 250 \text{ N/mm} \)

\[ P = 1000 \text{ N}, \quad u_1 = u_4 = 0 \]

Find: (a) the global stiffness matrix  (b) the displacements of nodes 2 and 3  
(c) the reaction forces at nodes 1 and 4  (d) the force in spring 2

**Fig. 1**

OR

2. The beam shown in Fig. 2 is clamped at the two ends and acted upon by force P and moment M in the mid span. Find the deflection and rotation at centre node and reaction forces and moments at the two ends.

**Fig. 2**
3(a) Derive equations of equilibrium in terms of displacement for the general state of stress in a three dimensional cartesian coordinate system.

3(b) The following displacement field is imposed at appoint. Determine whether the equilibrium equations are satisfied or not at the point (2, -3, 2). Assume body forces to be zero and take Poisson's ratio as 0.28.

\[ u = xy^2 + 5xz^2 \]
\[ v = y^2z + 6xy \]
\[ w = z^2x + 3x^2yz \]

OR

3. Suggest and validate a stress function that represents the stress condition of a cantilever beam of rectangular cross section and carrying a point load at the free end. Using the suggested stress function derive the relationship for the deflection curve.

4(a) What do you understand by model analysis? Discuss the circumstances under which it becomes essential.

4(b) Differentiate between direct and indirect model analysis. Give examples also.
Question

Max Marks: 60

1(a) What are the advantages of under reamed pile foundations in black cotton soils? 

Discuss the construction and design procedure of such foundations in accordance with Indian Standard Code of Practice IS 2911-Part III.

1(b) Determine the safe load of under reamed pile for the following data:

i) No. of under reamed bulb = 2

ii) Diameter of under reamed bulb = 1.40 m

iii) Diameter of pile stem = 0.65 m

iv) Length of pile = 7.0 m

v) Avg. cohesion value both below and above the bulb = 150 kN/m²

vi) Adhesion factor = 0.45

vii) Factor of safety = 2.5

2(a) Explain differences in De Beer and Marten's method and Meyerhof's method in settlement computation.

2(b) Comment on various approaches for finding bearing capacity using N-values.

2(c) A plate load test was carried out on a ground having a uniform sand stratum up to sufficient depth. The size of plate was 450×450 mm.

<table>
<thead>
<tr>
<th>Load (kN)</th>
<th>4.50</th>
<th>9</th>
<th>18</th>
<th>27</th>
<th>36</th>
<th>45</th>
<th>54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settlement (mm)</td>
<td>0.75</td>
<td>1.25</td>
<td>2.00</td>
<td>3.50</td>
<td>5.38</td>
<td>7.75</td>
<td>10.75</td>
</tr>
</tbody>
</table>

Plot load settlement curve. Determine settlement of a foundation 3m×3m size carrying a load of 40 kN and located at a depth of 4 m below ground surface.

Also determine bearing capacity and load that can be taken by a footing of size 1.5m×1.5m in this soil for an allowable settlement of 25 mm.

OR

A square footing is required to carry a load of 1000 kN. Determine size of footing if depth of foundation is 2.5 m and tolerable settlement is 35 mm. The soil is sandy with N=15 and water table is at a depth of 3.0 m. Use Peck, Hansen and Thornburn.
procedure. If water table rises up to 1.0m below ground, what will be change observed in net load carrying capacity of footing.

3(a) Briefly explain the load carrying capacity and efficiency of pile group in cohesive soils? [05]

3(b) A square group of 16 piles each of 0.45m diameter are spaced @ 1.5m centre to centre in a clay stratum of 20m depth underlain by a rock. The depth of pile extended to 16m below the surface. The average unit cohesion of clay is 75 kN/m² and adhesion factor is 0.45. The liquid limit of clay strata is 60%. Taking unit weight of clay as 19 kN/m³ and specific gravity as 2.72.

(i) Compute allowable load with FOS of 3.0
(ii) Determine settlement of pile group at that load.

OR

3'(a) What are the various types of pile foundations? What type of foundation would you recommend for the construction of railway over bridge if water table is encountered at shallow depth of 3.5m from natural ground level in silty sand? [05]

3'(b) A 300mm diameter pile of length 12m was subjected to a pile load test and the following results were obtained:

<table>
<thead>
<tr>
<th>Load (kN)</th>
<th>0.0</th>
<th>500</th>
<th>1000</th>
<th>1500</th>
<th>2000</th>
<th>2500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settlement during loading (mm)</td>
<td>0.0</td>
<td>8.5</td>
<td>16.5</td>
<td>25.5</td>
<td>38.0</td>
<td>60.0</td>
</tr>
<tr>
<td>Settlement during unloading (mm)</td>
<td>40.0</td>
<td>46.0</td>
<td>52.5</td>
<td>55.0</td>
<td>58.5</td>
<td>62.5</td>
</tr>
</tbody>
</table>

Draw the load settlement curve and find out the allowable load with FOS of 3.0.

4(a) Using 3 dimensional equation of motion, derive equations for s-wave and p-wave. [05]

4(b) Explain various approaches for finding depth in a three layer soil medium. [03]

4(c) Wave propagation tests were conducted near an industrial site. For determining in-situ velocities of wave propagation and dynamic elastic modulii, seismic waves were generated by impact of a hammer falling through a height of 3.0m. Three geophones were placed in ground respectively at 1.0m, 3.0m and 5.0m from source. The analysis of data gave velocity of compression wave as 300.0m/s increasing @ 30% in successive layers. The soil at site was cohesion less and position of water table was 1.0m depth below ground surface. Determine E, G, v, and v, for different layers. [07]