2011-2012
M.TECH. WINTER (II SEMESTER) EXAMINATION
STRUCTURAL ENGINEERING (CIVIL ENGINEERING)
FINITE ELEMENT ANALYSIS
(CE - 606)

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) Notations used bear their usual meanings

1. Evaluate the shape functions $N_1$, $N_2$, and $N_3$ at the interior point $P$ as shown in Fig. 1. Also determine the Jacobian of the transformation $J$ for the above triangular element.

2. A thin steel plate has a uniform thickness $t = 1$ inch, Young’s modulus $E = 30 \times 10^6$ psi and density $= 0.2836$ lb/in$^3$. In addition to its self-weight, the plate is subjected to point loads at two points as shown in Fig. 2.
   (a) Model the plate with three finite elements
   (b) Write down expressions for the element stiffness matrices and element body force vectors.
   (c) Assemble the structural stiffness matrix $K$ and global vector $F$.
   (d) Using the elimination approach, solve for the global displacement vector $Q$.
   (e) Evaluate the stresses in each element
   (f) Determine the reaction force at the support.

3. Write notes on any three of the following:
   (a) Rayleigh-Ritz method
   (b) Constant Strain Triangle (CST or T3)
   (c) Plain stress and plain strain
   (d) Global stiffness matrix
   (e) Shape functions

4. A simple plane truss is made of two identical bars (with $E$, $A$, and $L$) and loaded as shown in Fig. 3. Find:
   (a) the global stiffness matrix
   (b) displacement of node 2
   (c) stress in each bar

5. What do you mean by substructures or superelements? What are the advantages and disadvantages of using substructures/superelements.

6. How do you analyse a thin rectangular plate element using Kirchhoff’s Plate Theory in finite element?
The image contains diagrams labeled as Fig. 1, Fig. 2, and Fig. 3. The diagrams appear to be related to forces and geometry, possibly involving problems in statics or mechanics. The diagrams show points labeled with coordinates and labeled forces or distances. The text is not visible or legible in the provided image.
Note: (i) "Students governed by the old ordinance will be examined out of 75 marks and their obtained marks shall be proportionately raised."
(ii) Attempt any four questions
(iii) Any suitable data may be assumed, if any.
(iv) Use of IS 1893 is permitted.

1. Show that for an under damped system in free vibration the logarithmic decrement may be written as

\[ \delta = \frac{1}{k} \ln \left( \frac{y_i}{y_i - k} \right) \]

where \( k \) is the no of cycles.

1. A platform of weight \( W = 4000 \text{lb} \) is being supported by four equal columns which are clamped to the foundation as well as to the platform. Experimentally it has been determined that a static force \( F = 1500 \text{lb} \) applied horizontally to the platform produces a displacement of 0.10 inch. It is estimated that the damping in the structure is of order of 5% of the critical damping. Determine for the structure the following (i) undamped natural frequency; (ii) absolute damping coefficient; (iii) the number of cycles and the time required for the amplitude of motion to be reduced from an initial value of 0.1 inch to 0.01 inch.

2. Determine the first three terms of the Fourier series expansion for the time varying force and its response as shown in Fig.1

3. For the load time function shown in Fig.2 derive expression for the load factor (Dynamic Amplification Factor) for an undamped simple oscillator as a function of \( t, \omega, \) and \( t_\delta. \)

3. A machine of weight \( W = 2000 \text{N} \) and making 150rpm is supported by four helical springs made of steel wire of diameter \( d = 12 \text{mm} \). The diameter corresponding to the center line of helix is \( D = 10 \text{cm} \) and the number of
coils is 10.0. Determine the maximum vertical disturbing force transmitted to the foundation if the centrifugal force of unbalance for the angular speed equal to 1 rad/sec is 5N. Take damping ratio 5% and shear modulus (G) as 0.8 x 10^7 N/cm².

4. Determine for the two storey shear frame shown in Fig.3 (i) Natural frequency and mode shaped (ii) Normalize each mode so that roof displacement is unity. (iii) Normalize each mode so that the modal mass has unit values. Compare these modes with those obtained in part (ii) and comment on the differences.

5. Determine the steady state response of the shear frame shown in Fig. 4 subjected to a sinusoidal force at second floor level.

6. Derive mathematical expression for the displacement response of a simply supported uniform beam to the force distribution shown in Fig 5. The time variation of the force is a step function. Express the displacements in terms of the natural vibration modes of the beam. Identify the modes that do not contribute to the response. Neglect damping.
2011-12
M.TECH. WINTER (II SEMESTER) EXAMINATION
STRUCTURAL ENGINEERING (CIVIL ENGINEERING)
ADVANCED STEEL DESIGN
(CE – 608)

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 all questions
(ii) Assume suitable data if required
(iii) Notations used bear their usual meanings
(iv) Use of IS-800, IS-875(3) & Steel Table is permitted.

1. Design the continuous beam shown in Fig. 1 for most economical section. Take $\sigma_y = 250 \, N/mm^2$.

OR

In a two-bay, fixed base rectangular frame ABCDEF the three columns AB, FC and ED are each of length 4m and plastic moment 30 KNm, while the two beams BC and CD are each of length 5m and plastic moment 60 KNm. A horizontal load 25 KN acts at B, and there are two concentrated vertical loads 40 KN and 45 KN acting at the centers of the beam BC and CD respectively. Find out the collapse load factor.

2. A riveted steel rectangular flat bottom tank is of capacity 100,000 liters. The tank rests on four columns with an overhang of 0.5 m on all sides. The available width of plate in the market is 1.50 m and of length up to 10 m. Provide an appropriate dimensions of the tank, design the thickness of the steel plate and stage of the above tank.

3. A self supporting steel stack is 70 meters high and its diameter at top is 2.80 meters. Design the plates for the stack at 10 and 30 meters from top. The location of the place is such that the intensity of wind pressure up to 25 m height is 1.5 KN/m² where as the wind pressure at the top of the chimney is 1.80 KN/m². In between the wind pressure is varying linearly. Assume that the allowable stress in axial compression and in bending for the circular steel stack is 70 N/mm² and 80 N/mm² respectively.

OR

A Pratt truss girder through bridge is provided for single broad gauge track. The effective span of the bridge is 32 m. The cross-girders are spaced 4 m apart. The stringers are spaced 2 m between centre lines. 0.60 KN per metre stock rails and 0.40 KN per metre check rails are provided. Sleepers are spaced at 0.45 m from centre to centre and are of size 2.80 m x 0.25 m x 0.25 m. Weight of timber may be assumed as 7.5 KN per cubic metre. The main girders are provided at a spacing of 7 m between centre lines. Design any top chord or any diagonal member. The bridge is to carry standard main line loading.
4. (a) What are the Codal provisions in design of communication tower?

(b) A memorial building is proposed at Sriperumbudur, Chennai on a hill top. The size of the building is 40 m x 80 m and height is 10 m. The hill is 300 m high with a gradient of 1 in 5. The building is proposed at a distance of 100 m from the crest on the downwind slope. Calculate the design wind pressure on the building. The basic wind speed at Sriperumbudur is 50 m/s.
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 Five Questions  
(ii) All parts of a question should be attempted in one continuation  
(iii) All questions carry equal marks

Q. 1  
(a) Discuss various advantages in Integral Materials Management approach  
(b) What are the various factors affecting inventory? Discuss them in detail

Q. 2  
(a) Discuss competitive bid contract and negotiated bid contract in detail  
(b) What is a purchase order? Why a purchase order is important

Q. 3  
(a) How is recruitment is different from selection. Explain various sources of recruitment and methods of selection.  
(b) How an arbitration board is formed and how are arbitration proceedings conducted?

Q. 4  
(a) Write down a brief account on profile of construction industry in India  
(b) Discuss inherent characteristic of construction project in detail

Q. 5  
(a) Define and discuss various types of estimates with degree of accuracy and its uses  
(b) Explain the following cost with example

(i) Fixed Cost  
(ii) Variable Cost  
(iii) Installed Cost  
(iv) Sunk Cost  
(v) Opportunity Cost  
(vi) Historical Cost
Q.6  (a) In what ways purchasing of Capital Construction Equipment is different from routine purchasing. Discuss in detail (4)

(b) What are the various issues to be examined during the purchase of construction equipment? Discuss in detail (8)

Q.7  (a) Explain the phrase "Estimate is a opinion, Price is a policy and Cost is a fact" (6)

(b) Explain the following terms in context of accounting: (6)

(i) Equity  (ii) Liability

(iii) Asset  (iv) Creditors  (v) Debtors

(vi) Revenue
2011-2012
M.TECH. WINTER (II SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
HYDRAULIC STRUCTURES
HIGHER MATHEMATICS
(AM-611)

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".

Answer five questions by selecting at least two questions from each section.
Standard normal distribution chart is attached.

SECTION-‘A’

1.(a) Solve by Frobenus method the following differential equation:
\[ q x (1-x) \frac{d^2 y}{dx^2} - 12 \frac{dy}{dx} + 4y = 0 \]

(b) Show that:
\[ n P_n(x) = \sum P'_n(x) - P'_{n-1}(x) \]

2.(a) Show that:
\[ \int_{-1}^{1} P_m(x) P_n(x) \, dx = 0 \quad m \neq n \]

(b) Show that:
\[ T_{n+1}(x) = 2x T_n(x) + T_{n-1}(x) = 0 \]

3.(a) Find the Fourier transform of \( f(x) = e^{-|x|} \)

Also prove that:
\[ F[f(x)] = i \frac{d}{dw} F(w) \]
where \( F \) is Fourier transform and \( F(w) \) is the Fourier transform of \( f(x) \).

(b) Show that:
\[ x J'_a(x) = n J_n(x) - x J_{n+1}(x) \]

Find the Hankel transform of:
\[ f(x) = \begin{cases} 
  x^n, & 0 < x < a, \ n > -1 \\
  0, & n \geq a, \ n > -1 
\end{cases} \]

4.(a) Solve by graphical method the following linear programming problem:

Minimize \( Z = 3x + 2y \)

subject to:
\[ \begin{align*}
  5x + y & \geq 10 \\
  x + y & \geq 6 \\
  x + 4y & \geq 12 \\
  x, y & \geq 0
\end{align*} \]

......2.
(b) Apply simplex. Method to solve the following linear programming problem:
Maximize \( Z = -x_1 + 3x_2 - 3x_3 \)
subject to
\[
\begin{align*}
3x_1 - x_2 + 2x_3 & \leq 7 \\
2x_1 + 4x_2 & \geq -12 \\
-4x_1 + 3x_2 + 8x_3 & \leq 10 \\
x_1, x_2, x_3 & \geq 0
\end{align*}
\]

SECTION 'B'

5.(a) Show that \( P \left[ A \cap \overline{B} \right] U \left( \overline{A} \cap B \right) \]
\[= P(A) + P(B) - 2P(A \cap B).\]

(b) A lot consists 10 good items, 4 with minor defects and 2 with major defects. Two articles are chosen (without replacement). Find the probability that:
(i) at least one is good
(ii) neither has major defects
(iii) neither is good.

6.(a) The probability of the closing of each relay of the circuit shown in figure-1 is given by \( p \). If all relays function independently, what is the probability that a current exists between the terminals L to R?

(b) In a bolt factory, machines A, B and C manufacture 25, 35 and 40 percent of the total output, respectively. Of their outputs 5, 4 and 2 percent, respectively, are defective bolts. A bolt is chosen at random and found to be defective. What is the probability that the bolt came from machine A?

7.(a) Suppose that the random variable \( x \) has possible values 1, 2, 3, ... , and \( P(X = j) = \frac{1}{2^j}, j = 1, 2, 3, ... \)
Let \( A = \{ n: n \mu \text{ odd} \} \)
\( B = \{ n: n \mu \text{ a multiple of 3} \} \)
Calculate $P(A)$, $P(B)$, $P(A|B)$, $P(B|A)$

(b) The diameter of an electric cable, say $X$, is assumed to be a continuous random variable with pdf $f(x) = 6x(1-x), 0 \leq x \leq 1$. Calculate the cumulative distribution function $F(x)$. Determine $b$ such that $P(X < b) = 2P(X \geq b)$ and also calculate $P(X \leq \frac{1}{2} | \frac{1}{3} \leq X \leq \frac{2}{3})$.

8.(a) Suppose that the life lengths of two electronic devices say $D_1$ and $D_2$ have distributions $N(40,36)$ and $N(45,9)$ respectively. If the electronic device is to be used for a 44 hour period, which device is to be preferred?

(b) Suppose that $X$ has distribution $N(\mu, \sigma^2)$. Determine $C$ as a function $\mu$ and $\sigma$ such that $P(X \leq C) = 3P(X > C)$

(c) Let $X$ be exponentially distributed with pdf $f(x) = \alpha e^{-\alpha x}, x \geq 0, \alpha > 0$

Find the cdf $F(x)$, expected value $E(X)$.

Also prove that $P(X > s + t | X > t) = P(X > t), \text{ where } s < t$.  

Encl. chart

cont'd...4
\[
(z > Z) = np_z < x - x \frac{1}{l} \int = (z) P
\]

**TABLE 1 (Continued)**

| z | 0.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0
|---|---|---|---|---|---|---|---|---|---|---|---
| 0.0 | 0.000 | 0.002 | 0.006 | 0.010 | 0.013 | 0.017 | 0.020 | 0.024 | 0.027 | 0.030 | 0.033
| 0.1 | 0.036 | 0.039 | 0.042 | 0.045 | 0.048 | 0.051 | 0.054 | 0.057 | 0.060 | 0.063 | 0.066
| 0.2 | 0.069 | 0.072 | 0.075 | 0.078 | 0.081 | 0.084 | 0.086 | 0.089 | 0.092 | 0.095 | 0.098
| 0.3 | 0.101 | 0.104 | 0.107 | 0.110 | 0.113 | 0.116 | 0.119 | 0.122 | 0.125 | 0.128 | 0.131
| 0.4 | 0.134 | 0.137 | 0.140 | 0.143 | 0.146 | 0.149 | 0.152 | 0.155 | 0.158 | 0.161 | 0.164
| 0.5 | 0.167 | 0.170 | 0.173 | 0.176 | 0.179 | 0.182 | 0.185 | 0.188 | 0.191 | 0.194 | 0.197
| 0.6 | 0.199 | 0.202 | 0.205 | 0.208 | 0.211 | 0.214 | 0.217 | 0.220 | 0.223 | 0.226 | 0.229
| 0.7 | 0.232 | 0.235 | 0.238 | 0.241 | 0.244 | 0.247 | 0.250 | 0.253 | 0.256 | 0.259 | 0.262
| 0.8 | 0.265 | 0.268 | 0.271 | 0.274 | 0.277 | 0.280 | 0.283 | 0.286 | 0.289 | 0.292 | 0.295
| 0.9 | 0.298 | 0.301 | 0.304 | 0.307 | 0.310 | 0.313 | 0.316 | 0.319 | 0.322 | 0.325 | 0.328

**TABLE I. Values of the Standard Normal Distribution Function**

\[
(z < Z) = np_z < x + x \frac{1}{l} \int = (z) P
\]
Maximum Marks: 60
Duration : Three Hours

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

1(a) Differentiate between risk, reliability and safety factors.

(b) The observations on annual rainfall and annual runoff of a basin in cm for a period of 10 years are given below. Fit a linear regression equation between rainfall and runoff.

<table>
<thead>
<tr>
<th>Year</th>
<th>Rainfall</th>
<th>Runoff</th>
<th>Year</th>
<th>Rainfall</th>
<th>Runoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>106</td>
<td>48</td>
<td>1989</td>
<td>88</td>
<td>20</td>
</tr>
<tr>
<td>1982</td>
<td>96</td>
<td>30</td>
<td>1990</td>
<td>74</td>
<td>17</td>
</tr>
<tr>
<td>1983</td>
<td>95</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td>100</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>66</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>45</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>83</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>83</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2(a) Define the following terms:
(i) Probable Maximum Flood
(ii) Return period and Exceedence probability
(b) Calculate probable maximum precipitation for the design of spillway by using the given data. Take value of frequency factor as 12.

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual rainfall (cm)</th>
<th>Year</th>
<th>Annual rainfall (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>106</td>
<td>1979</td>
<td>98</td>
</tr>
<tr>
<td>1972</td>
<td>96</td>
<td>1980</td>
<td>74</td>
</tr>
<tr>
<td>1973</td>
<td>95</td>
<td>1981</td>
<td>67</td>
</tr>
<tr>
<td>1974</td>
<td>100</td>
<td>1982</td>
<td>79</td>
</tr>
<tr>
<td>1975</td>
<td>66</td>
<td>1983</td>
<td>115</td>
</tr>
<tr>
<td>1976</td>
<td>45</td>
<td>1984</td>
<td>121</td>
</tr>
<tr>
<td>1977</td>
<td>83</td>
<td>1985</td>
<td>45</td>
</tr>
<tr>
<td>1978</td>
<td>89</td>
<td>1986</td>
<td>58</td>
</tr>
</tbody>
</table>

3(a) Discuss the significance and procedure of Regional flood frequency analysis.

(b) A bridge has an expected life of 30 years and is designed for a flood magnitude of return period 110 years.
(i) What is the risk of this hydrologic design?
(ii) If a 5% risk is acceptable, what return period will have to be adopted?
4(a) What do you mean by prism storage and wedge storage?
4(b) A reservoir has the following elevation, discharge and storage relationships:

<table>
<thead>
<tr>
<th>Elevation (m)</th>
<th>Storage (Mm$^3$)</th>
<th>Outflow discharge (m$^3$/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100.00</td>
<td>3.350</td>
<td>0</td>
</tr>
<tr>
<td>100.50</td>
<td>3.472</td>
<td>10</td>
</tr>
<tr>
<td>101.00</td>
<td>3.880</td>
<td>26</td>
</tr>
<tr>
<td>101.50</td>
<td>4.383</td>
<td>46</td>
</tr>
<tr>
<td>102.00</td>
<td>4.882</td>
<td>72</td>
</tr>
<tr>
<td>102.50</td>
<td>5.370</td>
<td>100</td>
</tr>
<tr>
<td>102.75</td>
<td>5.527</td>
<td>116</td>
</tr>
<tr>
<td>103.00</td>
<td>5.856</td>
<td>130</td>
</tr>
</tbody>
</table>

When the reservoir level was at 100.50m, the following flood hydrograph entered the reservoir.

<table>
<thead>
<tr>
<th>Time (h)</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 (m$^3$/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 and obtain peak attenuation and peak lag.

5(a) Write short note on current meter.

5(b) For a catchment the effective rainfall hyetograph of an isolated storm and the corresponding direct runoff hydrograph is given below. Determine the coefficients $n$ and $K$ of Nash model IUH.

Coordinates of ERH:

<table>
<thead>
<tr>
<th>Time from start of storm (h)</th>
<th>Effective rainfall intensity (cm/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 6</td>
<td>4.3</td>
</tr>
<tr>
<td>6 to 12</td>
<td>2.8</td>
</tr>
<tr>
<td>12 to 18</td>
<td>3.9</td>
</tr>
<tr>
<td>18 to 24</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Coordinates of DRH:

<table>
<thead>
<tr>
<th>Time from start of storm (h)</th>
<th>Direct runoff (m$^3$/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>140</td>
</tr>
<tr>
<td>12</td>
<td>368</td>
</tr>
<tr>
<td>18</td>
<td>380</td>
</tr>
<tr>
<td>24</td>
<td>280</td>
</tr>
<tr>
<td>30</td>
<td>160</td>
</tr>
<tr>
<td>36</td>
<td>75</td>
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<td>42</td>
<td>30</td>
</tr>
<tr>
<td>48</td>
<td>10</td>
</tr>
<tr>
<td>54</td>
<td>0</td>
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</tbody>
</table>

6(a) Describe how the recession constants of direct runoff and base flow curves are obtained from semilogarithmic plot.

6(b) Characteristics of two catchments A and B measured from map are given below:

<table>
<thead>
<tr>
<th>Item</th>
<th>Catchment A</th>
<th>Catchment B</th>
</tr>
</thead>
<tbody>
<tr>
<td>$L_{ca}$</td>
<td>75 km</td>
<td>55 km</td>
</tr>
<tr>
<td>$L$</td>
<td>150 km</td>
<td>110 km</td>
</tr>
<tr>
<td>$A$(area)</td>
<td>2800 km$^2$</td>
<td>1400 km$^2$</td>
</tr>
</tbody>
</table>

For a 6 hr Unit Hydrograph in a catchment A, the peak discharge is at 37 hrs from the start of rainfall excess and its value is 205 m$^3$/s. Assuming the catchments A and B are meteorologically similar, determine the elements of 6 hr Synthetic Unit Hydrograph for catchment B using Synder’s Method.
M.TECH. (II SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
HYDRAULIC STRUCTURES
HYDROPOWER STRUCTURES
(CE - 617)

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 proportionally raised.)

NOTE:
(i) Attempt any Four questions. Each question carries equal marks
(ii) Assume suitable data if required
(iii) Symbols used have their usual meanings.

Q1. (a) What are the various sources of energy in nature? Briefly discuss the relative merits and demerits of hydro energy and thermal energy. Name two super power plants of India of any type (10)

Q1. (b) Draw the neat sketch of a run-off river scheme showing its necessary components (5)

Q2. (a) Differentiate among:
(i) Average load and peak load
(ii) Base load plants and peak load plants
(iii) Load curve and power duration curve (6)

Q2. (b) Following data indicates the average monthly flow of a river in a driest year on record:

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumecs</td>
<td>110</td>
<td>90</td>
<td>70</td>
<td>50</td>
<td>30</td>
<td>25</td>
<td>65</td>
<td>220</td>
<td>300</td>
<td>190</td>
<td>115</td>
<td>110</td>
</tr>
</tbody>
</table>

Assuming overall efficiency of turbine as 95%, construct and plot a power duration curve. Gross head = 100 m, head loss 2% of the gross head, specific weight of water = 9810 N/m³
Using this graph find:

(i) Base power
(ii) Power on the basis of availability of water for 50% of time
(iii) Determine the storage required to cope with the remaining 50% of the time

Q3. (a) What are draft tubes? How the hydraulic efficiency of a draft tube is defined? Draw the neat sketch of Moody’s type draft tube and explain its working.

Q3. (b) A hydroelectric station is to be supplied with 10 m$^3$/s of water through a penstock ($f = 0.016$). The maximum normal pressure on the penstock is $5 \times 10^3$ KN/m$^2$ and a water hammer over pressure of 30% over the normal pressure is anticipated. The safe stress in the steel is presumed to be $3 \times 10^5$ KN/m$^2$. The ready penstocks at the site are likely to cost Rs. 15000/ton including erection charges. The life of the project is 60 years and the rate of the interest is 11.5%. It is proposed to sell the energy at the rate of Rs. 3.25/KWh. What should be the optimum diameter of the penstock, given that OMR cost is 8%. Assume the turbine efficiency as 89% and annual load factor as 45%.

Q4.(a) What are the main functions of surge chambers? Draw neat sketch of any two type of surge chambers which are in operation in Indian hydel schemes.

A hydropower scheme in U.S.A. has a surge tank at the end of a 2 Km long tunnel having 4.0 m diameter. The surge tank which is rectangular in section may be presumed to be of circular cross section with 16.0 m diameter. The penstocks system consists of 5 penstocks each 1.525 m diameter and 3.8 m long. These can be represented by a single penstock, 380m long and 3.41 m in diameter. The friction factors for tunnel and penstocks are 0.018 and 0.032 resp. The acoustic wave velocity in the penstock is 1400 m/s. In steady state, the head reservoir level is EL 457.00 m with a discharge of 26.0 m$^3$/s. Find maximum upsurge, down surge and time of oscillation of the surge.
Q4. (5) What are the assumptions in the rigid water column theory of water hammer analysis?

Q5. Describe the elastic water column theory of water hammer analysis in closed conduits. Show that the differential equation for water hammer head using elastic water column theory is given by:

\[ \frac{\partial V}{\partial x_1} = -\frac{g}{a^2} \frac{\partial H}{\partial t} \]

\[ a = \sqrt{\frac{1}{\rho \left[ \frac{1}{E} + \frac{D}{2E} \right]}} \]

Where symbols have their usual meanings

Q6. Write short notes on any three of the following

i) Dimensioning of power house
ii) Spiral casings
iii) Cavitation in turbines and pumps
iv) Lining of tunnels
v) Intakes
vi) Specific speed of turbines
2011-2012  
M. Tech (II SEMESTER) EXAMINATION  
(CIVIL ENGINEERING)  
 ENVIRONMENTAL ENGINEERING)  
 BIOLOGICAL PROCESS OF WASTE WATER TREATMENT  
(CE 626)  

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 all questions  
(ii) Assume Missing data Suitably  
(iii) The symbols have their usual meanings.

1. (a) Briefly describe the necessity of providing biological treatment units in wastewater treatment.  
(b) Differentiate between a CSTR and a PFTR. What are their advantages and disadvantages? Briefly describe the suitability of the reactor systems for the biodegradation of toxic pollutants.  
(c) Determine the number of completely mixed chlorine contact chambers each having detention time of 25 minutes that would be required in a series arrangement to reduce the bacterial count of a polluted water sample from \(10^6\) organisms per mL to 25.5 organisms per mL if the first order reaction rate constant is equal to 6.1 h\(^{-1}\).  

OR

1'. (a) A completely mixed reactor is used to treat a wastewater of 5000 m\(^3\)/d. The BOD removal efficiency of the reactor was 80%. Calculate the volume of the reactor. Take the value of \(k = 0.23\) d\(^{-1}\). What would be the volume of the reactor if a PFTR was used for the same BOD removal efficiency? Calculate the total volume of the reactor if a number of CSTRs (2, 5, 10, 20 and 50) are used in a series arrangement. What do you conclude from this exercise?  
(b) Derive the formula for the effluent concentration for a CSTR receiving a constant input of a tracer undergoing decay.  

2. (a) Define half velocity coefficient and endogenous coefficient. Briefly explain their significance in biological treatment.  
(b) Derive the equation for bacteria growth \((dX/dT)\) and substrate degradation rate \((dS/dT)\).  
(c) Define \(Q_{\text{min}}\) and explain its significance.
3. (a) Differentiate between the working of a suspended growth and attached growth systems of biological treatment. Give at least two examples of each system. (4)

(b) Design an activated sludge process for a wastewater flow of 10,000 m$^3$/d using the following data.

Inlet BOD$_5$ = 200 mg/L, MLSS = 2000 mg/L, SVI = 100, Y = 0.4, Ks = 120 mg/L, k = 6.0 d$^{-1}$, k$_d$ = 0.08 d$^{-1}$. Assume a suitable value of SRT. (8)

OR

3' (a) Discuss in detail the different modified forms of the activated sludge process. (8)

(b) Describe the working of a sequencing batch reactor. Briefly explain its advantages over conventional biological reactor systems. (4)

4. (a) Describe the mechanism and microorganisms involved in anaerobic treatment of wastewaters. (6)

(b) Briefly explain the toxic effects of sulphides and ammonia on anaerobic treatment. (6)

5. Discuss in detail the different techniques used for the biological treatment of nitrogen. Support your answers with process description and chemical equations involved. (12)
2011-2012
M.Tech Winter (IInd Semester) Examination
CIVIL ENGINEERING
(Environmental Engineering)
INDUSTRIAL WASTEWATER TREATMENT
CE-627
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"

Attempt all questions.
Assume any information if required.

Q1 (a) What is an industrial waste survey aimed at? What information is obtained for the design of wastewater treatment for an industry? (06)

OR

Q1 (a') Describe briefly the various methods of volume and strength reduction of industrial wastewater. Give suitable examples. (06)

Q1 (b) Explain the purpose of equalization and suggest its location and design criteria in an industrial wastewater treatment scheme. (06)

OR

Q1 (b') What is the importance of neutralization in industrial wastewater treatment? What type of neutralization unit is designed for industrial waste highly acidic in nature? (06)

Q2 For the following data find out the minimum equalization volume required and also find out equalized flow rate and organic loading.

<table>
<thead>
<tr>
<th>Time (hrs)</th>
<th>Flow (m³/hr)</th>
<th>Average BOD (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 4</td>
<td>250</td>
<td>260</td>
</tr>
<tr>
<td>4 – 8</td>
<td>300</td>
<td>350</td>
</tr>
<tr>
<td>8 – 12</td>
<td>600</td>
<td>290</td>
</tr>
<tr>
<td>12 – 16</td>
<td>550</td>
<td>220</td>
</tr>
<tr>
<td>16 – 20</td>
<td>450</td>
<td>190</td>
</tr>
<tr>
<td>20 – 24</td>
<td>300</td>
<td>230</td>
</tr>
</tbody>
</table>

(12)

Q3 (a) Calculate the methane production and revenues generated in a distillery for the following data:
Spent wash volume: 50 m³/d
COD removed in reactor: 60,000 mg/L
Calorific value of methane: 35000 kJ/m³
Calorific value of coal: 1500 kcal/kg (06)

cont’d... 2
Q3 (b) How do you remove cyanides from wastewater of an electroplating industry? A plating waste stream with a flow of 10,000 L/d contains 5000 mg/L cyanides. Determine the amounts of chlorine and caustic soda required to oxidize the cyanide to N₂ and CO₂.

OR

Q3 (b') Give a flow diagram of processes in a brewery. Describe the various methods being practiced for control of pollution in this industry.

Q4 (a) The following data were collected for a Chlor-Alkali industry:
Production capacity: 20,000 T NaOH/yr
Salt consumption: 30,000 T/yr
Mercury consumption: 8000 kg/yr
Wastewater generated: 400 m³/d
The concentration of mercury in various streams are:
Brine mud: 2.4 mg/g , Caustic soda: 200 g/l, Hydrogen: 20 mg/m³, Wastewater: 2 mg/L

Estimate the amount of brine mud generated and loss of mercury through mud, hydrogen, caustic soda, and wastewater. Make a mass balance for mercury for this plant.

Q4 (b) Indicate the sources of wastewater in an electroplating industry. Describe the process and treatment flow diagram.

OR

Q4 (b') With the help of a flow diagram describe the various processes in a tannery. Give a schematic diagram of a treatment plant treating tannery waste.

Q5 Describe the manufacturing process, points of waste generation along with characteristics of wastewater for any two of the following industries. Also sketch and explain the treatment plant flowsheet for these industries.
(i) Petroleum refinery
(ii) Sugar Mill
(iii) Slaughterhouse
(iv) Distillery
Discuss in detail about the philosophy of selecting units of wastewater treatment plant (WWTP) with respect to its parameters along with the following issues:
  i. Hydraulics of the WWTP considering top water level of the discharge body
  ii. How intermediate pumping can be avoided?
  iii. Removal of grits from the Grit Channels

Suppose you are given a choice to plan and design a sewage treatment plant for your city (say Aligarh) having population of about 10 lakhs, which technology you would opt for? Support your answer with reasonable justification with its merits and demerits.

Discuss in detail the purpose of the following units and their design conditions:
  i. Inlet Chamber
  ii. Screen Chamber (Manual and Mechanical)
  iii. Grit Removal Facility
  iv. Proportional Weir

List wastewater treatment technologies based on aerobic and anaerobic principles and write their description in brief.

Design a complete sewage treatment plant (all the units essentially required) based on an activated sludge process using the following data:

Flow = 50 MLD
BOD$_{in}$ = 250 mg/l
TSS$_{in}$ = 400 mg/l
COD$_{in}$ = 500 mg/l
BOD$_{out}$ = 20 mg/l
TSS$_{out}$ = 30 mg/ml
Feacal Coliforms$_{in}$ = 4.1 x 106 MPN/100 ml
Feacal Coliforms$_{out}$< 10000

OR
Q.No. 3' Using the same data as in Q.No.3, Design a complete sewage treatment plant based on UASB Technology.

Q.No. 4a What are the different methods for dewatering of sludge? Discuss in brief the advantages and disadvantages of each method.

Q.No. 4b What is the difference in the design approach for a primary sedimentation tank and secondary clarifier?

Q.No. 5 Write brief notes on any four of the following:

i. Rising Main
ii. Historical development of UASB Technology in India
iii. Measurement Technique of Organic Matter (present in wastewater)
iv. How MBBR technology can be said as neither an attached growth nor suspended growth?
v. Purpose and Design Criteria of Parshall Flume
2011-12
M. Tech. Winter (II Semester) Examination
(Civil Engineering)
(Structural Engineering)
Tall Buildings
(CE 644)

Maximum Marks: 60  Credits: 04  Time: 3 Hours

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

Note:

i) Answer all questions.

ii) Assume any data suitably, if not given.

iii) Use of relevant Indian Standards is allowed.

iv) Notations used have their usual meanings.

1. Describe in detail the various types of structural systems used in tall buildings. Compare their relative merits and demerits.

Marks (15)

2. (a) Obtain the terrain, height and structure size factor \( k_2 \) for a class C building 60 m in height situated 1 km inside a category 2 area which is on a sea coast. Take the story height as 3 m.

(b) A RC framed building 45×15×60 m consists of storeys 4 m high. Assume the building is situated in terrain category 3 with basic wind speed of 50 m/s in a fully developed velocity profile. Determine the design wind force on the building normal to 45 m base.

Marks (10)

3. Using the provisions of IS:1893 (2002), evaluate the lateral forces and storey shear at each floor of a 15 storeyed OMRF building as shown in Fig. 1 with the following data:

Seismic zone  
Soil type  
Thickness of slab  
Wall thickness  
Beam cross section  
Column cross section  
Live load

IV  
Rock (Hard Soil)  
150 mm  
230 mm  
300×450 mm  
300×600 mm  
3 kN/mm²

Fig. 1

OR

Contd... 2
A 4 storeyed SMRF office building located in seismic zone V rests on medium stiff soil. The roof and floor loads are 3000 kN and 4200 kN respectively. Determine the design seismic forces for the building using dynamic analysis. Show the distribution of lateral forces and the storey shear along the building height using the free vibration properties of building as given below. The building is symmetrical in x and y direction and the properties in both the directions are same. Use the provisions of IS: 1893 (2002).

<table>
<thead>
<tr>
<th>Floor</th>
<th>Natural period (sec)</th>
<th>Mode I</th>
<th>Mode II</th>
<th>Mode III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.860</td>
<td>0.265</td>
<td>0.145</td>
</tr>
<tr>
<td>Mode shape coefficient</td>
<td></td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Roof</td>
<td>1.000</td>
<td>0.216</td>
<td>-0.831</td>
<td>-0.574</td>
</tr>
<tr>
<td>3\textsuperscript{rd} Floor</td>
<td>0.904</td>
<td>-0.701</td>
<td>-0.574</td>
<td>1.016</td>
</tr>
<tr>
<td>2\textsuperscript{nd} Floor</td>
<td>0.716</td>
<td>-0.921</td>
<td>-0.574</td>
<td>1.016</td>
</tr>
<tr>
<td>1\textsuperscript{st} Floor</td>
<td>0.441</td>
<td>-0.216</td>
<td>-0.831</td>
<td>-0.574</td>
</tr>
</tbody>
</table>

4. (a) What is ‘Shear Wall’? Mention its different types. Why the shear walls are provided in the tall buildings?

(b) A bar bell type shear wall with central part 4200×200 mm and two 450×450 mm strong bands at each end, supported on a footing 9×4 m, rests on soil whose modulus of sub grade reaction is 30000 kN/m² as shown in Fig. 2. Determine the lateral stiffness of wall. The height of the wall is 15 m. The grade of concrete is M20.

![Fig. 2](image)

4'. A simple one storey building has two shear walls in each direction as shown in Fig. 3. It has some gravity columns that are not shown. All four walls are in M25 grade concrete, 200 mm thick and 5 m long. The storey height is 4 m. The floor consists of cast in-situ reinforced concrete. Design shear force on the building is 200 kN in either direction. Compute design lateral forces on different shear walls as per the provisions of IS:1893 (2002).

![Fig. 3](image)
2011 – 2012
M.TECH. WINTER (II SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
(HYDRAULIC STRUCTURES)
WATER RESOURCES ENGINEERING
(CE-662)

Max Marks : 60
Duration : Three Hours

Note: (i) “Students governed by the old ordinance will be examined out of 75 marks and their obtained marks shall be proportionately raised.”
(ii) Attempt any four questions.
(iii) Assume suitable data, if required.

1. (a) Write a note on ‘Interlinking of rivers in India’. 10
    (b) Outline the objectives of water resources development. 05

2. Two alternative plans are considered for a section of an aqueduct. Plan A uses a tunnel; plan B uses a section of lined canal and a section of steel flume. In plan A, the estimated first cost of the tunnel is $500,000, estimated annual maintenance is $5,000 and its estimated life is 100 years. Estimated first cost and lives for the elements of plan B are canal (not including lining), $125,000, 100 year; canal lining, $ 50,000, 20 yr; flume, $90,000, 50 yr. The annual maintenance cost is $10,500. All salvage values are assumed to be negligible. Compare the equivalent annual costs for both the plans. The interest rate to be used in economy study is 6% per annum and the study period is 100 yr. 15

3. (a) What do you understand by “Multi-purpose projects”? Discuss the functional requirements and their compatibility in Multiple purpose projects. 10
    (b) Write a short note on ‘Environmental consequences of water-resources projects’. 05

4. Five alternative projects are under consideration. The estimated annual benefits and costs of the projects are tabulated as below. Which of these projects would you select? Give the reasons also.

<table>
<thead>
<tr>
<th>Project</th>
<th>Annual Benefit ($)</th>
<th>Annual cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1,50,000</td>
<td>1,28,104</td>
</tr>
<tr>
<td>II</td>
<td>2,10,000</td>
<td>1,56,048</td>
</tr>
<tr>
<td>III</td>
<td>2,75,000</td>
<td>2,08,064</td>
</tr>
<tr>
<td>IV</td>
<td>3,00,000</td>
<td>2,84,152</td>
</tr>
<tr>
<td>V</td>
<td>3,40,000</td>
<td>3,36,158</td>
</tr>
</tbody>
</table>

15

5. (a) Explain ‘Commonly accepted measures’ for reducing flood damage. 08
    (b) Discuss a suitable example of cost analysis for a combination of flood-mitigation measures. 07

Contd.....2,
6. Give graphical solution to linear programming for the following problem-

A reservoir has 6 units of water to be supplied in 30 days. Two groups of crops are to be grown in the command area. For the first group of crop two units of water is required in 7 days while the second group requires one unit of water in 8 days. The price of irrigation revenue is Rs.150 only for the first crop requiring- two units of water and Rs.80 only for the second crop. If the revenue collection is to be the maximum, then how many units of water for each crop should be supplied?
2011-2012
M. TECH. WINTER (II SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
INSTRUMENTAL METHODS FOR ENVIRONMENTAL
ANALYSIS
(CE-683)

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".

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

Q.1(a) How the environmental analysis differs from traditional analytical chemistry. 5 Marks

Q.1(b) Show the chemical structure of some important organic pollutants found in the environment. 7 Marks

OR

Q.1(b)' What is the difference in meaning of the term ‘parts per million’ when applied to gas concentration and aqueous concentration? 7 Marks

Q.2(a) Discuss the importance of calibration curve or standard curve used in environmental analysis. 6 Marks

Q.2(b) Describe various reasons that can cause heterogeneity, that is, the difficulties in obtaining representative samples from surface water. 6 Marks

OR

Q.2(b)' Make a list of important factors that are useful in developing in sample design including where, when, and how many samples are collected. 6 Marks

Q.3(a) Give a list of water quality parameters that must be measured immediately in the field while sample is being taken. 5 Marks

Q.3(b) Explain the potential contaminants that may leach from sample containers or sampling tools made of glass, PVC, plastics and stainless steel. 7 Marks

OR

Q.3(b)' Explain what fractions of atoms in the flame are typically in the exited state? Why flame absorption based spectrophotometers are normally more sensitive than flame emission spectrometer? 7 Marks

Continued .... Page No.2
Q.4(a) Write short notes on any two of the following:
   i)  Nebulizer and atomizer in the FAA
   ii) Monochromator
   iii) Light source  
   OR

Q.4(a) Explain how Zeeman background correction is used to minimize spectral interferences.

Q.4(b) Why a capillary column is more efficient than a packed column in separation?

Q.5(a) Draw a schematic diagram showing the essential components of a GC.
   OR

Q.5(a) Explain why ECD is highly sensitive to chlorinated pesticides, such as DDT?

Q.5(b) Write the importance of GC-MS and discuss its application in environmental engineering.
2011-2012

M. TECH. WINTER (II SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
ENVIROMENTAL POLICIES AND IMPACT ANALYSIS
(CE-686)

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".

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

Q.1(a) Briefly outline the project activities of any one industry that disturb the conditions in the sustainable environment.

Q.1(b) Name the various impact evaluation methodologies. Discuss any one of them in detail with necessary diagram.

OR

Q.1(b)' State the requirements of an environmental management system and duties of an environmental engineer in an industry.

Q.2(a) Discuss the various examples of socioeconomic factors and their potential changes resulting from project implementation.

Q.2(b) Discuss the representative socioeconomic issues in water quality management planning efforts.

OR

Q.2(b)' Write short notes on any two of them.
   i) Major elements of environmental impact analysis
   ii) Primary maximum contaminant level (PMCL) and secondary maximum contaminant level (SMCL)
   iii) Advantages of environmental impact analysis

Q.3(a) Outline the various factors affecting dispersion of 05 pollutants in the atmosphere.

Q.3(b) The heat emission rate associated with a stack gas is 4850 kJ/s, the wind and stack gas speeds are 5 and 15 m/s, respectively, and the inside stack diameter at the top is 2m. Estimate the plume rise by means of Moses & Carson general equation and Holland formula.

Continued .... Page No.2
Q.3(b) The wind speed and stack gas speeds are 3 and 6 m/s, respectively, and the stack diameter is 2m. The atmospheric stability condition is neutral with a temperature of 300 °K, and the stack gas temperature is 440 °K. Estimate the plume rise in meters by TVA model equation. C=1.58

Q.4(a) Discuss the sources of errors in Gaussian Model. Describe the advantages and disadvantages of Gaussian models.

OR

Q.4(a)' Write the basic Gaussian plume model with its usual notations and show variable plume model through diagram.

Q.4(b) Estimate the total hydrocarbon concentration at a point 300 m downwind from an expressway at 6:30 P.M. on an overcast day. The wind is perpendicular to the highway and has a speed of 4 m/s. The traffic density along the highway is 8000 vehicles per hour, and the average vehicle speed is 64000 m/hr. The average vehicle emission rate of hydrocarbon is $2 \times 10^{-2}$ g/s.


Table 4-1 KEY TO STABILITY CATEGORIES

<table>
<thead>
<tr>
<th>CLASS</th>
<th>DAY</th>
<th>NIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>INCOMING SOLAR RADIATION</td>
<td>CLOUD COVER</td>
</tr>
<tr>
<td></td>
<td>STRONG</td>
<td>MODERATE</td>
</tr>
<tr>
<td>SPEED AT 10 m (m/s)</td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>&lt; 2</td>
<td>A</td>
<td>A-B</td>
</tr>
<tr>
<td>2-3</td>
<td>A-B</td>
<td>B</td>
</tr>
<tr>
<td>3-5</td>
<td>B</td>
<td>B-C</td>
</tr>
<tr>
<td>5-6</td>
<td>C</td>
<td>C-D</td>
</tr>
<tr>
<td>&gt; 8</td>
<td>C</td>
<td>C-D</td>
</tr>
</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 unstable.*