Q.No. 1.

For a spring system shown in Fig. 1, 
\( k_1 = 200 \text{ N/mm}, \ k_2 = 150 \text{ N/mm}, \ k_3 = 150 \text{ N/mm}, \ k_4 = 175 \text{ N/mm}, \ F_1 = 300 \text{ N}, \ F_2 = 200 \text{ N}, \ U_f = U_4 = 0 \)

![Spring System Diagram]

Obtain: (a) the global stiffness matrix 
(b) the displacement of nodes 2 and 3 
(c) the reaction forces at nodes 1 and 4.

Q.No. 2.

Determine the nodal displacement at node 2, stresses in each material and support reactions in the bar as shown in Fig. 2, due to applied force \( P = 400 \text{ kN} \) and temperature rise of 30° C.

![Bar with Aluminium and Steel Diagram]

\[
\begin{align*}
A & = 2400 \text{ mm}^2 \\
E & = 0.7 \times 10^5 \text{ N/mm}^2 \\
\alpha & = 22 \times 10^{-6} / ^\circ \text{C} \\
\end{align*}
\]

\[
\begin{align*}
A & = 1200 \text{ mm}^2 \\
E & = 2.0 \times 10^5 \text{ N/mm}^2 \\
\alpha & = 12 \times 10^{-6} / ^\circ \text{C} \\
\end{align*}
\]

Fig. 2

OR

2. (a) Derive relations for shape functions both in Cartesian and Natural coordinates for a...
two noded bar element.
(b) Using Generalised Hooks law for homogeneous and isotropic material, derive expression for stiffness matrix for a plane-stress problem.

3 For the three bar truss as shown in Fig. 3, determine the member forces if the support B sinks by 0.1 mm. Find the support reactions also. Take $E = 200 \, \text{GPa}$.

\[ \text{Fig. 3} \]

4 Derive relationship for shape functions for a three noded triangular (Constant Strain Triangular) element and its Strain-Displacement matrix $[B]$.

OR

4' A beam with loading is shown in Fig.4. Assuming two, two-noded beam elements, form the stiffness matrices for each element, assemble global $[K]$ matrix and determine;
(a) slopes at nodes 2 and 3
(b) vertical deflection at the midpoint of the distributed load.

\[ E = 200 \, \text{GPa} \]
\[ I = 4 \times 10^6 \, \text{mm}^4 \]

\[ \text{Fig. 4} \]
2014-15
(Winter Semester) Examination
M.Tech. Civil (Structural Engineering)
Dynamics
CE-607

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
IS 1893 is permissible.
Notations used have their usual meaning.

Q.No. Question M.M.

1(a) Derive the relation for forced vibration (sinusoidal force) for single degree freedom system and plot the graph between dynamic amplification factor (μ) v/s frequency ratios (η) for different damping ratio (ξ).

1(b) An empty elevated water tank is pulled by a steel cable by applying 30 kN force. The tank is pulled horizontally by 5 cm. The cable is suddenly cut and the resulting free vibration is recorded. At the end of five complete cycles, the time is 2.0 second and the amplitude is 2.0 cm. Determine the damping ratio, natural period of undamped vibration, effective stiffness, effective weight and damping coefficient for the given data.

OR

1'(a) A mass of 0.07 kg is suspended from a spring of stiffness 45 N/m. The mass is pulled downward by 15 mm from its equilibrium position and then released. The upward velocity observed was 25 mm/s. Determine the maximum velocity, maximum acceleration and the phase angle.

1'(b) A machine foundation supports a motor weighing 15 kN. It has unbalanced mass of 10N at an eccentricity of 40 mm radius. The resonance occurs at 2100 rpm. Determine the maximum amplitude of vibration if the operating speed of machine is 2800 rpm and damping ratio is 10%.

Contd...2.
2(a) A single degree of freedom system with natural period \( T_0 \) and damping ratio \( \xi \) is subjected to the periodic force as shown in Fig. 1 with an amplitude \( P_0 \) and period \( T_0 \). Expanding the forcing function in its Fourier Series.

\[ \text{Fig. 1} \]

2(b) Using Green's theorem derives the response (displacement) time equation for rectangular pulse.

3(a) Define the Rayleigh's method. Determine the natural frequency of vibration of a spring-mass system considering also the distributed mass of the spring as shown in Fig. 2. The spring has a length \( L \) and total mass \( m_0 \).

\[ \text{Fig. 2} \]

3(b) Determine the first three natural frequencies and the corresponding modal shapes of vibration of a simply supported beam of span \( L \) having uniform flexural rigidity and subjected to any system of loading.

4 For the building shown in Fig. 3 below is located in seismic zone IV. The type of soil encountered is medium stiff and is proposed to design the building with a special moment resisting frame. Determine the dynamic properties i.e. natural periods and mode shapes for vibrations in both directions.

The two-storey RCC school building is having the following dimensions:

- Thickness of the slab = 150 mm

Contd....3.
width of the outer walls = 300 mm
width of the inner walls = 150 mm
size of the column = 300 mm x 300 mm
live load on floors = 4 kN/m² and live load on roof = 1.5 kN/m²

Fig. 3
OR

4’ The plan of a five-storey symmetrical RCC building is shown in Fig. 4. Each storey is 3.5 high. The building is located in seismic zone V. The type of soil encountered is rocky/hard and is proposed to design the building with special moment resisting frame. The intensity of dead load is 10kN/m² and the floors are to cater an imposed load of 3kN/m². Determine the design seismic loads on the structure by static analysis.

Fig. 4
2014-15
M.TECH. (WINTER SEMESTER) EXAMINATION
STRUCTURAL ENGINEERING (CIVIL)
ADVANCED STEEL DESIGN
CE-608

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q.No. Question
1.0 A self supporting steel chimney is 70 m high and has a shell diameter of 2.75 m at
top. The location of the chimney is such that the intensity of wind pressure up to
10m height is 1.5 kN/m², which linearly increases to 1.85 kN/m² at a height of 70 m.
Configure the other parameters of the chimney as per IS specifications. Take the
allowance for corrosion also as per IS specifications. Design the thickness of the
chimney shell at 20m from top. Assume that the allowable stress in axial
compression and in bending for the circular steel stack as 72 N/mm² and 80 N/mm²
respectively.

2.0 A deck type plate girder bridge is to be provided for a single meter gauge track and
standard main line loading. The total span of main girder from centre to centre of
bearing is 24 m. The main girders are provided at a spacing of 1.30 m between their
centre lines. 0.60kN/m stock rails and 0.40kN/m guard rails are provided. The
weight of fastenings may be taken as 0.20kN/m. The sleepers are spaced at 400 mm
centre to centre and are of size 2.0 m x 250 mm x 250 mm. The unit weight of
timber may be assumed as 7.50kN/m³. The floor is open deck type. Design the
maximum section of the main plate girders.

Note:

Contd...2.
Equivalent Uniformly Distributed Live Load in kN on each Track

<table>
<thead>
<tr>
<th>Span L (metres)</th>
<th>Total Load for B.M. (kN) M.L.</th>
<th>Total Load for S.F. (kN) M.L.</th>
<th>Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>1658</td>
<td>1408</td>
<td>1802</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1528</td>
</tr>
</tbody>
</table>

M.L. = Main Line, B.L. = Branch Line

OR

2.0' A Pratt-truss through bridge is provided for single broad gauge track. The effective span of the bridge is 50 m. The cross girders are spaced at 5 m apart. The stringers are spaced 2 m between centre lines whereas 0.60 kN/m stock rails and 0.40 kN/m check rails are provided. The weight of fastenings may be taken as 0.20kN/m. The sleepers are spaced at 0.45 m centre to centre and are of size 2.0m x 0.25m x 0.20m. The weight of the timber is 7.5kN/m³. The main girders are provided at a spacing of 7m between their centre lines. Design any top or bottom chord member.

Note:

Equivalent Uniformly Distributed Live Load in kN on each Track

<table>
<thead>
<tr>
<th>Span L (metres)</th>
<th>Total Load for B.M. (kN) M.L.</th>
<th>Total Load for S.F. (kN) M.L.</th>
<th>Impact Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>4380</td>
<td>3470</td>
<td>4713</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3702</td>
</tr>
</tbody>
</table>

M.L. = Main Line, B.L. = Branch Line

3.0 A microwave tower of 50 m height is proposed over a hill top at Coimbatore as shown in Fig. 1. The height of the hill is 50m with a gradient of 1 in 4. The terrain category is III. The tower is mounted with a hollow hemispherical dome of 2m diameter weighing 10kN. Calculate the solidity ratio of top five panels. Also compute the design wind pressures of top five panels.

OR

3.0' A riveted steel rectangular flat bottom tank is of capacity 80,000 litres. The tank rests on four columns with an overhang of 0.5m on all sides. The available width of the plate in the market is 1.25 m and of length up to 6.5 m. The height of staging is 10 m. Provide an appropriate dimension of the tank. Design the thickness of the bottom steel plate and T-cover for joining the plates.

Contd...
The permissible stress in direct tension for water tanks $= 0.8 \times 0.6 = 0.48$
Permissible stress in bending tension and bending compression in plates $=0.8 \times 0.66$
$= 0.528$

4(a) Determine the load factor of the portal frame shown in Fig.2 if plastic moment capacity of all members is 100kN.m.

![Fig. 2]

4(b) Explain any three

(i) fatigue and fatigue damage
(ii) difference between high-cycle and low-cycle fatigue failures.
(iii) $S-N$ curve
(iv) important general points for the design of a welded structure with respect of fatigue strength.

Contd...4.
Maximum Marks: 60

Note:
(i) Answer any Five Questions
(ii) All parts of a question should be attempted in one continuation in one copy
(iii) All questions carry equal marks

Q. 1 (a) Discuss various types of discounts offered by the seller company in detail.
        (6)
       
(b) Discuss various types of cost associated with inventory management.
        (6)

Q. 2 (a) Discuss main features, advantages and drawbacks of following types of contracts:
         (1) Lump Sum Contract
         (2) Item Rate Contract
         (3) Cost Plus Contract
         (6)

(b) Explain the managerial and legal aspect of construction activity in detail.
     (6)

Q. 3 (a) Discuss concept of wage and its types in detail.
        (6)

(b) Write down the H R (Human Resource) hierarchy of Structural Engineering consultancy firm. Discuss role of each position in detail. Also draw the H R calendar.
     (6)

Q. 4 (a) Write down a brief account on profile of construction industry in India.
        (6)

(b) Discuss inherent characteristics of construction project in detail.
     (6)

Q. 5 (a) List and discuss factors of production needed for any economic activity in detail.
        (6)

(b) Discuss Marginal Utility, Marginal Cost, Marginal Revenue in detail with examples.
     (5)

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 in detail “Estimate is a opinion, Price is a policy and Cost is a fact.”
        (6)

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

   (i) Equity  (ii) Liability  (iii) Asset  (iv) Creditors  (v) Debtors  (vi) Revenue
M.TECH. (II SEMESTER) EXAMINATION  
(CIVIL ENGINEERING)  
(HYDRAULIC STRUCTURES)  
ADVANCED ENGINEERING HYDROLOGY  
CE-616

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 the following:  [06]
     (i) Deterministic and probabilistic processes  (ii) Storm transposition and maximization  (iii) Skewness and kurtosis
1(b)  Enumerate various theoretical distributions normally used for hydrologic design. During the construction period of 10 years of a reservoir, a coffer dam is required to be constructed with a capacity to take care of 5 year flood. What is the probability that the flood will not occur at all.  [06]

OR

1' Route the flood hydrograph through a river reach and estimate attenuation and time lag for the following inflow hydrograph of the reach

<table>
<thead>
<tr>
<th>Time(h)</th>
<th>0</th>
<th>4</th>
<th>8</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>28</th>
<th>32</th>
<th>36</th>
<th>40</th>
<th>44</th>
<th>48</th>
<th>52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow (m³/s)</td>
<td>42</td>
<td>68</td>
<td>116</td>
<td>164</td>
<td>194</td>
<td>200</td>
<td>192</td>
<td>170</td>
<td>150</td>
<td>128</td>
<td>106</td>
<td>88</td>
<td>74</td>
<td>62</td>
</tr>
</tbody>
</table>

The value of K and x for the reach may be taken as 12 h and 0.278 respectively. Assume outflow 42 m³/s at the start of inflow.

2(a) Calculate probable maximum precipitation for the design of spillway using the following data:

Contd... 2.
<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>

Take value of frequency factor as 12

2(b) Give the step wise procedure for constructing flood frequency curve of an ungauged catchment.

OR

The ordinates of a 2 - h U.H. of a basin of area 300 km² measured at 1 - h intervals are 5, 35, 65, 90, 105, 92, 78, 67, 57, 48, 40, 33, 26, 22, 16, 12, 8, 5.2 and 1 m³/s respectively. Obtain the ordinates of a 3 - h U.H. for the basin using the S-curve technique.

3 What is the significance of a Unit Hydrograph? Derive a 3 h synthetic unit hydrograph of a basin with the following data: Basin area = 3000 km², Length of the main stream = 120 km; Distance from centroid of the basin to the outlet = 63 km. The Synder’s coefficients Cᵣ and Cₛ may be assumed to be 1.6 and 0.64 respectively.

4 Discuss Clark’s model for developing an IUH (Instantaneous unit hydrograph). A drainage basin has the following characteristics:

<table>
<thead>
<tr>
<th>Travel time t (h)</th>
<th>0 - 2</th>
<th>2 - 4</th>
<th>4 - 6</th>
<th>6 - 8</th>
<th>8 - 10</th>
<th>10 - 12</th>
<th>12-14</th>
<th>14-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isochrone area (km²)</td>
<td>3</td>
<td>9</td>
<td>20</td>
<td>22</td>
<td>16</td>
<td>18</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

Determine the IUH for this catchment.

5 A reservoir has the following elevation, discharge and storage relationships:

<table>
<thead>
<tr>
<th>Elevation (m)</th>
<th>Storage (Mm³)</th>
<th>Outflow discharge (m³/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>
</tbody>
</table>

Contd...
When the reservoir level was at 100.50 m, 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 (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 Goodrich method.
2014-2015
M. Tech. WINTER (II SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
(HYDRAULIC STRUCTURES)
Advanced Hydraulics
CE-618

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). Derive the discharge formula for Sutro weir. Also derive the equation for the profile of its curved portion. [12]

OR

1' (a). A rectangular sharp crested suppressed weir is 3m long and 1.2m high. During a high flow in the channel, the weir was submerged with the depth of flow of 1.93m and 1.35m at the upstream and downstream of the weir respectively. Estimate the discharge. [06]

1' (b). For a hydraulic jump taking place in a horizontal, frictionless, triangular channel show that the sequent depths \( y_1 \) and \( y_2 \) are related to the pre-jump Froude number \( F_1 \) as

\[
F_1^2 = \frac{2 \eta^2 (\eta^2 - 1)}{3(\eta^2 - 1)}
\]

Where \( \eta = y_2 / y_1 \) [06]

2(a). Using basic differential equation of Spatially Varied flow with decreasing discharge, derive De Marchi equation for side weirs stating its assumptions. [06]

2(b). Classify the various types of flow over longitudinal bar bottom racks. [06]

3. A lateral spillway channel is trapezoidal in cross section with \( B = 5 \) m, side slope \( m = 1 \) and \( n = 0.018 \). The bed slope is 0.10. If the lateral inflow is 2.5 m\(^3\)/s/m, find the critical depth and its location. Assume \( \beta = 1.20 \). [12]

OR

3'. A rectangular channel of 2m width carries a flow with a velocity of 8.75m/s and... [12]
depth of 1.25m. A side weir of height 0.75m and length 1.2m is provided in one of its walls. Find the quantity of flow diverted.

4(a). Explain the Fick’s law of diffusion in an open channel. Differentiate advective and turbulent diffusion. [04]

4(b). A stream having a width of 22m and a depth of 1.1m carries water at a velocity of 0.85m/s. The bed slope is 0.00025. An effluent from an industry on the bank of this stream was accidentally discharged into the stream in the form of a slug over the entire width, the volume of disposed effluent being 5 m³. Plot the curve of concentration vs time at a section 2 km downstream of the point of discharge. [08]

5. Write short note on any three of the following:
(a) Self-aeration in Hydraulic jump
(b) Uniformly discharging side weirs
(c) Compound channel
(d) Aeration need of rectangular weir

(12)
2014-15
M.TECH. (WINTER SEMESTER) EXAMINATION
ENVIRONMENTAL ENGINEERING
Biological Processes for Wastewater Treatment
CE 626

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)     Name the different biological treatment systems used in wastewater treatment                     [02]
1 (b)     Draw the hydraulic profiles of CSTR and PFTR under pulse and step input of non conservative tracer. [04]
1 (c)     Determine the volume of a CSTR required to achieve 90% removal efficiency of a tracer undergoing decay with a first order reaction rate constant of 6.1 hr⁻¹. Assume flow rate as 5 MLD. What is the volume of a PFTR for the same removal efficiency? Calculate the volume requirement if 2 nos., 5 nos., 10 nos., 20 nos. and 50 nos. of CSTRs are arranged in series. What conclusions you draw from the above exercise? [06]

OR

1' (a)    Derive the equation used for the determination of effluent concentration of a tracer in a PFTR receiving continuous input of a tracer undergoing decay. Assume steady state conditions. [04]
1' (b)    Briefly explain how mass balance concepts help in determining the tracer behaviour in reactors? [02]
1' (c)    Define Ks, k, Y, μ_max and k_d and explain their significance in biological treatment of wastewaters. [06]

2 (a)     Using mass balance derive the expression for S and X in a CSTR with cells recycle. [06]
2 (b)     What do you understand by Θ_c min? Explain its significance. [02]

contd... 2
2 (c) Define loading velocity, food to microorganism ratio, mean cells residence time and write their expressions for a CSTR with cells recycle

3 (a) Design an activated sludge process for the treatment of 12500 m$^3$/d of domestic wastewater using the following data:
$S_0 = 200$ mg/L, $k = 7$ d$^{-1}$, $K_s = 50$ mg/L, $Y = 0.45$, $k_d = 0.06$ d$^{-1}$. Assume suitable values of MLSS. Take SVI as 90.

OR

3' (a) Enumerate the different modified forms of activated sludge process. Describe in detail the extended aeration system and sequencing batch reactor configurations. Also explain their suitability and advantages.

3 (b) With the help of diagram describe the functioning of Rotating Biological Contact process.

4 (a) Enumerate the different methods of phosphorous removal. Describe the mechanism involved in enhanced biological phosphorous removal system.

4 (b) Design a UASB process for the treatment of 10 MLD of municipal wastewater in a single module. Peak flow is expected to be twice the average flow. The characteristics of wastewater may be taken as follows:
pH = 7.5, BOD 300 mg/L, COD 600 mg/L, $SO_4 = 100$ mg/L, TSS = 400 mg/L

5 (a) Describe the nutrient requirements in anaerobic treatment

5 (b) Write Prescod McGarry equation for maximum organic loading to be applied in aerobic pond without becoming anaerobic.

5 (c) Design a stabilization pond system that will contain anaerobic pond followed by three facultative pond and two maturation ponds. The maturation ponds would be operated in parallel, but other ponds are operated in series. The design temperature is 20°C. The influent BOD may be assumed as 300 mg/L and the flow rate as 2000 m$^3$/d. Assume BOD removal of 40% in anaerobic pond. The HRT in maturation pond may be taken as 24 hours. Assume suitable values of design parameters.
2014-15
M.TECH. II (WINTER SEMESTER) EXAMINATION
CIVIL ENGINEERING
(Environmental Engineering)
INDUSTRIAL WASTEWATER TREATMENT
CE-627

Maximum Marks: 60
Duration: Three Hours

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

Q1(a). What is the difference between a grab sample and a composite sample? About 4 litres of composite sample of wastewater is needed to carry out necessary analysis. It is proposed to collect samples at 2 hr interval over 24 hours. In what proportion to the flow the sample volume should be collected if the expected wastewater volume during one day is 500 m³. The actual flow and COD measurements on the day of the sample collection are given below. Determine the average flow, volume and COD of the composite sample.

<table>
<thead>
<tr>
<th>Time</th>
<th>9am</th>
<th>11am</th>
<th>1pm</th>
<th>3pm</th>
<th>5pm</th>
<th>7pm</th>
<th>9pm</th>
<th>11pm</th>
<th>1am</th>
<th>3am</th>
<th>5am</th>
<th>7am</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow (m³/hr)</td>
<td>15</td>
<td>14</td>
<td>18</td>
<td>16</td>
<td>16</td>
<td>22</td>
<td>14</td>
<td>20</td>
<td>18</td>
<td>20</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>COD (mg/L)</td>
<td>180</td>
<td>210</td>
<td>310</td>
<td>280</td>
<td>350</td>
<td>250</td>
<td>200</td>
<td>100</td>
<td>300</td>
<td>210</td>
<td>130</td>
<td>280</td>
</tr>
</tbody>
</table>

Q1(b). Explain the purpose of equalization in industrial wastewater treatment. For the following data find out the minimum equalization volume required and also find out the 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>

Contd... 2
Q2(a). Indicate the sources of wastewater in an electroplating industry. Describe the process and treatment flow diagram. 

Q2(b). A metal processing industry produces 20000 litres per day of a waste stream containing 325 mg/L cyanide as NaCN and 550 mg/L hexavalent chromium as H₂CrO₄. Calculate:
(i) the stoichiometric amounts of chlorine and caustic soda required to oxidize the cyanide to N₂ and CO₂.
(ii) the amount of SO₂ required to reduce the chromium to the less toxic trivalent form.

Q3. Describe in detail, the manufacturing process in a Chlor-Alkali industry. How the wastewater stream containing mercury is treated? How much mercury is consumed in a plant producing 30,000 Tonnes NaOH/year? Make a mass balance for mercury in this plant and calculate mercury losses through different major routes.

OR

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

Q3'(b). Design an activated sludge process for a sugar mill discharging 2000m³/d wastewater having a BOD of 1200 mg/L. Your design should include aeration tank volume, excess sludge amount, sludge recirculation and oxygen requirement. Assume, efficiency of BOD removal = 90%, 0ₖ = 5 days, kₐ = 0.05 d⁻¹, Y = 0.5, X = 2000 mg/L and, Xₛ = 10,000 mg/L.

Q4. Sketch and explain the flow diagram of processes and waste generation in a distillery. Suggest a treatment scheme for the wastewater in this industry. A distillery producing 6 kL/d alcohol consumes furnace oil at the rate of 130 kg/hr. Calculate energy recovery potential, given: spent wash COD 1,00,000 mg/L, waste flow 90 m³/d, efficiency of COD removal 65%, calorific value of methane 8550 kcal/m³, calorific value of furnace oil 9588 kcal/L.

Q5(a). Describe the manufacturing process, points of waste generation along with characteristics of wastewater for a brewery. Also sketch and explain the treatment plant flowsheet for this industry.

OR

Q5(a'). With the help of a flow diagram describe the various processes and wastewater streams in a tannery. Give a schematic diagram of a treatment plant treating tannery waste.

Q5(b). For a tannery processing 500 hides everyday, calculate the spent chrome tan liquor generated. How much basic chromium sulphate is consumed and discharged in waste annually? Suggest a methodology to be adopted for chromium recovery.
2014-2015
M.Tech (IInd Semester) Examination
Environmental Engineering
WASTEWATER TREATMENT PLANT DESIGN AND OPERATIONS
CE-629

Maximum Marks: 60

Duration: Three Hours

Instructions:
Attempt/Answer all the questions.
Assume suitable data, in case it not given.
Notations have their usual meanings.

Q.No. 1a  It is said that under Indian context, there are many challenges and issues for wastewater treatment / management. Enumerate some of these challenges and propose your solutions to overcome.

Q.No. 1b  What are the common technologies for municipal wastewater treatment? Explain the merits and demerits of each technology.

Q.No. 1c  What are the aerobic and anaerobic processes for wastewater treatment? Write chemical equation of each process for the biological degradation of organic matter.

OR

Q.No. 1c  Explain any attached culture growth system for wastewater treatment and its working principle. Prepare a diagram showing section of this type of treatment system.

Q.No. 2a  What are the essential parameters (pollutants) you look for sewage treatment? Discuss the significance of each parameter from environmental point of views and their removal mechanism at the wastewater treatment plants.

Q.No. 2b  Design an inlet chamber, screen chamber, grit channel and a proportional weir to treat a flow of 15 MLD. Peak factor is 2.25. The size of grit particle is 0.15 mm and specific gravity is 2.65. Assume the width of rectangular bar as 6mm and clear spacing of 25mm. You have a choice to divide the flow into two or more streams with provision of standby. Prepare a neat sketch of your design.

contd - 2
Q.No. 2b  Design a primary sedimentation tank (circular) of an activated sludge process based sewage treatment plant for the same flow as in Q.No. 2b. Your design should essentially include:
   i. Diameter of the tank
   ii. Water Depth and Free Board
   iii. Length of Effluent Weir
   iv. Number of V-notches
   v. Head over V-notch
   vi. Effluent launder (width of the launder and water depth at closed end)

Q.No. 3  Design a wastewater treatment based on an activated sludge process (aeration tank, secondary clarifier and anaerobic digester) to treat a flow (Q.No. 2a) for influent BOD of 275 mg/l, TSS 400 mg/l, and COD 450 mg/l. The outlet BOD and TSS concentration should be less than 20 mg/l and 50 mg/l respectively. Use the following data:
   Mean Cell Residence Time = 10 d
   MLSS Concentration = 3000 mg/l
   Y = 0.5 g VSS/ g CODrem
   Kd = 0.1gVSS/g VSSd
   Underflow Sludge Concentration = 10000 mg/l
   Neatly draw schematic of your designed units

Q.No. 4  Using the same data (Q.No. 3), design a wastewater treatment plant based on UASB technology. Your design should essentially include UASB reactors and biogas holder:
   i. No. of reactors required
   ii. Surface Area and Volume of each reactor
   iii. HRT
   iv. Sludge bed depth
   v. Settler Area
   vi. Height of the reactor
   vii. Sludge production from reactors
   viii. Height and volume of the biogas holder
   Neatly draw schematic of your design.
2014-15
M.TECH. (II SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
STRUCTURAL ENGINEERING
ADVANCED CONSTRUCTION MATERIALS
(CE-642)

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Attempt all the questions.
All questions carry equal marks

Q.No. Question M.M.
1(a) With the help of neat sketch describe the various defects in timber. [08]
1(b) What is varnish? What are its ingredients? [04]

OR

1'(a) What are the various ingredients of paints? State the functions of each of them. [08]
1'(b) Enumerate the various applications of plastics in building industry. [04]

2. Write short note on any Three of the followings: [12]
   (i) Natural and artificial seasoning.
   (ii) Organic and inorganic polymers.
   (iii) Distemper
   (iv) Stress - strain curve of FRC under tension.
   (v) Polymer concrete.

3(a). What are Fibre Reinforced Polymeric (FRP) meshes? [02]
3(b). Discuss in details the factors affecting the properties of Fibre Reinforced Concrete (FRC). [10]

4(a). What are the advantages and disadvantages of Ferrocement? Write down the normal ranges of composition of Ferrocement. [05]
4(b). Explain the behaviour of RCC and Ferrocement under tension. [07]

5(a). Mention some of the commonly used fibres in FRC and their relative advantages and disadvantages. [05]
5(b). Give the classification of steel and discuss their main properties and uses. [04]
5(c). What are the applications of Ferrocement? [03]

OR

5'(a) With neat sketches, explain various types of wire meshes used in Ferrocement. [05]
5'(b) Briefly discuss the mechanical properties of Ferrocement. [04]

5'(c) What are the advantages and disadvantages of Fibre Reinforced Polymeric (FRP) meshes. [03]
1. Discuss in detail various types of vertical and lateral load resisting system used in tall buildings. [15]

2. Calculate the horizontal shear at each floor of 12 storey building frame shown in Fig.1 with the following data. Use the provisions of IS: 1893 (2002).

- Thickness of slab = 150 mm
- Wall thickness = 225 mm
- Beam cross section = 300×400 mm
- Column cross section = 300×600 mm
- Live load = 3 kN/m²
- Concrete grade = M20
- Steel grade = Fe415

![Plan and Elevation Diagram](image)

**Fig.1**

**OR**

2. A three storey OMRF school building, located in seismic zone V rests on medium stiff soil. The roof and floor loads are 600 kN and 700 kN respectively. Determine the design seismic forces for the building using dynamic analysis and show the distribution of lateral forces with building height using the free vibration properties of the building as given below. The building is symmetrical in the x and y direction and its properties in both the directions are same. Use the provisions of IS: 1893 (2002). [15]
<table>
<thead>
<tr>
<th>Natural Period (sec)</th>
<th>Mode I 0.0647</th>
<th>Mode II 0.023</th>
<th>Mode III 0.016</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd floor</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2nd floor</td>
<td>0.802</td>
<td>-0.555</td>
<td>-2.247</td>
</tr>
<tr>
<td>1st floor</td>
<td>0.445</td>
<td>-1.246</td>
<td>1.8018</td>
</tr>
</tbody>
</table>

3(a). What are the various effects induced by wind in tall buildings. Elaborate at length the dominance of each of them with reference to the geometry of the tall building.

3(b). What are the various factors influencing the along wind response of the tall buildings. Explain them briefly.

OR

3. The plan of a thirty storied building is shown in Fig.2. The column positions are marked in the figure. The building has to serve as community structure in Aligarh. Using gust factor method of IS:875(Part-III), calculate the wind forces at 3m, 12m, 18m, 30m, 39m, 48m, 54m, 60m, 75m and 90m above the ground level in an intermediate frame marked by section 1-1. Following data are given (Assume all other data suitably if required):
Height of each story = 3 m
Total height of the building = 90 m
Mean probable life of the building = 100 years

![Fig. 2](image)

4(a). List different types of shear walls using neat sketches. Discuss their merits and demerits.

4(b). A bar bell type shear wall with central part 4000×200 mm and two 300×300 mm strong bands at each end is supported on a footing of size 9.5x4.5 m, as shown in Fig.3. Determine the lateral stiffness of the wall. The height of the wall is equal to 10 m. Assume characteristic compressive strength of concrete $f_{ck} = 30$N/mm$^2$, shape factor = 0.8 and Poisson's ratio, $\nu = 0.23$.

![Fig.3](image)
### Question Details

**Maximum Marks: 60**

**Credits: 04**

**Duration: Three Hours**

**Answer any FOUR questions.**
**Assume suitable data if missing.**
**All questions carry equal marks.**

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(a) Write a note on recent floods in Kashmir</td>
<td>5x3</td>
</tr>
<tr>
<td></td>
<td>(b) Discuss the objectives of water resources development.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(c) Write a short note on 'Future of Water Resources' in India.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(a) Write a short note on interlinking of rivers in India</td>
<td>[5]</td>
</tr>
<tr>
<td></td>
<td>(b) Explain commonly accepted measures for reducing flood damage and the methods of raising levee height in emergencies.</td>
<td>[10]</td>
</tr>
<tr>
<td>3</td>
<td>(a) What do you understand by Multipurpose Projects? Discuss the functional requirements and their compatibility in multipurpose projects.</td>
<td>[10]</td>
</tr>
<tr>
<td></td>
<td>(b) Define ‘Flood Fighting’. Discuss some typical flood wall sections with clear sketches.</td>
<td>[5]</td>
</tr>
<tr>
<td>4</td>
<td>(a) Write a short note on system analysis in water resources projects.</td>
<td>[5]</td>
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<tr>
<td></td>
<td>(b) Give an optimal solution for the following problem:</td>
<td></td>
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<tr>
<td></td>
<td>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 for the first crop while Rs.80 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?</td>
<td>[10]</td>
</tr>
<tr>
<td>5</td>
<td>(a) Write a note on environmental consequences of Water Resources Projects.</td>
<td>[5]</td>
</tr>
</tbody>
</table>
(b) Four alternative small-scale hydroelectric projects are under consideration. The estimated annual costs and benefits of some water resources projects are tabulated as follows:

<table>
<thead>
<tr>
<th>Project</th>
<th>Annual cost</th>
<th>Annual benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$100,000</td>
<td>$135,000</td>
</tr>
<tr>
<td>B</td>
<td>140,000</td>
<td>250,000</td>
</tr>
<tr>
<td>C</td>
<td>250,000</td>
<td>400,000</td>
</tr>
<tr>
<td>D</td>
<td>330,000</td>
<td>450,000</td>
</tr>
</tbody>
</table>

Which of these projects would you select?

(a) Define capital recovery factor. Discuss various steps in economic analysis of water resources projects.

(b) 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 $450,000, its estimated annual maintenance cost is $4000, and its estimated life is 100 years. Estimated first costs and lives for the elements of plan B are canal (not including lining), $120,000, 100 years; canal lining, $50,000, 20 years; flume $90,000, 50 years. The annual maintenance cost is $10,500. The interest rate to be used in the economy study is 6 percent per annum. The study period is 100 years. All salvage values are assumed to be negligible.
2014-2015
M.TECH. (II SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
INSTRUMENTAL METHODS FOR ENVIRONMENTAL ANALYSIS
(CE-683)

Maximum Marks: 60

Duration: Three Hours

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

Q.1(a) What is the need of preservation of some water samples? 5.0

Q.1(b) What do you understand by Grab samples, Composite samples and Integrated samples? Discuss their merits and demerits for environmental analysis.

OR

Q.1(b) Draw the structure of the following organic compound by their functional group.
   i) $\text{CH}_3\text{CH}_2\text{NH}_2$
   ii) $\text{CH}_3\text{CH}_2\text{COOH}$
   iii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

Q.1(c) Discuss the application of standard calibration curve in analytical analysis for environmental sampling.

Q.2(a) Describe the common environmental laboratory techniques for water sampling.

Q.2(b) What is the quality of reagent water? Write the methods of preparation of reagent water.

OR

Q.2(b) Discuss the application of Beer-Lamberts' law in quantitative analysis.

Q.2(c) Discuss the application of Spectrophotometer. Explain the function of Monochrometer.

Continue.....Page 2
Q.3(a) Draw the schematic diagram showing the essential parts of GC.

OR

Q.3(a) Describe the general strategy in keeping different zone of GC. Why is this important?

Q.3(b) What differs between packed column and capillary columns regarding their performance in separation?

Q.3(c) Two chemicals (A and B) are separated on a GC capillary column with retention times 14.5 and 18.5 minute, and peak widths (at base) 0.80 and 0.93 minute for A and B respectively. An unretained air peak occurs at 1.1 minute. Calculate: retention factor, separation factor, resolution and average plate number.

Q.4(a) What are the major similarities and difference between the mass spectrometers used in atomic mass spectroscopy and those used in molecular mass spectroscopy?

Q.4(b) What are the factors (criteria) in selecting which atomic spectroscopic instruments for metal analysis?

Q.4(c) Discuss the function of any two of the following in brief. i) Nebulizer and Atomizer. ii) Detectors. iii) Carrier gases. iv) Injector.

END
M.TECH. (WINTER SEMESTER) EXAMINATION
CIVIL (ENVIRONMENTAL)
SOLID AND HAZARDOUS WASTE MANAGEMENT
CE-685

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) How the properties of solid waste are characterized? What are the typical [06]
components of domestic solid waste generated?
1(b) What are the different functional elements of Integrated Solid Waste [06]
Management? Explain each elements briefly.
2(a) What are the recommendations of EPA, Heuristic Report for Solid Waste [06]
Collection? What is the collection system for high rise buildings?
2(b) Discuss the cost curve for direct haul system and cost curve for transport when [06]
transfer station is included. Give reasons for consideration of transfer station in
collection routes.

OR

2'(b) What is the cause of temperature and pH variation during the composting process? [06]
What is the role of thermophilic and mesophilic microorganisms in composting
process? What is the importance of nutrients and oxygen concentration in
composting process?
3(a) What are the different physical, chemical and biological processes used for [06]
treatment of leachate? Draw the Landfill Plan for different components of landfills.
3(b) Determine the methane production rate from anaerobic digestion of tonne of waste [06]
if the ultimate analysis without sulphur including water is C_{50}H_{100}O_{40}N. Assume
CHON is 55 percent of the wet weight of the waste. Density of methane is
0.7167kg/m³. Also estimate the energy content for this composition of solid waste.
4(a) Determine the area required for a new sanitary landfill site with a projected lifetime [04]
of 25 years. The landfill will serve a population of 250,000 persons. Waste density

contd... 2
in the landfill averages 550 kg/m$^3$ and the landfill height is not to exceed 15m.

4(b) At a compost facility, a mixture of about 10 tonnes of food waste, yard waste and paper waste is to be composted. The moisture content of this waste measures 7.5%. The intent is to make a mixture for composting of 50% moisture. Calculate the amount of water to be added to the solids to achieve this moisture content in the compost pile?

4(c) A carbonaceous waste given by chemical formula C$_{48.5}$H$_{96.2}$O$_{31.6}$N$_{1.2}$ is to be incinerated. Proximate analysis of the waste gives moisture and non-combustibles to be 5.1 and 6.8% respectively. Calculate the volume of air needed for the complete combustion of 2000 kg of the input material.

5(a) Identify the characteristics of major hazardous waste generated in your locality with suitable example

OR

5'(a) What is Mass burn and Refuse Derived Fuel (RDF)? Explain briefly about the process to obtain RDF?

5(b) Discuss the generation source of hazardous waste.

OR

5'(b) Discuss the various equipment required for collection of hazardous waste.

5 (c) Discuss the physical, chemical and biological methods of treating hazardous waste.
<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Discuss the following in detail</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>i) Frame work for environmental impact analysis</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>ii) Distinguish between criteria and standard. Discuss the standards for Bathing beaches and Receiving Waters</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>iii) Distinguish between EIA and EIS</td>
<td>5</td>
</tr>
<tr>
<td>2(a)</td>
<td>Define four levels of ambient air quality</td>
<td>5</td>
</tr>
<tr>
<td>2(b)</td>
<td>Explain air quality impact assessment approach.</td>
<td>10</td>
</tr>
<tr>
<td>3(a)</td>
<td>Discuss what is necessity of Environmental Policies?</td>
<td>5</td>
</tr>
<tr>
<td>3(b)</td>
<td>Discuss act related to air and water.</td>
<td>10</td>
</tr>
<tr>
<td>4(a)</td>
<td>What do you understand by attributes? Discuss various environmental attributes generally required for conducting EIA studies.</td>
<td>5</td>
</tr>
<tr>
<td>4(b)</td>
<td>What are the effect of toxic chemicals on environment, support your answer with example?</td>
<td>10</td>
</tr>
<tr>
<td>5(a)</td>
<td>What are the various methodologies to carry out EIA?</td>
<td>5</td>
</tr>
<tr>
<td>5(b)</td>
<td>Explain Check list method and Leopold Matrix method to carry out Environmental Impact Analysis.</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Explain with the help of conceptual approach to carry out</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>i) Surface water environmental impact analysis</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>ii) Impacts on the biological environment</td>
<td></td>
</tr>
</tbody>
</table>