Q.1 (a) Compute all the singularities of the following functions. State the types and order (in case of poles) of these singularities and also find residue at each singular point.

(i) $z \cos \left(\frac{1}{z^2}\right)$

(ii) $\frac{\sin z}{z^2(z-\pi)}$

(b) For $c > 0$, the function $f(z) = e^{z^c + \frac{c^2}{2z^2}}$ is analytic at all points in the plane except at $z = 0$ and $z = \infty$. Hence $f(z)$ can be expanded in the annulus $r < |z| < R$ as a Laurent’s series where $r$ is small and $R$ is large such that $f(z) = \sum_{n=-\infty}^{\infty} a_n z^n$, where $a_n = \frac{1}{2\pi i} \int_C \frac{f(z)dz}{z^{n+1}}$. Considering $C: |z| = c$, show that

$$a_n = \frac{e^{-c/2}}{2\pi n} \int_0^{2\pi} e^{c(\cos^2 \theta + \cos \theta)} \cos [c \sin \theta (1 - \cos \theta) - n \theta] d\theta.$$ 

Q.2 (a) Let us consider the contour $C: |z - 1| = 1$. Evaluate the following integrals by the specified methods (i) $\oint_C \frac{dx}{z^{n+1}}$, by residue theorem (ii) $\oint_C \frac{\sin z}{(z-1)^n} dz$, by Cauchy integral formula.
Q.2 (b) Using residue theorem, evaluate \(\int_{-\infty}^{\infty} \frac{\cos 2x}{4-x^2} \, dx\) \hspace{1cm} (6)

Q.3 (a) Consider the function \(f(z) = z + \frac{1}{z}\). Describe the two level curves \(v(x, y) = 0\) and \(v(x, y) = 1\). Discuss it in terms of flow.
(b) Show that the function \(f(z) = -(2xy + 5x) + i(x^2 - 5y - y^2)\) is analytic for all \(z\). Find \(\frac{df}{dz}\).
(c) Compute the circulation and net flux for the given flow and the indicated closed contour.
\(f(z) = \frac{\cos z + 2zi}{(z-1)^2}, |z - 1| = 2\).

Q.4 (a) Use the Schwarz-Christoffel formula to construct a conformal mapping from the upper half plane as shown in Fig. 1 to the region shown in Fig. 2.

(b) The complex potential \(G(z) = k\log(z - 1) - k\log(z + 1)\) with \(k > 0\) gives rise to a flow on the upper half plane with single source at \(z = 1\) and single sink at \(z = -1\). Show that the streamlines are the family of circles with centre on the \(y\)-axis.

(SECTION B)

Q.5 (a) The system of equations
\[
\begin{align*}
x^2y + y^3 &= 10 \\
x^2y^3 - x^3 &= 3
\end{align*}
\]
has a solution near \(x = 0.8, y = 2.2\). Perform two iterations of the Newton-Raphson method to obtain the root of the desired accuracy.
(b) Solve the system of differential equations
\[
\begin{align*}
\frac{dy}{dx} &= xz + 1 \\
\frac{dz}{dx} &= -xy
\end{align*}
\]
for \(x = 0.2\) using fourth order Runge Kutta method with \(h = 0.2\). The initial conditions are \(y = 0, z = 1\) at \(x = 0\).
Q.6 (a) Solve the BVP by the Rayleigh-Ritz method
\[
\frac{d^2y}{dx^2} + y = x^2, \quad y(0) = 0 = y(1)
\]
(b) Using Galerkin technique, solve the equation
\[
\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = K, \quad 0 < x, y < 1
\]
with \( u = 0 \) on the boundary \( C \) of the region \( R \).

Q.7 (a) Determine by iteration method the values at the interior lattice points of a square region of the harmonic function \( u \) whose boundary values are given as shown in the figure below up to two steps.

(b) Use Gram Schmidt's method to solve the heat equation \( \frac{\partial u}{\partial t} = 5 \frac{\partial^2 u}{\partial x^2} \) with the boundary conditions \( u(0, t) = 0, u(5, t) = 0 \) and
\[
u(x, 0) = \begin{cases} 
20x, & 0 \leq x \leq 3 \\
60, & 3 \leq x \leq 5
\end{cases}
\]
For three time steps with \( h = 1 \).

Q.8 (a) Evaluate the pivotal values of the following equation taking \( h = 1 \) and up to one half of the period of vibrations \( 16 \frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2} \), given that \( u(0, t) = u(5, t) = 0, u_t(x, 0) = 0 \) and \( u(x, 0) = x^2(5 - x) \).
(b) Solve \( \frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} \) subject to the initial condition \( u = \sin \pi x \) at \( t = 0 \) for \( 0 \leq x \leq 1 \) and the boundary conditions \( u = 0 \) at \( x = 1 \) for \( t > 0 \). Take \( h = 0.2, \lambda = 1 \) and compute the values of \( u \) at the internal mesh points up to two time steps.
### Question 1

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Explain the fatigue failure under cyclic loading.</td>
<td>[5]</td>
</tr>
<tr>
<td>1(b)</td>
<td>Design the most economical section of the continuous beam as shown in Fig. 1. Take $\sigma_y = 250 \text{ N/mm}^2$.</td>
<td>[10]</td>
</tr>
</tbody>
</table>

![Fig. 1](image)

**Fig. 1**

**OR**

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1'(a)</td>
<td>Explain in detail the brittle fracture mechanism.</td>
<td>[5]</td>
</tr>
<tr>
<td>1'(b)</td>
<td>A two bay rectangular portal frame is loaded as shown in Fig. 2. Find the value of $M_p$.</td>
<td>[10]</td>
</tr>
</tbody>
</table>

![Fig. 2](image)

**Fig. 2**

2. The self supporting steel chimney is 65 m high and has a shell diameter of 2.5 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 1.75 kN/m² at a height of 65 m. Configure the other parameters of the chimney as per IS specifications. Also design the thickness of the chimney at 30m and 50 m height from the bottom. Assume that the allowable stress in axial compression and in bending for the circular steel stack is 71.8 N/mm² and 78.7 N/mm² respectively.

[contd... 2]
3 A riveted steel rectangular flat bottom tank is of capacity 90,000 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 1.20 m and of length upto 10 m. The height of staging is 10 m. Provide an appropriate dimensions of the tank. Design the thickness of the bottom steel plate and an intermediate longitudinal beam on which the tank is resting.

The permissible stress in direct tension for water tanks = \(0.8 \times 0.6 \sigma_y = 0.48 \sigma_y\)

Permissible stress in bending tension and bending compression in plates = \(0.8 \times 0.66 = 0.528 \sigma_y\)

OR

3' A Pratt-truss through bridge is provided for single broad gauge track, the effective span of the bridge is 45 m as shown in Fig. 3. The cross girders are spaced at 4.5 m apart. The stringers are spaced 2 m between centre lines where as 0.60 kN per meter stock rail and 0.40 kN per meter check rails are provided. The sleepers are spaced at 0.45 m centre to centre and are of size 2.8m x 0.25m x 0.20m. The weight of the timber is 7.5 kN/m³. The main girder are provided at a spacing of 7m between their centre lines. The equivalent uniformly distributed line loads (EUDL) in kN for B.M. and S.F. are 3995 and 4301 respectively on each track for main line at 45 m length and at impact factor of 0.339. Design any top or bottom chord member.

![Fig. 3](image)

4 A microwave tower is proposed at Sriperumbudur, Madras on a hill top. The height of the tower is 85 m. The hill is 300 m high with a gradient of 1 in 5 on the right side and a gradient of 1:3 on the left side of the crest. (i.e. the actual length of the upward slope on either side of the crest are 1500 m and 900 m respectively). the tower is proposed at a distance of 100 m from the crest on the downward slope. The tower to be designed for a period of 50 years. Calculate the design wind pressure on the tower on both sides of the hill. Adopt the wind forces as per IS:875 - Part3.
2013-14
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
1(a) Explain the following:
   (i) Probable Maximum Precipitation
   (ii) Standard Project Flood
   (iii) Skewness and kurtosis
1(b) Differentiate among risk, reliability and safety factors giving examples in context with hydrology.

OR

1' A drainage basin of area 600 km² has experienced a 12 - h storm with rainfall intensities of 25, 18 and 23 mm/h respectively in successive periods of 4-h each. The percentage of the distribution graph for storms of 4 - h duration are 5, 15, 30, 20, 13, 9, 5.5 and 2.5. Determine the ordinates of discharge hydrograph. Assume an average Φ - index of 0.8 cm/h and neglect base flow.

2(a) Give step-wise procedure for calculating peak flood corresponding to a given return period by Log Pearson type III distribution.
2(b) Describe the method of regional flood frequency analysis for constructing flood frequency curve of an ungauged catchment.

OR

2' 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...
3 Write short notes on any two of the following:
(i) Methods of measurement of stage of a river (ii) Double Mass curve technique
(iii) Significance of unit hydrograph.

4 Discuss the factors affecting the rising limb of a flood hydrograph. The ordinates of the
recession limb of a hydrograph are listed below. Assuming that runoff consists of only
direct runoff and base flow, find the recession constants for the base flow and direct
runoff.

<table>
<thead>
<tr>
<th>Time (days)</th>
<th>Flow (m³/s)</th>
<th>Time (days)</th>
<th>Flow (m³/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>411</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>15</td>
<td>358</td>
<td>21</td>
<td>83</td>
</tr>
<tr>
<td>16</td>
<td>250</td>
<td>22</td>
<td>70</td>
</tr>
<tr>
<td>17</td>
<td>192</td>
<td>23</td>
<td>58</td>
</tr>
<tr>
<td>18</td>
<td>151</td>
<td>24</td>
<td>49</td>
</tr>
<tr>
<td>19</td>
<td>122</td>
<td>25</td>
<td>41</td>
</tr>
</tbody>
</table>

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>
<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 100.50 m, the following flood hydrograph entered the
reservoir.

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>Discharge (m³/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>12</td>
<td>55</td>
</tr>
<tr>
<td>18</td>
<td>80</td>
</tr>
<tr>
<td>24</td>
<td>73</td>
</tr>
<tr>
<td>30</td>
<td>58</td>
</tr>
<tr>
<td>36</td>
<td>46</td>
</tr>
<tr>
<td>42</td>
<td>36</td>
</tr>
<tr>
<td>48</td>
<td>25</td>
</tr>
<tr>
<td>54</td>
<td>20</td>
</tr>
<tr>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>66</td>
<td>13</td>
</tr>
<tr>
<td>72</td>
<td>11</td>
</tr>
</tbody>
</table>

Route the flood by Goodrich method and obtain peak attenuation and peak lag.
M.TECH EXAMINATIONS
(CIVIL ENGINEERING)
HYDRO-POWER STRUCTURES
(CE - 617)

Maximum Marks = 60

Note: Attempt all questions. All questions have equal marks. Assume suitable data if needed. Terms used have their usual meanings.

Q.

(a) Compare any two non-conventional sources of energy.

(b) Calculate head loss through trash rack using following data:
- Clear spacing of bars = 10 cm
- Thickness of bars = 1.0 cm
- Angle of inclination of bars with horizontal = 60°
- Discharge in front of bars = 100 m³/s
- Length of trash rack = 10 m
- Depth of flow of water in front of rack = 5 m

OR

(a) Differentiate between
(i) Storage and Forebay
(ii) Draft tube and Vortex tube
(iii) Flow duration curve and Power duration curve

(b) Draw the neat sketch of tower type intake. Give two examples of this type.

(c) How penstocks are classified based on materials of construction?

Q(2)

Following data show the variation of flow in a stream. Draw the power duration curve and find:

(i) Primary Power
(ii) P10, P50, P75

(III) If the primary power is to be enhanced by 30% of its original power either by providing a diesel unit or by providing a reservoir, in both cases, find the capacity of diesel unit and reservoir.

<table>
<thead>
<tr>
<th>Month</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nom</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>m³/s</td>
<td>140</td>
<td>120</td>
<td>90</td>
<td>60</td>
<td>40</td>
<td>20</td>
<td>300</td>
<td>400</td>
<td>275</td>
<td>200</td>
<td>175</td>
<td>150</td>
</tr>
</tbody>
</table>

Take the overall efficiency as 92%. Gross Head is 100 m. The head lost in penstock etc. may be taken as two times the velocity head. Take velocity of flow in the penstock as 10 m/sec.
Q3 What are the functions of Surge Tanks in hydro-power plants?
Taking usual symbols derive expressions for maximum upsurge for a surge tank.

OR

Q3'(a) Explain the phenomenon of water hammer in a penstock. What are limitations of Rigid Water column theory?

Q3'(b) What is the function of the following in context with a hydel scheme?

(i) Manifold
(ii) Turbine
(iii) Spiral casing
(iv) Head race tunnel

Q4(a) Explain the phenomenon of cavitation in hydraulic machines. How turbines are classified based on specific speed, head or discharge?

OR

4'(a) Briefly discuss the analytical method to find the diameter of a steel penstock.

4(b) What are the advantages of lining of power canals?

5(a) Determine the absolute pressure head at the inlet of a vertical divergent draft tube which has following geometrical and hydraulic data.

Inlet diameter = 0.8 m
Outlet diameter = 1.2 m
Overall length = 6.0 m
Length of draft tube drowned = 0.5 m
Head loss = 0.3 times velocity head at outlet
Velocity of flow at inlet = 6.0 m/s

5(b) Write short notes on any two of the following

(i) Power house dimensioning
(ii) Setting of water turbines
(iii) Intake losses
2013-2014
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.  For the compound channel (Fig – 1), determine the discharge using Posey’s method. Take \( n = 0.02 \) and \( S_0 = 0.0009 \) for all parts of perimeter. Also estimate the depth \( y_m \) for which there is no underestimation of discharge.  

OR

1'(a)  Write the uses of linear proportional weir. Derive the discharge formula for Sutro weir.  

1'(b)  A hydraulic jump occurs in a horizontal 90° triangular channel. If the sequent depths in this jump are 0.60 m and 1.20 m, estimate the flow rate and Froude numbers at the beginning and end of the jump.  

2.  Show that by Mustkow’s method of analysis, the minimum length \( L_m \) of a parallel bar bottom rack required to completely divert the initial discharge \( Q_1 \) in a channel is given by

\[
L_m = \frac{Q_1}{\varepsilon C_1 B \sqrt{2 g E}} = \frac{E}{\varepsilon C_1} \left[ \frac{y_1}{E} \sqrt{\frac{1}{1 - \frac{y_1}{E}}} \right]
\]

3.  A lateral spillway channel is trapezoidal in cross section with \( B = 10 \) m, side slope \( m = 0.5 \) and \( n = 0.018 \). The bed slope is 0.15. If the lateral inflow is 2.5 m³/s/m, find the critical depth and its location. Assume \( \beta = 1.20 \).  

OR

3'  A rectangular channel \( B = 3 \) m, \( n = 0.015 \) is laid on a slope \( S_0 = 0.0004 \). A side weir is required at a section such that it comes into operation when the discharge is 2 m³/s and diverts 0.6 m³/s when the channel discharge is 3.6 m³/s. Design the elements of side weir.

contd ... 2
4(a) Define and Explain the terms:
   (i) Diffusion, (ii) Dispersion, (iii) Diffusion coefficient in transverse dimensions, and (iv) Dispersion coefficient for meandering channel.

4(b) An industry is located on the bank of river of 30 m width and depth of 1.5m. The slope of the river is $1.8 \times 10^{-4}$ and $n = 0.02$. The industry discharges 0.1 m$^3$/s of effluent continuously into the river. Find the concentration 15 km downstream of the point of discharge 4 hours the start of injection.

5. Write short note any three of the following:
   (a) Self-aeration in spillways
   (b) Trench Weir
   (c) Side channel spillway
   (d) Weir and sill
2013-14
M.TECH. (WINTER SEMESTER) EXAMINATION
CIVIL (ENVIRONMENTAL) ENGINEERING
INDUSTRIAL WASTEWATER TREATMENT
CE-627

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Describe in short, giving suitable examples, the various methods of volume reduction, strength reduction and neutralization of industrial wastewater.</td>
<td>[09]</td>
</tr>
<tr>
<td>1(b)</td>
<td>An industrial waste stream contains 550 mg/L of hexavalent chromium at a flow rate of 20000 L/d. Determine the amount of SO₂ required to reduce the chromium to the less toxic trivalent form.</td>
<td>[03]</td>
</tr>
<tr>
<td>2(a)</td>
<td>How do you remove cyanides from wastewater of an electroplating industry? A plating waste stream contains 85 kg of CN⁻ daily. Determine the amounts of chlorine and caustic soda required to oxidize cyanide to N₂ and CO₂.</td>
<td>[06]</td>
</tr>
<tr>
<td>2'(a)</td>
<td>How the wastewater stream containing mercury is treated in a Chlor-Alkali industry? Estimate the amount of brine mud generated and loss of mercury for a Chlor-Alkali industry with the following data: Production capacity: 20,000 T NaOH/yr, Salt consumption: 30,000 T/yr Mercury consumption: 8000 kg/yr, Wastewater generation: 400 m³/d The concentration of mercury in various streams are: Brine mud: 2.4 mg/g , Caustic soda: 200 g/T, Hydrogen: 20 mg/m³ , Wastewater: 2 mg/L</td>
<td>[06]</td>
</tr>
<tr>
<td>2(b)</td>
<td>With the help of a flow diagram describe the various processes in a leather industry. What quality of effluent can you expect from a chrome tanning industry? Give a schematic diagram of a treatment plant treating tannery waste.</td>
<td>[06]</td>
</tr>
</tbody>
</table>

cont'd...
3(a) An activated sludge process treatment system is to treat 5000 m³/d of industrial wastewater. The wastewater has a BOD of 550 mg/L which is to be reduced to 30 mg/L before it can be discharged into a river. Assuming \( \theta_c = 5 \) days, \( k_d = 0.05 \text{ d}^{-1} \), \( Y = 0.5 \), \( X = 3000 \text{ mg/L} \) and \( X_0 = 10,000 \text{ mg/L} \), calculate the volume of aeration tank, excess sludge amount, sludge recirculation and oxygen requirement.

OR

3'(a) 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>Average Flow (m³/sec)</th>
<th>Average BOD (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 4</td>
<td>0.225</td>
<td>150</td>
</tr>
<tr>
<td>4 – 8</td>
<td>0.140</td>
<td>90</td>
</tr>
<tr>
<td>8 – 12</td>
<td>0.425</td>
<td>110</td>
</tr>
<tr>
<td>12 – 16</td>
<td>0.350</td>
<td>210</td>
</tr>
<tr>
<td>16 – 20</td>
<td>0.275</td>
<td>160</td>
</tr>
<tr>
<td>20 – 24</td>
<td>0.250</td>
<td>80</td>
</tr>
</tbody>
</table>

3(b) Explain the difference between a grab sample and a composite sample. List the different methods for measurement of waste flow in an open channel.

4(a) With the help of a flow diagram describe the various processes in a leather industry. What quality of effluent can you expect from a chrome tanning industry? Give a schematic diagram of a treatment plant treating tannery waste.

4(b) Give a flow diagram of operations/processes in a distillery and brewery. Describe the various methods being practiced for the control of pollution in these industries.

5 For a sugar industry, give the following information:

(i) Manufacturing process
(ii) Wastewater streams generated and wastewater characteristics
(iii) Waste management plan
(iv) Effluent standards for the industry
2013-2014
M.Tech (IIInd Semester) Examination
(Civil Engineering)
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 if not given.
Answer in order of sequence of the questions.
Notations have their usual meanings.

Q.No. 1a Prepare an artistic diagram showing general topography of the city, sewer system, location of main pumping station, sewage treatment plant, discharge body and other relevant features. 5

Q.No. 1b What are the recent techniques for municipal wastewater treatment? Explain the theory of UASB Process with the help of a neat sketch. 5

Q.No. 2a A city having population of about 1 Million people has a water demand of 130 lpcd. Assuming suitable growth rate and using various methods for population prediction, estimate the population for the year 2025. For this flow, and taking into account the city character, poor energy status, propose a wastewater treatment scheme. Draw the flow diagram of the proposed scheme and write the function of each unit. 10

Q.No. 2b For the calculated flow in Q.No. 2a, design an inlet chamber, screen chamber, grit channel and a proportional weir. The size of grit particle is 0.15 mm and specific gravity is 2.65. Assume width of rectangular bar as 10mm and clear spacing of 25mm. Peak factor is 2.25. You have a choice to divide the flow into two or more streams with provision of standby. 10

OR

Q.No. 2b' Design a primary sedimentation tank (circular) of an activated sludge process based sewage treatment plant for the same flow as calculated in Q.No. 2a. Your design should essentially include:
   i. Diameter of the tank
   ii. Water Depth and Free Board

Contd... 2
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 an aeration tank and secondary clarifier with recycle of an Activated Sludge Process based sewage treatment plant to treat flow (Q.No. 2a) for influent BOD of 325 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
K_d = 0.3 g VSS/g VSS_d
Underflow Sludge Concentration = 10000 mg/l

Neatly draw schematic of your designed units

Q.No. 4a
What are the different methods for sludge dewatering? Design the sludge drying beds to dry the daily sludge production of 5000 kg. Assume drying cycle time of 10 days.

Q.No. 4b
Write brief notes on three of the following:

(i) Difference in between MBBR and MBR Technology for WWT
(ii) Do you agree that SBR is a modified form of ASP? If Yes, explain the reason.
(iii) Historical development of UASB Technology in India
(iv) General Planning for Siting a WWTP
2013-14
M.TECH. (II SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
STRUCTURAL ENGINEERING
ADVANCED CONSTRUCTION MATERIALS
(CE-642)

Maximum Marks: 60  Credits: 04  Duration: Three Hours

Answer all the questions.
All questions carry equal marks

Q.No.  Question  M.M.
1(a)  What is seasoning of timber and why is it done?  [05]
1(b)  What is the effect of paint on unseasoned timber?  [02]
1(c)  Describe various defects in timber.  [05]

OR

1'. Write short note on the followings:
   (i) Preservation of timber.
   (ii) High Fibre Volume Micro-Fibre Systems.
   (iii) Slurry infiltrated fibre concrete.  [12]

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

3(a). What are the advantages and disadvantages of Ferrocement? Write down the normal ranges of composition of Ferrocement.  [05]
3(b). Explain the behaviour of RCC and Ferrocement under tension.  [07]
4(a). Mention some of the commonly used fibres in FRC and their relative advantages  [04]
4(b). Explain the mechanism of Fibre-Matrix Interaction in FRC under tensile load.
4(c). What are the applications of Ferrocement?

5(a) With neat sketches, explain various types of wire meshes used in Ferrocement.
5(b) Briefly discuss the mechanical properties of Ferrocement over Reinforced cement concrete.
5(c) Enumerate the main factors that affect the reinforcement corrosion in FRC.

OR

5'. Write short note on the followings:

   (i) Compact Reinforced Composites (CRC)
   (ii) Polymer concrete.
   (iii) Stress–strain curve of FRC under tension.
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 IS: 875 (Part-III) and IS 1893 (2002) is permitted.

<table>
<thead>
<tr>
<th>Q. No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.(a)</td>
<td>What are the important aspects concerning the lateral stability of the tall structures?</td>
<td>[7]</td>
</tr>
<tr>
<td>1.(b)</td>
<td>Describe in details the different types of lateral load resisting tall building framing systems.</td>
<td>[8]</td>
</tr>
<tr>
<td>2.</td>
<td>The plan of a twenty five storied building is shown in Fig.1. 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, 9m, 15m, 27m, 36m, 45m, 51m, 60m, 66m and 75m 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 \text{ m}) Total height of the building (= 75 \text{ m}) Mean probable life of the building (= 100 \text{ years})</td>
<td>[15]</td>
</tr>
</tbody>
</table>

![Fig. 1](image)

2'(a). Sketch the flow of wind past the following types of buildings indicating salient details:
(i) Square buildings (considering the plan only)
(ii) Rectangular building with along wind direction side fairly long (considering the plan only)
(iii) Rectangular building (considering all three dimensions)

2'(b). Enumerate the idealisation made for the dynamic analysis of tall buildings subjected to wind loads. Also generate the mass, stiffness, damping, force and displacement matrices for a \(n\)-storied building.

contd... 2
3. A 10 storey OMRF building has plan dimensions as shown in Fig. 2. The storey height is 3 m. The dead load per unit area of the floor, consisting of the floor slab, finishes etc. is 4 kN/m². Weight of the partition on the floor can be assumed to be 2 kN/m². The intensity of the live load on each floor is 3 kN/m² and on the roof is 1.5 kN/m². The soil below the foundation is hard and the building is located in Delhi. Determine the seismic forces and shears at different floor levels.

![Fig. 2](image)

OR

3. 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></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roof</td>
<td>1.000</td>
<td>1.000</td>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td>3rd Floor</td>
<td>0.904</td>
<td>0.216</td>
<td>-0.831</td>
<td></td>
</tr>
<tr>
<td>2nd Floor</td>
<td>0.716</td>
<td>-0.701</td>
<td>-0.574</td>
<td></td>
</tr>
<tr>
<td>1st Floor</td>
<td>0.441</td>
<td>-0.921</td>
<td>1.016</td>
<td></td>
</tr>
</tbody>
</table>

4(a) Discuss how the position of shear wall is decided in a structural system.

4(b) Explain step by step procedure to estimate the lateral stiffness of the shear wall.
M. TECH (II SEMESTER)  
CIVIL ENGINEERING  
(HYDRAULIC STRUCTURES)  
WATER RESOURCES ENGINEERING  
CE-662

Maximum Marks: 60  
Duration: Three Hours

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

1 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 section of steel flume. In plan A the estimated first cost of tunnel is Rs.4.5×10⁶, its estimated annual maintenance cost is Rs.4.0×10⁵ and its estimated life is 100 years. Estimated first cost and lives for the elements of plan B are canal (not including lining) Rs.2×10⁶, 100 years; canal lining Rs.5×10⁵, 20 years; flume Rs.9×10⁵, 50 years. The annual maintenance cost is Rs. 1.05×10⁵. The interest rate to be used in the economy study is 6% per annum. The study period is 100 years. All salvage values are assumed to be negligible. Compare the equivalent annual cost for both the plans.

2(a) Discuss various methods for raising levee height in emergencies.  

(b) Four alternative small scale projects are under consideration. The estimated annual cost and benefits are tabulated as following.

<table>
<thead>
<tr>
<th>Project</th>
<th>Annual cost(Rs.)</th>
<th>Annual benefit(Rs.)</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>

(i) Which of project would you select?
(ii) If project A was selected; Give at least two good reasons why this decision might have been reached?

3(a) Write a note on flood bypass.

(b) Water flows at the rate of 250 m$^3$/s in a river (n=0.045) whose flow cross section can be approximated as a rectangle 63 m wide and 4.5 m deep. If a bypass could be made available to divert 50 m$^3$/s of the 250 m$^3$/s, what would be the maximum drop in stage downstream of the bypass diversion? Assume a constant river width, bed slope, and Manning’s n.

4(a) Write short notes on any two of the following
(a) Level of planning
(b) Phases of planning
(c) Project evaluation
(d) Project formulation

(b) What are the commonly accepted measures for flood mitigation? Discuss any two in detail.

5 Discuss various steps in engineering economy study

A reservoir has 6 units of water to be supplied in 28 days. Two groups of crops are to be grown in the command area. For the first group of crops 2 units of water is required in 7 days while the second group requires 1 unit water in 8 days the price of irrigation revenue is Rs. 120/- for the crop requiring 2 units of water and 80/- for second crop. If the revenue collection is to be the maximum then how many units of water for each crop should be supplied? When the water is supplied to one unit the canal system cannot supply water to the second unit

6 (a) Write a note on urgent need of water resources development in India.
(b) Discuss some environmental impact and their mitigation of water resources project.
© Discuss the influence of interest rate in computing the cost of various water resources projects.
2013-2014
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) Describe the objectives of environmental sampling and analysis. 7.5

Q.1(b) Maximum concentration level of dioxin in drinking water is 0.00000003 mg/l. Convert this concentration to ppt and molarity (M). What is the equivalent number of dioxin molecules per liter of water? The molecule weight of dioxin is 322 g/mole. 7.5

OR

Q.1(b) The concentration of arsenic and selenium in drinking water were 2.0 and 3.5 ppb. Convert arsenic concentration into ppm and mg/l and convert selenium concentration in to molarity (M) and micro molarity. The atomic weight of Se is 79. 7.5

Q.2(a) Draw the structure of the following organic compound by their functional group.
i) CH₃CH₂NH₂
ii) CH₂CH₂COOH
iii) CH₃CH₂CH₂OH

Q.2(b) Make a list of important factors (criteria) that are important in developing sampling design including where, when, and how many samples are collected? 9

OR

Q.2(b) Define type I error and type II error. Explain why both false positive and false negative should be avoided in the analysis and monitoring of environmental contaminants? 9

contd... 2
Q.3(a) A spectrometric method was developed to determine 7.5
nitrite (NO$_2^-$, MW=46 g/mol) in human saliva and rain
water. The method was reported to have an absorption
maximum of 546 nm and molar absorptivity of 4.6x10$^4$
I/(mol cm). What range of concentrations can be
measured so the absorbance remains within the range
0.05-0.80, using 1.0 cm cell?

OR

Q.3(a)' Discuss the application of Beer-Lambert's Law in 7.5
environmental analysis.

Q.3(b) Explain the difference in light source used in atomic 7.5
absorption vs. the light source used in UV-VIS
spectrometer.

Q.4(a) Name the most common detectors (for chromatography) 7.5
used for environmental trace analysis together with
applications.

Q.4(b) Write the importance of GC-MS and discuss its 7.5
application in environmental engineering.

OR

Q.4(b)' Define any three of the following terms 7.5
i) Retention factor
ii) Separation factor
iii) Resolution
iv) No. of theoretical plates.
2013-14
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)  What are the impact of improper disposal of solid waste on land and poorly [06] designed landfills?
1(b)  What are the different functional elements of solid waste management? Explain [06] each elements briefly.
2(a)  What are the recommendations of EPA Report 1974 for Solid Waste Collection? [06]
2(b)  Discuss the cost curve for direct haul system and cost curve for transport when [06] transfer station is included.

OR

2'(b)  What are the factors taken when laying out collection routes? Differentiate between [06] Hauled Container System and Stationary Container System.

3(a)  Describe the vertical gravity trash chute system for collection of solid waste in high [06] rise buildings.
3(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?
4(a)  The chemical composition of the organic fraction of a residential MSW is given by [06] the formula C_{700} H_{1900} O_{875} N_{13} S. Estimate the energy content of the residential [06] MSW. In this formula C, H, O, S, and N represent the weight percent composition [06] of the waste for carbon, hydrogen, oxygen, sulphur and nitrogen respectively. How
many moles of methane and Carbon dioxide are formed during anaerobic decomposition of organic matter $C_{16.8}H_{27.0}O_{12.1}N_{0.24}$.

4(b) Describe the landfill gas recovery system using vertical wells. What is the difference between methanogenesis steady and methanogenesis unsteady stage during biodegradation of solid waste?

OR

4'(b) What are the different physical, chemical and biological processes used for treatment of leachate?

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

OR

5'(a) What are the different Hazardous waste treatment technologies? Describe the deep well injection system for hazardous waste.

5(b) What is the role of Lifecycle Assessment (LCA) in solid waste management?
2013-2014
M. TECH. WINTER (II SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
ENVIRONMENTAL POLICIES AND IMPACT ANALYSIS
(CE-686)

Maximum Marks : 60

Duration: Three Hours

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

Q.1(a) What are the aims and objectives of EIA? 8
Q.1(b) Discuss the Primary maximum contaminant level (PMCL) 7
and the Secondary maximum contaminant level (SMCL)

OR

Q.1(b) State the requirements of an environmental management system in an industry for sustainable development. 7

Q.2(a) Discuss various components involved in prediction and 8
assessment of socio-economic environment.

Q.2(b) Explain check lists method and Leopold Matrix method 7
for impact analysis.

OR

Q.2(b) Discuss the legal and regulatory framework for 7
environmental protection in India.

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

Q.3(b) Estimate the total hydrocarbon concentration at a point 10
490 m downwind from an expressway at 5:00 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 7500 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.

OR

Q.3(b) The wind speed and stack gas speeds are 3.5 and 6.5 m/s, 10
respectively, and the stack diameter is 3m. 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

Continued ..... 2
Q.4 Write short notes on any three of the following
(a) What are major functions of environmental audit?
(b) Objectives of international organization for standardization.
(c) Various steps in EIA
(d) Environmental (Protection) Act, 1986

END

---


---

### Table 4.3 KEY TO STABILITY CATEGORIES

<table>
<thead>
<tr>
<th>Class (k)</th>
<th>Day (Incoming Solar Radiation)</th>
<th>Night (Cloud Cover)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>Strong</td>
<td>Mostly Overcast</td>
</tr>
<tr>
<td>Class 2</td>
<td>Moderate</td>
<td>Mostly Clear</td>
</tr>
<tr>
<td>Class 3</td>
<td>Slight</td>
<td></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 $F$ moderately unstable and class $E$ slightly stable.*

---