Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

NOTE: Answer ALL the questions. Symbols used have their usual meanings.

1(a) What do you mean by static dielectric constant? Discuss the different polarization mechanisms in dielectrics.  

1(b) Define local field in dielectrics and obtain the expression \( E_I = \frac{E}{1-\beta} \)  

1(c) What are the main characteristics of ferroelectric materials? Discuss the origin of ferroelectricity in BaTiO3.  

1(d) Calculate the polarization of the He gas if placed in a field of \( 6 \times 10^5 \) V/m. The polarizability of He is \( 0.18 \times 10^{-40} \) Fm³ and the concentration of the atoms is \( 2.6 \times 10^{27} / \) m³. Also find the separation between positive and negative charges.

OR

1(d') There are \( 10^{27} \) HCl molecules/m³ in HCl vapour. Determine the orientational polarization at 300 K, if the vapour is subjected to an electric field of \( 10^7 \) V/m. The permanent dipole moment of HCl molecule is 1.04 Debye. (1 Debye = \( 3.33 \times 10^{-30} \) coulomb metre)

2(a) Discuss the frequency dependence of electronic polarizability in detail. Plot the real and imaginary parts of the polarizability with frequency for a single electron.

OR

2(a') Define relaxation time and evaluate in-phase and out-of-phase components of polarization?

2(b) Discuss the drift and diffusion phenomena in semiconductors. Obtain the expression for the depletion layer width of the p-n junction.

2(c) An intrinsic Si sample is doped with donors from one side such that \( N_d = N_o \exp(-\alpha x) \).
   (i) Find an expression for \( \varepsilon(x) \) at equilibrium over the range for which \( N_d >> n_i \).
   (ii) Evaluate \( \varepsilon(x) \) when \( a = 4 \) (µm)⁻¹.

3(a) Discuss Langevin's theory for a paramagnetic gas and obtain an expression for the paramagnetic susceptibility of the gas. What are the main drawbacks of this theory?

Continued........2
3(b) What are ferrites? How are they superior to ferromagnetic materials? [4.0]

3(c) Discuss the phenomenon of antiferromagnetism. How does and antiferromagnetic substance differ from a diamagnetic substance? [4.0]

4(a) Explain the term critical magnetic field in a superconductor. How does the critical magnetic field vary with temperature in type I and type II superconductors. What is Meissner effect? [7.0]

4(b) The London penetration depths for Pb at 3 K and 7.1 K are 39.6 nm and 173 nm respectively. Calculate its transition temperature as well as penetration depth at 0 K. [4.0]

4(e) The resistivity of superconductor becomes zero. Consequently the flux density is zero due to this abrupt change. Prove that the superconductors behave as a perfect diamagnetic. [4.0]

OR

4'(a) Explain d.c. Josephson effect. Show that the supercurrent of superconducting pairs across the junction depends on the phase difference. [8.0]

4'(b) A superconductor sample has a critical temperature of 3.722 K at zero magnetic field and 0.0305 T at 0 K. Evaluate the critical field at 2 K. [3.0]

4'(c) Discuss High Tc superconductors and mention its applications. [4.0]

Some useful physical constants

\[ h = 6.63 \times 10^{-34} \text{ J.s}, \quad k_B = 1.38 \times 10^{-23} \text{ J/K} \]

\[ m_e = 9.1 \times 10^{-31} \text{ kg}, \quad m_p = 1.67 \times 10^{-27} \text{ kg}, \quad c = 3 \times 10^8 \text{ m/s} \]

\[ q_e = 1.6 \times 10^{-19} \text{ C}, \quad 1 \text{ amu} = 1.66 \times 10^{-27} \text{ kg} \]
2014-15
B.TECH. (WINTER SEMESTER) EXAMINATION
(Civil/Mechanical/ Electrical/Electronics/Computer/Chemical/Petrochemical/Architecture Engineering)

WATER RESOURCES AND WATERSHED MANAGEMENT
Open Elective

(CE-483)

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 Discuss the various sectors of water utilization and management. [15]

OR

1'(a) What is a watershed? Discuss in brief, the following characteristics of a watershed. [07]
   (i) Size (ii) Shape (iii) Slope

1'(b) Enlist different forms of precipitation and explain with a neat diagram, the Hydrologic Cycle. [08]

2(a) Define the following terms used in water resources engineering. [05]
   (i) Run off (ii) Soil erosion (v) Rainwater harvesting

2(b) (i) Enumerate different types of rain gauges. What are the considerations for selecting a rain gauge? [10]
   (ii) Discuss with neat sketches the necessity of Canal Headwork, River Training Works and Cross Drainage Works.

OR

2'(a) Discuss the physical and chemical characteristics of water fit for drinking purpose. [07]

Contd...
2' (b) Define lag time and time of concentration. Estimate the lag time and time of concentration for the following data pertaining to a watershed:

Hydraulic length = 1000 m, contour interval = 2.0 m, land slope = 2.0 %
The curve number for the soil and vegetative cover of the watershed = 80

3 Discuss the various steps involved in the planning of water-resources engineering projects.

OR

3' How does the economic viability of water resources project is determined?

A 350 kW hydropower project has the following two alternatives for conveyance of water from the reservoir to the power house. Which of the alternatives is more economical. The annual interest rate may be taken as 6%.

1st Alternative:

Initial cost of the lined tunnel = Rs 2,50,000.00
Useful life = 100 years
Annual maintenance cost = Rs 25000.00

2nd Alternative:

(i) cost of power channel = Rs 510,000.00
useful life = 100 years
annual maintenance cost = Rs 12,000.00
(ii) cost of lining = Rs 151,000.00
useful life = 50 years
annual maintenance cost = Rs 8000.00
(iii) cost of penstocks = Rs 229,000.00
useful life = 50 years
annual maintenance cost = Rs 9000.00

4 What is meant by flood? What are causes of flood? Discuss structural non-structural measures of flood control.

From a watershed the following information is available.

Area of watershed = 25 km². Calculate the flood discharge using Dicken’s formula.
The value of Dicken’s coefficient = 28.
Q.No. Question M.M.
1(a) What are the various types of properties of MSW? Explain the significance of properties in selecting appropriate disposal technology. [07]

OR

1(a') Discuss the waste generation in a technological society. [07]

1(b) Assuming half life of a hazardous substance, $\tau$ is 15 hr.

i) Determine $t_{1/8}$, $t_{3/8}$, $t_{5/8}$, $t_{7/8}$, $t_{1/4}$, $t_{3/4}$, $t_{1/2}$ and tabulate your results.

ii) Plot $1 - (C/C_0)$ verses time (where $C_0$ is initial concentration)

Explain what $1 - (C/C_0)$ represents. According to the first order model, how long would it take to achieve 99% decay? [08]

2(a) What are the two types of collection system used based on mode of operations? [08]

Explain with neat sketches operational sequences for both.

(OR)
2(a') Explain the following terms with reference to waste collection operation.

(i) Pickup
(ii) Haul
(iii) At Site
(iv) Off Route

2(b) The following average speeds (Table II) were obtained for various round trip distances to a disposal site. Find the haul speed constants, a and b, and the round trip haul time for a site that is located 18 km away.

Table II: Round Trip Distance and Average Haul Speed

<table>
<thead>
<tr>
<th>Round Trip Distance (x), km/trip</th>
<th>Average Haul Speed, km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>27</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>8</td>
<td>52</td>
</tr>
<tr>
<td>12</td>
<td>58</td>
</tr>
<tr>
<td>16</td>
<td>65</td>
</tr>
<tr>
<td>20</td>
<td>68</td>
</tr>
<tr>
<td>25</td>
<td>73</td>
</tr>
</tbody>
</table>

3(a) With the help of a neat illustration give a brief account of final landfill cover explaining various components involved into it?

(OR)

3(a') What is a leachate? Explain how would you differentiate between old and fresh leachate? Explain the Water Balance Method for estimating the quantity of leachate.
3(b) Derive an approximate molecular formula for the organic portion of a solid wastes sample with the following composition. Determine the theoretical amount of gases \((O_2 \& CH_4)\) generated in kg from 1000 kg of the above waste.

<table>
<thead>
<tr>
<th>Component</th>
<th>Dry mass</th>
<th>Chemical Components (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>Food wastes</td>
<td>4.50</td>
<td>2.160</td>
</tr>
<tr>
<td>Paper</td>
<td>42.3</td>
<td>18.40</td>
</tr>
<tr>
<td>Cardboard</td>
<td>4.75</td>
<td>2.090</td>
</tr>
<tr>
<td>Plastics</td>
<td>4.90</td>
<td>2.940</td>
</tr>
<tr>
<td>Yard wastes</td>
<td>4.00</td>
<td>1.912</td>
</tr>
<tr>
<td>Wood</td>
<td>4.00</td>
<td>1.980</td>
</tr>
</tbody>
</table>

Specific weight of Methane at STP = 0.7176 kg/m³
Specific weight of carbon dioxide at STP = 1.9783 kg/m³

4(a) List down and discuss various types of Gasifiers used for the gasification of organic waste.

(OR)

4(a) Discuss the various design and operational considerations involved in the process of aerobic composting.

4(b) Leaves with a C/N ratio of 50 are to be blended with the activated waste sludge from a waste obtained from a water treatment plant with a C/N ratio of 6.3.

Determine the proportions of each component so that a blended C/N ratio of 25 is achieved.

Following conditions apply

1. Moisture content of sludge = 75%
2. Moisture content of leaves = 50%
3. Nitrogen content of sludge = 5.6%
4. Nitrogen content of leaves = 0.7%
## Questions

<table>
<thead>
<tr>
<th>Q. No.</th>
<th>Questions</th>
<th>MM.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a).</td>
<td>What are the main features of non-conventional energy sources?</td>
<td>(06)</td>
</tr>
<tr>
<td>1(b).</td>
<td>Comment on the oil crisis of 1973. What are its after effects?</td>
<td>(06)</td>
</tr>
<tr>
<td>2(a).</td>
<td>Define beam, diffused and global radiations.</td>
<td>(06)</td>
</tr>
<tr>
<td>2(b).</td>
<td>Why power loss occurs in two series connected solar cells having mismatched characteristics?</td>
<td>(06)</td>
</tr>
<tr>
<td>2'(a).</td>
<td>What are the limitations of thermo-mechanical systems? Draw the layout of central tower receiver power plant.</td>
<td>(06)</td>
</tr>
<tr>
<td>2'(b).</td>
<td>What is the effect of variation of solar insolation and temperature on open-circuit voltage and short-circuit current of a solar PV panel?</td>
<td>(06)</td>
</tr>
<tr>
<td>3(a).</td>
<td>Classify the biogas plants and with a neat sketch discuss the working of a batch type biogas plant. Why they are not suitable for Indian conditions?</td>
<td>(06)</td>
</tr>
<tr>
<td>3(b).</td>
<td>Calculate the volume of a fixed dome type biogas digester for the output of 2 cows. Also, calculate the thermal power available from biogas. Use the following data:</td>
<td>(06)</td>
</tr>
<tr>
<td></td>
<td>Retention time = 30 days</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dry matter produced = 2 kg/day/cow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biogas yield = 0.22 cubic metre/kg of dry matter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Percentage of dry matter in cow dung = 18%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Density of slurry = 1090 kg/ cubic metre</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Burner efficiency = 60 %</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heating value of biogas = 23 MJ / cubic metre</td>
<td></td>
</tr>
<tr>
<td>4(a).</td>
<td>Sketch the diagram of a vertical axis wind turbine (VAWT) and explain the functions of its main components.</td>
<td>(06)</td>
</tr>
<tr>
<td>4(b).</td>
<td>A propeller-type wind turbine has the following data: Average free wind speed at a height of 10 m = 12 m/s, Air-density = 1.226 kg/m$^2$,</td>
<td>(06)</td>
</tr>
</tbody>
</table>

*contd... 2*
\( \alpha = 0.14 \)
Hub height from the ground = 100 m,
Diameter of rotor = 80 m
Wind velocity at turbine reduces by 20%.
Generator efficiency = 85% 
Find:
(i). Total power available in wind 
(ii). Power extracted by the turbine 
(iii). Electrical power generated

OR

4'(a). With the help of a suitable diagram explain the functions of main components of horizontal axis wind turbine (HAWT).
4'(b). With the help of block diagram, explain the functions of various blocks of wind energy conversion system.
5(a). What are the major advantages and limitations of an MHD generating system.
5(b). What are the main hurdles in the development of tidal energy?

OR

5 (b'). What is a fuel cell and what are its main advantages?
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 “PINDEX” scheme for assessing air pollution severity.</td>
<td>[7]</td>
</tr>
<tr>
<td>1(b).</td>
<td>Describe Planetary boundary layer on Earth’s surface and discuss how does the mechanical and convective turbulence affect the pollutant dispersion in atmosphere?</td>
<td>[5]</td>
</tr>
</tbody>
</table>

OR

| 1’(a). | Describe the Pollution cycle and the various exchanges and interactions between Air-Water-Land.                                             | [8]  |
| 1’(b). | For a township, applying PINDEX scheme for Air Pollution Severity, the following values were obtained (after applying Tolerance Factors)    | [4]  |

PINDEX = 1.41

- Particulate Matter (PM) = 0.381
- Sulphur Oxides (SO$_x$) = 0.086
- Nitrogen Oxides (NO$_x$) = 0.204
- Carbon Monoxide (CO) = 0.181
- Hydrocarbons (HC) = 0.111
- Oxidants (OOO) = 0.361

Calculate SYNERGISM and explain its significance.
2. Describe in detail the formation mechanism of Nitric oxide (thermal, fuel bound and prompt) in combustion systems.

OR

2'. What do you understand by 'Photochemical Smog'? Describe the nature of photochemical smog and its effects.

3. What do you understand by Iso-kinetic sampling conditions? Explain the Stack sampling technique highlighting the traverse point selection in circular and rectangular stacks.

OR

3'. What do you understand by Chemiluminescence technique? With the help of schematic diagram, explain the working of a Chemiluminescent NO/NOx analyzer.

4(a). Name the techniques commonly employed to remove particulates from polluted gas streams. Describe Gravity settling chambers and Cyclone separator in detail.

4(b). Methane is to be destroyed in a Flare. The flow rate is 0.25 m$^3$/s at 3 bar and 25 °C. Assuming that the personnel will not be exposed to flare for periods exceeding 20 minutes, find the height of the flare above the ground if its diameter is 0.2 m. Take the lower calorific value of methane as 50 MJ/kg.

5. Write short notes on any two of the following
(i) Sources of Evaporative Emissions in Petrol Engines
(ii) Exhaust Emissions from Diesel Engines
(iii) Three-way catalytic converter
2014-15
B.TECH. (WINTER SEMESTER) EXAMINATION
(ARCHITECTURE/CIVIL/ELECTRICAL/CHEMICAL/ELECTRONICS/
MECHANICAL/COMPUTER/PETRO-CHEMICAL)
NON-CONVENTIONAL ENERGY (OPEN ELECTIVE)
ME-462

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) State the limitations of Non-Conventional energy resources.

1(b) A 2 kW PV rooftop plant cost Rs 200,000 and has a useful life of 25 years. The annual average maintenance cost is 5% of the capital cost and the discount rate is 10%. Calculate the unit cost of a solar PV generated electricity, if it supplies a load of 25% of its power rating for 10 hours daily.

1(c) Classify the energy resources based on usability and long term availability of energy.

OR

1(c) What are Tradable emission permits and how do they encourage renewable energy use?

2(a) Define solar constant and instantaneous efficiency of a solar collector. Draw the typical efficiency curve; mentioning the slope, intercept, etc., for a flat plate solar collector.

2(b) Explain geometric tilt factor for diffuse & direct solar radiations and find the relations for them. Calculate the total solar radiation incident on the collector tilted at 20° and facing south on 27th May at 11:30 A.M. (solar time). The collector is located at Dehradun (30.3° N, 78° E). The solar radiation on horizontal surface measured by pyranometer is 700 W/m². Assume, 20% diffuse radiation and ground reflectance 0.2.

Given that δ = 23.45 sin [360 (284+n)/365] and

\[ \cos \theta = \sin \delta \sin \phi \cos \beta - \sin \delta \cos \phi \sin \beta \cos \gamma + \cos \delta \cos \phi \cos \beta \cos \omega + \cos \delta \sin \phi \sin \beta \cos \gamma \cos \omega + \cos \delta \sin \beta \sin \gamma \sin \omega. \]

OR

Contd...
2(b') Derive the expression for transmittance of the cover system of a flat plate solar collector and calculate the transmittance of the following cover system:

Material: Glass, Number of cover = 1, Refractive index of glass relative to air = 1.52, Extinction coefficient of glass= 14 m⁻¹, Thickness of glass= 4 mm, Incidence angle = 20°.

3 With the help of schematic diagrams discuss any two (02) of the following:

(i) Natural and forced circulation solar water heating systems
(ii) Solar refrigeration using vapour absorption system and
(iii) Solar passive heating and cooling of buildings.

4(a) Using the Actuator Disc theory, prove that power extracted by the turbine,

\[ P_T = [4a (1-a)^2] \times P_o \] where, 'a' is interference factor and 'P_o' is power contained in the wind.

OR

4(a') With the help of Blade Element Theory, show that by tapering the wind turbine blades, shear stresses acting on the blades can be reduced, hence preventing blade failure.

4(b) Write short notes on any four (04) of the following:

i) Beaufort Scale
ii) Local winds
iii) Effect of solidity of rotor
iv) Yawing
v) Anemometers

5 Answer any three (03) of the following:

(i) What are the main advantages and disadvantages of biomass energy? What are the different biomass energy resources?
(ii) Discuss the Double Basin (Decour Scheme) Tidal Turbine system. Show also on a diagram the variation of water level in the two basins with respect to time and the duration of power generation.
(iii) What are the three types of energy extracted from a Geo-pressured Resource of Energy?
(iv) With the help of a neat diagram, describe the working principle of an open cycle Magneto-hydrodynamic generating system. Why is seeding necessary?
Answer all the questions.
Marks allotted are indicated against each question.
Notations used have their usual meaning.

Q.No. Question M.M. 
1(a) What are major, minor and trace chemical constituents of the atmosphere? [05]
1(b) Discuss the role of hydrocarbons and NOx in the formation of photochemical smog. [05]
2(a) What types of electrons are responsible for most UV and visible electron transitions? [03]
2(b) Write with examples the types of molecules that absorb IR region of electromagnetic radiations. [03]
2(c) Discuss the role of hollow cathode lamp in atomic absorption spectrophotometer. [04]
3 Write short notes on any two of the followings: [05\times2]
a) Indoor air quality
b) Ethanol as an alternative fuel
c) Catalytic destruction of Ozone by Chlorine

OR

3' Attempt any two of the followings:
   a) Impacts of increased exposure to UV action spectrum
   b) Methane is a greenhouse gas but it reduces the stratospheric Ozone depletion
   c) Nitrogen cycle

4(a) Classify air pollutants on the basis of origin, chemical composition and state of matter with examples. [04]
4(b) Describe the sources and physiological effects of Carbon monoxide in the atmosphere. [06]
5(a) Describe the physical, chemical and biological characteristics of particulate matter. [06]
      How human respiratory system defends itself against the invasion of particulates?
5(b) Describe the principle and working of electrostatic precipitator. [04]
6(a) Describe the absorption method for collecting gaseous pollutants. [04]
6(b) Write notes on any two of the following [03\times2]
   (i) Hopcalite based CO monitor
   (ii) PRA method for the determination of SO2 in the atmosphere
   (iii) Acid titration method for the determination of CO2 in the air
Maximum Marks: 60

Duration: Three Hours

Note: (i) Answer all questions.
(ii) Use of programmable calculators not allowed.
(iii) Write answers up to four decimals.

1. (a) Use ONE iteration of Bairstow method to extract a quadratic factor \( x^2 + px + q \) from the polynomial
\[
x^4 + x^3 + 2x^2 + x + 1 = 0
\]
Take \( p_0 = 0.5 = q_0 \).

OR

(a') Use TWO iterations of Newton-Rapson method to solve the system of nonlinear equations.
\[
x^2 + xy + y^2 = 7; \quad x^3 + y^3 = 9.
\]
Take \( x_0 = 1.5 \) and \( y_0 = 0.5 \).

(b) Using the Jacobi method find all the eigen values and corresponding eigen vectors of the matrix \( A \), where
\[
A = \begin{bmatrix}
1 & \sqrt{2} & 2 \\
\sqrt{2} & 3 & \sqrt{2} \\
2 & \sqrt{2} & 1
\end{bmatrix}.
\]

(c) Obtain a Chebyshev linear polynomial approximation to the function
\[
f(x) = \int_0^x \left( \frac{x^2}{y^3} \right) dy
\]
on \([0, 1] \)

[5+5+5]

2. (a) Evaluate
\[
\int_0^1 \left( 1 + \frac{\sin x}{x} \right) dx
\]
Correct to 3-decimals, using Simpson’s rule for \( h = \frac{1}{2}, \frac{1}{4}, \frac{1}{8} \). Improve this result by using Romberg Integration.

OR

(a') Evaluate the integral
\[
\int_{-1}^{1} \left( 1 - x^2 \right)^{\frac{1}{3}} \cos x \ dx
\]
by using 3-points Gauss-Legendre and Gauss-Chebyshev formulae.
(b) Use Runge-Kutta method of fourth order to solve
\[ \frac{d^2y}{dx^2} - x^2 \frac{dy}{dx} - 2xy = 1 \]
with \( y(0) = 1, \ y'(0) = 0 \) at \( x = 0.1 \) with \( h = 0.1 \).

(c) Solve the boundary value problem
\[ y'' - 64y + 10 = 0 \] with \( y(0) = 0 = y(1) \)
by finite difference method for \( h = \frac{1}{4} \) OR by shooting method.

3. (a) Solve the Laplace equation \( \nabla^2 u = 0 \) in the square region \( R = \{(x, y): 0 \leq x, y \leq 4\} \) with boundary conditions:
\[
\begin{align*}
  u &= 0 \quad \text{for} \quad 0 \leq y \leq 4 \\
  u &= 12 + y \quad \text{for} \quad 0 \leq y \leq 4 \\
  u &= 3x \quad \text{for} \quad 0 \leq x \leq 4 \\
  u &= x^2 \quad \text{for} \quad 0 \leq x \leq 4
\end{align*}
\]
with \( h = 1 = k \). Improve this result by using one iteration of Gauss-Seidel method.

(b) Solve the heat conduction equation
\[ \frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} \] subject to the initial and boundary conditions
\[
\begin{align*}
  u(x, 0) &= \sin \pi x, \quad 0 \leq x \leq 1; \\
  u(0, t) &= 0 = u(1, t)
\end{align*}
\]
by using Crank-Nicolson Scheme for \( h = \frac{1}{3} \) and \( K = \frac{1}{36} \). Integrate up to two time levels.

4. (a) Obtain a two parameter solution of the boundary value problem
\[ y'' + (1 + x^2) y + 1 = 0, \ y(\pm 1) = 0 \]
for \( \psi_0 = 0, \psi_1 = (1 - x^2) (1 - 4x^2), \psi_2 = \frac{16}{3} x^2 (1 - x^2) \) by Galeskin’s method OR collocation method with collocation points \( \frac{1}{3} \) and \( \frac{2}{3} \).

(b) Solve, by FEM the following BVP:
\[ y'' + y = x, \quad y(0) = 0 = y(1), \text{ for } h = \frac{1}{3}. \]
2014-15
B.TECII (WINTER SEMESTER) EXAMINATION
OPEN ELECTIVE
BIOPHYSICS
AP-304

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.

1(a) Define the ionization energy, electron affinity, and electronegativity. Differentiate between electronegative and electropositive atoms on the basis of values of $e_N$. [04]

1(b) Discuss the formation of ionic bonds and covalent bonds. Explain interatomic potentials for strong bonds. [05]

1(c) Differentiate between rotational, vibrational, electronic and Raman spectra. How can one find relative abundance of isotopes of an element? [06]

2(a) What is vertebrate heart? How many chambers does it have? Is heart really a pump? Show the pathway of blood circulation through it. [09]

2(b) 'A cell can be thought of as a factory', explain with a suitable diagram. OR [06]

2(b') Differentiate between active and passive transport through the membrane. Write the function of biological membrane. [06]

3(a) Explain the term LASER, spontaneous emission, stimulated emission, population inversion and optical pumping. [05]

3(b) Calculate the ratio of rates of stimulated and spontaneous emission and comment on the result. Given, $T=2000K$, $\lambda=1.449 \mu m$, $c=3x10^8 m/s$, $h=6.626x10^{-34} J.s$. [03]

3(c) Draw figures of 2-level, 3-level and 4-level systems to explain laser action and write the types of lasers. [03]

3(d) Write applications of LASER induced fluorescence spectroscopy in the diagnosis of cancer and sequencing of bases in Human Genome Project. [04]

4(a) What do you understand by Relative Biological Effectiveness? [05]

4(b) Calculate the penetration range of 5 Mev $\alpha$-particles in tissues. Given, $R_{air} = 3.5 cm$, $\rho_{air}/\rho_{tissue} = 0.00129$. [05]

4(c) What is PIXE technique? How many types of spectra can be collected from it? What are the essential requirements for its analysis? [05]
2014-2015
B.Tech (VIII SEMESTER /WINTER) EXAMINATION
Electrical/Mechanical/Civil/Electronics/Computer/Architecture/Chemical/Petro Chemical Engineering
(Open Elective)
Advance Environmental Engineering
(CE-481R)

Duration 3 hours
Credits - 04
Maximum Marks : 60

Instructions:
Attempt all the questions.
Assume suitable data/value, if not given or missing.
Notations used have their usual meanings.

Q.No.1a  DO in any water body has its own significance for aquatic life. Besides aquatic life, it also helps in indicating the health of any water body like river, lake etc. What do you infer from the figure given below? Write in detail.

Q.No.1b  Data provided by the water analyst indicates that the unknown water sample has high pH, alkalinity, sulphates, BOD, solids, and coliforms.

(i) What is the possible source of sample on the basis of the data provided?
(ii) What are the significance of these parameters?
(iii) What are the laboratory tests for these parameters?

OR

contd... 2
Q.No.1'b (i) Three samples were collected from a drain carrying wastewater flow. These samples were diluted 4 times. Initial and final DO of each sample was found to be 7.4, 7.5, 7.3 and 3.1, 3.2, 3.4 mg/l respectively. The volume of sample taken in each BOD bottle was 5ml. Determine the average BOD of this sewage water.

(ii) Commercial sulfuric acid, H2SO4 is purchased as a 95 percent solution. Find the mg/l of H2SO4 and the molarity and normality of the solution. Sulfuric acid has a specific gravity of 1.839.

Q.No.2a A water treatment plant to treat 1000 m3 per day of receiving water from a nearby river is to be proposed for domestic water supply for a town. The average values of raw water data is as under:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.9</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>275 mg/L as CaCO3</td>
</tr>
<tr>
<td>TS</td>
<td>4500 mg/L</td>
</tr>
<tr>
<td>Total Hardness</td>
<td>325 mg/L as CaCO3</td>
</tr>
<tr>
<td>Turbidity</td>
<td>650 NTU</td>
</tr>
</tbody>
</table>

Suggest the scheme or units required to make this raw water as ‘potable’. Prepare flow diagram of your scheme and discuss functioning of each proposed unit.

Q.No.2b (i) On what principle the process of gravitational sedimentation is based? Write the equation and, explain the significance of each factor.

(ii) A circular sedimentation tank has a radius of 13.5 m and the depth of 3.5 m. The flow rate is 7.5 MLD. What is the retention time in hours and SoR of the tank?

Q.No.3a (i) An activated-sludge process has a influent BOD concentration of 165 mg/L, influent flow of 20,000 m3/d and 3500 mg/l of MLSS under aeration. Calculate the F/M ratio when HRT is 5.5 hours.

(ii) What are the different types of aeration system? Discuss merits and demerits of each.

OR

Q.No.3a (i) Discuss aerobic and anaerobic processes for wastewater treatment. List some of the technologies based on these processes separately.

(ii) What do you mean by sloughing? Discuss its importance in the removal process of organic matter present in the wastewater.

Q.No.3b A sewage treatment plant of capacity 5000 m3/day is to be designed to treat incoming BOD of 205 mg/l and TSS concentration of 400 mg/l. Contd. ... 3
mg/l to the level of outlet BOD as 20 mg/l and TSS 30 mg/l respectively. Design the following units while ensuring to meet the above effluent quality:

i. Primary Sedimentation Tank
ii. Aeration Tank
iii. Secondary Clarifier

Q.No.4a (i) Explain the working of Centrifugal Collectors for particulate removal.

(ii) In a cement industry a settling chamber is to be used to collect particle of 40 microns in diameter and 2400 kg/m$^3$ density from a stream of 12 m$^3$/s of standard air. If the chamber is 2 m wide and 2.5 m high and it is having 9 trays including the bottom surface. What should be the length of the settler be given theoretically for perfect efficiency. Assume flow to be laminar. $\mu = 1.84 \times 10^{-5}$ kg/ms

What will be the collection efficiency if $L = 1$m, number of trays $=100$ and particle diameter is 20 micron.

Q.No.4b (i) What are the different functional elements of solid waste management? Explain each element briefly.

(ii) What is the cause of temperature and pH variation during the composting process? What is the role of thermophilic and mesophilic microorganisms in composting process?

Q.5 Write brief notes on any four of the following:

a) Indoor Air Quality
b) Primary & Secondary Sources of Air Pollution
c) Difference between Garbage and Rubbish
d) Different Technologies for Wastewater Treatment
e) Effects of Noise Pollution and their remedial measures