2017-18
B.E. (I SEMESTER) EXAMINATION
(ELECTRICAL/MECHANICAL/CIVIL ENGINEERING)
APPLIED CHEMISTRY
(EACS-1110/EAC-111)
Credits:04

Maximum Marks: 60
Duration: Two Hours

Answer all the questions
Assume suitable data if missing
Marks are allotted against each question

Q. No. Questions M.M.
1.(a) Draw a neat and labelled break-point chlorination curve. 2
1.(b) Calculate the amount of lime (85% pure) and soda (90% pure) required for 5
softening of water having following dissolved salts in mg/L: Mg(HCO₃)₂ = 60.0; Ca(HCO₃)₂ = 90.5; MgCl₂ = 120.5; CaSO₄ = 100.6; Fe₂O₃=80.0 and NaCl=20.0. (Atomic weights: Mg=24; Ca=40; Fe=56; C=12; O=16; H=1; Cl=35.5; Na=23; S=32).
1.(c) What are ion-exchange resins? Discuss their role in water softening. Explain regeneration of spent resins. 6
1.(c') List the steps involved in municipal water treatment. Discuss sedimentation with coagulation.

OR

1.(d) Give the chemical equation for the removal of temporary hardness by boiling. 2

2.(a) Write the different fractions obtained during the fractional distillation of petroleum. Write the industrial uses of each fraction. 3
2.(a') Distinguish between proximate and ultimate methods of coal analysis.
2.(b) Describe Fischer-Tropsch process for the generation of synthetic fuel. 3
2.(c) What are the advantages of gaseous fuel over solid fuels? 3
2.(d) Write short notes on any two the followings:
(a) Mechanism of extreme-pressure lubrication
(b) Solid lubricant
(c) Additives in blended-oil 2×3

Contd.... 2.
3.(a) Define corrosion and give its classification. Discuss the mechanism of electrochemical corrosion by absorption of oxygen.

3.(b) Calculate the EMF of a Daniel cell at 298K, when the concentration of ZnSO$_4$ and CuSO$_4$ are 0.001M and 0.01M, respectively. The standard potential of the cell is 1.1V.

3.(c) Answer any two of the followings:
   (i) Impressed current cathodic protection
   (ii) Importance of Galvanic series
   (iii) Characteristics of good Varnish or Paint

4.(a) What are polymers? Differentiate between addition and condensation polymers. Write the mechanism of anionic or cationic polymerization with proper chemical reactions.

4.(b) Discuss the properties, preparation and uses of Nylons.

4.(b') Explain the number-average and the weight-average molecular mass of a polymer.

4.(c) What is vulcanization? How does it improve the properties of natural rubber?
Q.NO | QUESTIONS | MARKS
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1(a) | Find the eigenvalues and eigenvectors of the matrix \( A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix} \) | [08]
1(a') | Verify Cayley-Hamilton theorem for the matrix \( A = \begin{bmatrix} 1 & 2 & -2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix} \) and hence find \( A^{-1} \). |  
1(b) | Test the consistency of the following system of equations and solve. 
\[ 2x + 3y + 4z = 11, \ x + 5y + 7z = 15, \ 3x + 11y + 13z = 25 \] | [07]
2(a) | Find all the asymptotes of the curve 
\[ x^3 - 2x^2y + xy^2 + x^2 - xy + 2 = 0 \] | [07]
2(a') | Trace the curve giving all silent features \( x = (y - 1)(y - 2)(y - 3) \). |  
2(b) | If \( y = \sin(\log(x^2 + 2x + 1)) \), prove that | [08]
\[(x + 1)^2 y_{n+2} + (2n + 1)(x + 1)y_{n+1} + (n^2 + 4)y_n.\]

Hence or otherwise expand \(y\) by Maclaurin’s theorem in powers of \(x\) as far as sixth degree term.

3(a) If \(s\) be the length of the arc of the centenary \(y = c \cosh \left(\frac{x}{c}\right)\) from the vertex \((0,c)\) to the point \((x,y)\), show that \(s^2 = y^2 - c^2\).

3(b) Find the volume of the solid generated by the revolution of the ellipse \(\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1\) about x-axis.

OR

3(b') Show that the surface area of the spherical zone contained between two parallel planes is \(2\pi rh\) where \(r\) is the radius of the sphere and \(h\) the distance between two planes.

4(a) Solve the following differential equations.

i. \(\frac{d^2 y}{dx^2} - 3 \frac{d^2 y}{dx^2} + 4 \frac{dy}{dx} - 2y = e^x + \cos x\)

ii. \(x^2 \frac{d^2 y}{dx^2} - 2x \frac{dy}{dx} - 4y = x^4\)

4(b) Solve the following simultaneous differential equations.

\[\frac{dx}{dt} - y = t, \quad \frac{dy}{dt} + x = t^2\]

OR

4(b') A particle falls under gravity in a resisting medium whose resistance varies with velocity. Find the relation between distance and velocity if initially the particle starts from rest.
2017-18
B.E.(EVENING) I-SEMESTER EXAMINATION
APPLIED MATHEMATICS-I
(EAMS-1110)

Maximum Marks: 60 Credit: 04 Duration: Two Hours

Note: Answer all the questions

Q.No. Questions M.M.
1(a) Let $V$ be the set of all ordered pairs $(x, y)$, where $x, y$ are real numbers. [7.5]
Let $a = (x_1, y_1)$ and $b = (x_2, y_2)$ be two elements in $V$. Define addition as
$a + b = (x_1, y_1) + (x_2, y_2) = (x_1 + x_2, y_1 + y_2)$ and scalar multiplication as
$\alpha(a, y_1) = (\alpha x_1, \alpha y_1)$. Show that $V$ is a vector space.

1(b) Find the eigen values and eigen vectors and hence diagonalise the following matrix: [7.5]
\[
A = \begin{bmatrix}
1 & 0 & -1 \\
1 & 2 & 1 \\
2 & 2 & 3 \\
\end{bmatrix}
\]

OR

1(b') Verify Cayley-Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & -2 & 3 \\
2 & 4 & -2 \\
-1 & 1 & 2 \end{bmatrix}$ and hence find
the inverse of the matrix. [7.5]

2(a) Trace the curve giving its salient features $y = (x - 2)(x + 1)^2$. [07]

OR

(a') Given $y = e^{\tan^{-1}x}$. Expand $y$ in powers of $x$ as far as $x^5$ by Maclaurin's theorem. [07]

2(b) Check the convergence of the following infinite series:

(i) $\sum_{n=1}^{\infty} \frac{1}{\sqrt{n+\sqrt{n+1}}}$ (ii) $\frac{x}{1.2} + \frac{x^2}{2.3} + \frac{x^3}{3.4} + \frac{x^4}{4.5} + \cdots$

3(a) Find the intrinsic equation of the parabola $y^2 = 4ax$. [07]

OR

3(a') Find the curved surface area of the solid formed by the revolution about the $x$-axis of an arch of the cycloid $x = a(\theta + \sin \theta), y = a(1 + \cos \theta)$. [07]

Contd...
3(b) Show that the volume of the solid generated by the revolution of the curve

\[(a - x)y^2 = a^2 \, x\] about its asymptote is \(\frac{1}{2} \pi^2 a^3\).

4(a) Solve any two of the following:

\[\text{(i) } (4x^3y^3 + 1/x)dx + (3x^4y^2 - 1/y)dy = 0\]

\[\text{(ii) } \frac{d^2y}{dx^2} - 2 \frac{dy}{dx} + 4y = x^2 + 3e^{-2x} + 4 \sin x\]

\[\text{(iii) } x^3 \frac{d^3y}{dx^3} + 3x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = x + \log x\]

4(b) Solve the following simultaneous differential equations.

\[\frac{dx}{dt} + 2y = -\sin 2t, \quad \frac{dy}{dt} - 2x = \cos 2t.\]
Assume Missing data suitably
Notations have their usual meaning

Q1(a) What are natural resources? Discuss about the uses & over-exploitation of forest resources. (6)
Q1(b) Discuss the benefits of using renewable energy sources for the conservation of energy resources & protecting the environment. (6)

OR

Q1'(a) Explain the importance of water resource with concerns of water conflict. Give few examples. (6)
Q1'(b) What are forest resources? Discuss the causes & consequences of deforestation and over exploitation of forest resources. (6)

Q2(a) Classify the air pollutants on the basis of origin, chemical composition. Discuss their health effects (6)
Q2(b) What are ecological pyramids? Classify and explain in detail. (6)

Q3(a) Explain the various causes of threats to Biodiversity due to Human-wildlife conflict. (6)
Q3(b) Discuss the importance of Biodiversity & its conservation. Discuss different forms of Biodiversity. (6)

OR

Q3'(b) Explain Disaster management and mitigation measures. Also write about its major consequences? (6)

Q4(a) Explain the causes & effects of a nuclear accident along with the case history of Fukushima Daiichi Nuclear disaster. (6)

OR

Q4'(a) Write in detail about Climate change & its effects. (6)
Q4(b) Discuss the term “Resettlement & Rehabilitation” with some natural and man-made causes. (6)
Q5(a) Explain the impact of Mortality, Natality & Immigration on population explosion. (6)
Q5(b) Discuss the role of Information Technology on Environment and human health. (6)
Q1(a) Discuss the role of an individual in conservation of natural resources. 
Q1(b) Discuss the benefits of using renewable energy sources for the conservation of energy resources & protecting the environment. 

OR

Q1'(a) Discuss the causes and concerns of water conflict with some examples. 
Q1'(b) What are forest resources? Discuss the causes & consequences of deforestation and over-exploitation of forest resources. 

Q2(a) Explain the classification of air pollutants on the basis of origin, chemical composition & state of matter? 
Q2(b) What are ecological pyramids? Classify and explain in detail. 
Q3(a) Explain the various causes of threats to Biodiversity due to Human-wildlife conflict 

Q3(b) Discuss various threats and conservation actions for preventing extinction of endangered species. Discuss the two categories of extinction and biodiversity conservation. 

OR

Q3'(b) Explain Disaster management and mitigation measures. Also write about its major consequences? 
Q4(a) What is the importance of sustainable development & what are the ways to achieve it. 

OR

Q4'(a) Write in detail about Climate change & its effects. 
Q4(b) Discuss in brief about the importance & objectives of “The Environment Protection Act, 1986. 
Q5(a) Explain the consequences of population explosion on environment. 
Q5(b) Discuss the role of Information Technology on Environment and human health.
PART – A (Electrical Engineering)

Q.No. | Question | M.M.
---|---|---
1(a) | Using Thevenin’s Theorem, find the current through 3Ω resistor in Fig.1. | [07]

[Diagram of a circuit with resistors and a voltage source]

1(b) | Draw the phasor diagram and derive the relationship between phase current and line current for a delta connected 3 phase balanced system. | [08]

OR

1(b’) | Describe the operating principle of transformer. A single phase transformer has 180 turns and 90 turns respectively in secondary and primary windings. The respective resistances are 0.233 Ω and 0.067 Ω. Calculate the equivalent resistance of:
(i) primary side in terms of secondary side.
(ii) secondary side in terms of primary side. | [08]

2(a) | A three phase induction motor has 4 poles, star connected stator and runs at a speed of 1200 rpm when supplied with 220 V, 50 Hz supply. Calculate-

i) the synchronous speed of the motor.

ii) the slip. | [08]

2(b) | Describe the constructional details and principle of operation of the dynamometer wattmeter. | [08]

OR

2(b’) | Draw the layout of hydroelectric power plant. Briefly describe the components and explain the functioning of hydroelectric power plant. | [08]
PART – B (Electronics Engineering)

1(a) Describe the principle of operation of a bipolar junction transistor. Draw the output characteristic of NPN BJT in the common emitter configuration and describe the various regions of operation from it.

1(b) In the circuit of Figure 1, D₁ and D₂ are ideal diodes. Find \( i_D_1 \) and \( i_D_2 \).

\[ \text{Figure 1} \]

\[ \text{OR} \]

1(b') Determine the quiescent operating point (\( I_CQ \& V_{CEO} \)) in the BJT common Emitter with emitter Resistor as shown in Figure 2.
\[ \beta = 180; \ V_{cc} = 16 \ V; \ R_B = 330K \Omega; \ R_C = 1100 \Omega; \ R_E = 550 \Omega. \]

\[ \text{Figure 2} \]

2(a) Explain the construction and working of p-channel depletion type MOSFET. Also plot the drain characteristic.

2(b) Draw an OPAMP based differentiator circuit. Derive the formula for its output voltage. Draw the output voltage waveform for triangular and sine wave inputs.

\[ \text{OR} \]

2(b') Calculate the \( V_{OUT} \) for the circuit shown in Figure 3. The given values are:
\[ V_1 = 3.0 \ \text{Volts}, \ V_2 = -2.0 \ \text{Volts}, \ V_3 = 2.5 \ \text{Volts}, \ R_1 = R_3 = 5k \Omega \ \text{and} \ R_2 = R_f = 10k \Omega. \]

\[ \text{Figure 3} \]
B.E. (AUTUMN SEMESTER) EXAMINATION
BRANCH: ELECTRICAL/Mechanical/Civil
BASICS OF ELECTRICAL ENGINEERING
COURSE CODE: EEEA1110

Maximum Marks: 60  Credits: 03  Duration: Two Hours

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

Q. No. | Questions | M.M.
---|---|---
1 (a) | With the help of suitable diagrams, explain the phasor representation of ac voltage and current. | [08]
1 (b) | State Thevenin's theorem and find the current through 5 Ω resistor in the circuit shown below, using Thevenin's theorem. | [12]

OR

1'b) | For the circuit shown below, find the current through 6 Ω resistor using Superposition theorem. | [12]

Contd..... 2.
2 (a) Define the following:

(i) Magnetic field intensity
(ii) Magnetic flux density
(iii) Permeability

2 (b) In the magnetic circuit shown in the following figure (with all dimensions in mm), calculate the required current to be passed in the coil having 200 turns in order to establish a flux of 1.28 mWb in the air gap. Relative permeability of the magnetic material is 4000.

2 (c) The resistances and leakage reactances of a 10 kVA, 50 Hz, 2300/230 V distribution transformer are:

\[ r_1 = 3.96 \, \Omega \]
\[ r_2 = 0.0396 \, \Omega \]
\[ x_1 = 15.8 \, \Omega \]
\[ x_2 = 0.158 \, \Omega \]

It delivers rated kVA at 0.8 pf lagging to a load on the LV side. Find

(i) The HV side voltage necessary to maintain 230 V across load terminals.
(ii) The percentage voltage regulation

OR

2' (c) A single phase transformer working at unity power factor has an efficiency of 90% at both half load and at the full-load of 500 W. Determine the efficiency at 75% full load and the maximum efficiency.

3 (a) Explain how a rotating magnetic field is produced by a 3-phase stator winding supplied with 3-phase ac supply.

OR

3'(a) Draw a single line diagram of power system and explain briefly.

3 (b) What are the various advantages of rotating field type alternator over rotating armature type alternator?

3 (c) With the help of a layout, briefly discuss the working of a thermal power plant.

OR

3' (c) With the help of a layout, briefly discuss the working of a nuclear power plant.
Q.No. Question M.M.
1(a) Define Thermodynamic System and its different types. [2]
1(b) Explain Pascal’s Law. [7]

A multifluid container is connected to a U-tube, as shown in Fig.1. For the given specific gravities and fluid column heights, determine the gage pressure at A. Also determine the height of a mercury column that would create the same pressure at A.

![Fig. 1](image)

1(c) Illustrate the working of Electrical Resistance thermometer. [6]
The e.m.f. in a thermocouple with the test junction at \( t^\circ C \) on gas thermometer scale and reference junction at ice point is given by \( e = 0.2t - 5 \times 10^{-4}t^2mV \). The millivoltmeter is calibrated at ice and steam points. What will this thermometer read in a place where the gas thermometer reads 50°C?

2(a) A certain gas of mass 4kg is contained within a piston cylinder assembly. The gas undergoes a process for which \( P \sqrt{V} = C \). The initial state is given by 3 bar, 0.1m³. The change in internal energy of the gas in the process is \( u_s - u_i = -4.6 \text{ kJ/kg} \). Find the net heat transfer for the process when the final volume is 0.2 m³. Neglect the changes in K.E. and P.E. [5]

2(b) Apply SFEE to an Adiabatic Nozzle. [10]
At the inlet to a certain nozzle, the enthalpy of the fluid passing is 3000 kJ/kg and the velocity is 60m/s. At the discharge end, the enthalpy is 2762 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it.

1. Find the velocity at exit from the nozzle.
2. If the inlet area is 0.1m² and the specific volume at inlet is 0.187m³/kg, find the mass flow rate.
3. If the specific volume at the nozzle exit is 0.498 m³/kg, find the exit area of the nozzle.

OR

2(b') A rigid tank of volume 0.5 m³ is initially evacuated. A tiny hole develops in the wall, and air from the surroundings at 1 bar, 21°C leaks in. Eventually, the pressure in the tank reaches 1 bar. The process occurs slowly enough that the heat transfer between the tank and the surroundings keep the temperature of the air inside the tank constant at 21°C. Determine the amount of heat transfer.

3(a) Define a pure substance. Explain whether a system comprising of mixture of air and fuel vapours can be considered as a pure substance

3(b) One kg of steam at 8.5 bar and 0.95 dryness expands adiabatically to a pressure of 1.5 bar. The law of expansion is \( pV^{1.2} = C \). Determine (a) the final dryness fraction of the steam and (b) the change in internal energy.

3(c) A sample of steam from a boiler drum at 3 MPa is put through a throttling calorimeter in which the pressure and temperature are found to be 0.1 MPa, 120°C. Find the quality of the sample taken from the boiler.

4(a) Define Coefficient of Performance (COP). Show that the COP of heat pump is greater than the COP of refrigerator by unity.

4(b) What is Clausius inequality? Derive expression for the same.

4(c) A reversible engine is supplied with heat from two constant temperature reservoirs at 900 K and 600 K and rejects heat to a constant temperature sink at 300 K. The engine develops 100 kW and rejects 3600 m kJ of heat per minute. Determine the heat supplied by each source per minute and the engine efficiency.

OR

4'(a) State Kelvin Planck and Clausius statement of the Second Law of Thermodynamics.

4'(b) Draw the steam power cycle (Rankine cycle) on T-s diagram. Write down the equations for heat supplied and work done in various processes.

4'(c) In an air standard Otto cycle the compression ratio is 7, and compression begins at 35°C, 0.1 MPa. The maximum temperature of the cycle is 1200 °C. Find (a) the temperature and pressure at the cardinal points of the cycle, (b) the heat supplied per kg of air, (c) the work done per kg of air, (d) the cycle efficiency, and (e) the mean effective pressure (m.e.p.) of the cycle.