B.Tech. (Chemical Engineering)
Scheme & Syllabi

Effective from 2022-23 Admitted Batch

ANDHRA UNIVERSITY
DEPARTMENT OF CHEMICAL ENGINEERING

SCHEME AND SYLLABI
(with effect from 2022-23)

B.Tech. (Chemical Engineering)
III Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
CH-3101	PC	Process Instrumentation and Control	4	0	30	70	100	3
CH-3102	PC	Mass Transfer-I	4	0	30	70	100	3
CH-3103	PC	Chemical Reaction Engineering - I	4	0	30	70	100	3
CH-3104	PE	Professional Elective-I	4	0	30	70	100	3
CH-3105	OE	Open Elective-I	4	0	30	70	100	3
CH-3106	PC	Mass Transfer-I Lab	0	3	50	50	100	1.5
CH-3107	PC	Process Instrumentation and Control Lab	0	3	50	50	100	1.5
CH-3108	SC	Analytical Techniques	1	2	50	50	100	2
CH-3109	INT	Internship – I			50	50	100	2
							Total Credits	**22**

CH-3101 PROCESS INSTRUMENTATION AND CONTROL

Course Objectives:

In studying this course Chemical Engineering students will come to know the measurement of various process variables and acquire the knowledge of the operation of various process control systems effectively. The students learn

- How physical quantities are measured and how they are converted to electrical or other forms.
- To use various types of instruments.
- Represent the processes in terms of mathematical equations
- The concept of stability and know how to operate a control system in a stable way.
- To deal with various controllers and their functions and applications.
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Course Outcomes:

At the end of the course, the student will be able to

- Recommend suitable instrument for the measurement temperature
- Select a method of measurement for pressure,composition, flow and level
- Develop transfer functions for the processes
- Examine the stability of various control systems
- Apply advanced control schemes for processes and identify the characteristics of control valves

SYLLABUS

Qualities of Measurement: The elements of instruments, static and dynamic characteristics, dynamic response of first order and second order instruments.

Expansion Thermometers: Temperature scales, constant-volume gas thermometer, bimetallic thermometer, pressure spring thermometer, theory of volumetric and pressure thermometers, static accuracy of thermometer, comparison of pressure-spring thermometers.

Thermoelectric Temperature Measurement: Thermoelectricity, industrial thermocouples, thermocouple lead wires, thermal wells, response of thermocouples, the mill voltmeter.

Resistance Thermometers: Thermal coefficient of resistance, industrial resistance thermometer bulbs, resistance thermometer circuits, null-bridge resistance thermometers, deflectional resistance thermometers.

Radiation Temperature Measurement: Introduction, blackbody devices and radiation receiving elements, radiation pyrometers, photoelectric pyrometers and optical pyrometers.

Methods of Composition Analysis: Spectroscopic analysis, absorption, Emission and Mass spectroscopy- IR, UV absorption and mass spectrometers, Gas analysis by thermal conductivity, analysis of moisture in gases (humidity), psychrometer method, hygrometer method, dew-point method for moisture analysis in gases, measurement of moisture in paper, textile and lumber.

Measurement of Pressure and Vacuum: Pressure, vacuum and head, liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for pressure gauges, measurement of absolute pressure, measurement of pressure in corrosive fluids, static accuracy of pressure gauges.

Measurement of Head and Level: Density and specific gravity, direct measurement of liquid level, pressure(level) measurement in open vessels, level measurement in pressure vessels, density measurement, level measurement by weighing.

Introduction to Process Dynamics and Control: Response of First Order Systems - Physical examples of first order systems.

Response of first order systems in series, higher order systems: Second order and transportation lag.

Control systems: Controllers and final control elements, Block diagram of a chemical rector control system Closed loop transfer functions, Transient response of simple control systems.

Stability Criterion: Routh Test, Root locus. Transient response from root locus, Application of root locus to control systems Introduction to frequency response, Control systems design by frequency response.

Advanced control strategies: Cascade control, Feed forward control, ratio control, Smith predictor, dead time compensation, internal model control. Controller tuning and process identification. Control valves.

Text Books:

1. Donald P Eckman. Industrial Instrumentation, CBS Publishers, New Delhi, 2004.
2. D.R. Coughanowr. Process Systems Analysis and Control, Mc Graw Hill, 1991

Reference Books:

1. Hand Book of Instrumentation and control, Considine.
2. Chemical Process Control, G. Stephanopolous, Prentice Hall, 1984.

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CH-3102 MASS TRANSFER –I

Course Objectives:

- To explain the students with the basic principles of mass transfer operations and other separation processes with examples.
- To impart knowledge on how certain substances undergo the physical change with diffusion/mass transfer of components from one phase to other phases.
- To describe the students with equipment used in operations involving mass transfer and other separation processes and their advantages and disadvantages.
- To focus on absorption and distillation operations and the process design aspects of the same operations.
- To provide the knowledge on humidification and dehumidification operations and their applications in real situations

Course Outcomes:

At the end of the course, the student will be able to

- Identify diffusion phenomena in various chemical processes
- Determine diffusivity coefficient in gases and liquids.
- Calculate mass transfer coefficients at interfaces of multiphase mass transfer systems
- Understand the VLE concepts and application to different distillations
- Understand the importance of humidification and dehumidification processes and their industrial applications
- Design equipment for gas-liquid mass transfer operations

SYLLABUS

Introduction: Mass transfer Operations.

Molecular Diffusion in Fluids: Binary solutions, Fick's law, equation of continuity, Steady state equimolal counter current diffusion, Stefan's diffusion, estimation of diffusivity of gases and liquids, application of molecular diffusion.

Mass Transfer Coefficients: Mass transfer coefficients in turbulent flow, theories of mass transfer, analogy between momentum, heat and mass transfer in laminar and turbulent flow, correlations for mass transfer coefficients in simple situations, diffusion in solids.

Interphase Mass Transfer: Concept of equilibrium, diffusion between phases, two resistance theory, material balances in steady state co-current and counter-current stage processes, Murphy stage efficiency.

Equipment for Gas-liquid Operations: Sparged vessels, mechanically agitated vessels for single phase liquids and gas-liquid mixtures, tray towers, sieve tray for absorption and distillation, venturi scrubbers, spray towers and spray chambers, packed towers for absorption and distillation, tray towers versus packed towers.

Humidification operations: Definition of fundamental terms, Psychrometric charts, theory of adiabatic saturation and wet bulb temperature, Lewis relation, gas-liquid contact operations, water cooling with air, dehumidification of air-water-vapor mixture, cooling towers, evaporative cooling.

Absorption: Solubility's of gases in liquids, two component systems, multi-component systems, ideal and non-ideal solutions, choice of solvent for absorption, single component absorption material balances, counter current multistage operations, dilute gas mixtures, on-isothermal operation, tray efficiency, continuous contact equipment, HETP, HTU, NTU concepts for single operation absorption with chemical reaction.

Distillation: Principles of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation, McCabe-Thiele method,

Ponchon-Savarit method, tray efficiencies, introduction to multi-component distillation, azeotropic and extractive distillations.

Text Book:

Mass transfer Operations, Robert E. Treybal, 3rd edition, McGraw-Hill Book Co.,

Reference Books:

1. ”Unit Operations in Chemical Engineering” by McCabe,W.L.,Smith,J.C.and Harriot,P., 5th Edition, McGraw-Hill Book Co.,
2. “Chemical Engineering Hand Book” by J.H. Perry.

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CH-3103 CHEMICAL REACTION ENGINEERING – I

Course Objectives:

- To learn principles of rate law and stoichiometry. Isothermal reactors- Batch, plug flow reactor and mixed flow reactor. Design of single and multiple reactors.
- To endow with the knowledge on thermal characteristics of various reactions

Course Outcomes:

At the end of the course, the student will be able to

- Derive the rate law for non-elementary chemical reactions and determine the kinetics of chemical reaction using integral, differential and fractional life methods.
- Design reactors for homogenous reactions under isothermal conditions for single and multiple reactions
- Select optimal sequence in multiple reactor systems

SYLLABUS:

Introduction and overview of chemical reaction engineering – Variables affecting a chemical reaction – Kinetics of homogeneous reactions – Concentration dependent term of rate equation – Elementary and nonelementary reactions – Temperature dependent term – Arrhenius law, activation energy, collision theory, transition state theory Searching for a mechanism.

Interpretation of batch reactor data – Methods of analysis, integral, differential and half life methods – Analysis of different types of reactions, irreversible and reversible – Variable volume reactor.

Ideal reactors for a single reaction – Performance equations for batch, mixed flow and plug flow reactors – Space time, space velocity and mean residence time.

Design for single reactions – Size comparison of reactors – Multiple reactor systems – Recycle reactor.

Design for parallel reactions – Qualitative and quantitative discussion about product distribution.

Design for series reactions – Qualitative and quantitative discussion about product distribution.

Text Book:

"Chemical Reaction Engineering"., Levenspiel, O. 3rd Edition, John Wiley and Sons.

Reference Books:

1. "Chemical Engineering Kinetics" Smith, J.M, 3rd Edition. McGraw Hill Inc.

2. “Elements of Chemical Reaction Engineering”., Fogler, H.S, 3rd Edition, Prentice Hall India Ltd.

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Professional Elective-I: CH-3104 FERTILIZER TECHNOLOGY

Course Objectives:

- To introduce various nutrients and their role in growth of a plant
- To introduce different types of the nitrogenous, phosphatic, potassic and compound fertilizers
- To introduce different fertilizer production methods

Course Outcomes:

At the end of the course, the student will be able to

- understand different raw material availability
- Explain the beneficiation of rock phosphate
- Discuss the production of all types of fertilizers
- Formulate different fertilizer mixtures

SYLLABUS

Details about Indigenous Fertilizer Production – raw materials, details of various nutrients with their importance, sources of nitrogen and hydrogen, steam reforming of hydrocarbons, partial oxidation of fuel cells with gas purification including high and low temperature shift conversion, carbondioxide removal processes and methanation.

Coal Gasification, ammonia synthesis, thermodynamic principles associated with ammonia synthesis, ammonia reactors, nitric acid and sulfuric acid.

Urea – total recycle and stripping processes, process details of ammonium sulfate, ammonium chloride, ammonium nitrate, calcium ammonium nitrate.

Phosphate Rock – availability and beneficiation methods for upgrading, bone meal, basic slag, single super phosphate, triple super phosphate, phosphoric acid by wet process and furnace

process, AMI process with hydrochloric acid, complex fertilizers like mono and di-ammonium phosphates, urea ammonium phosphate.

Text Book:

'Hand Book of Fertilizers' published by fertilizer Association of India, New Delhi

Reference Books:

1. 'Chemistry and Technology of Fertilizers' by V. Sauchelli, Reinhold Publications.
2. 'Fertilizers Manual, a UNIDO Publication from International Fertilizer Development Centre, Alabama, USA.
3. 'Chemical Technology-II' published by IIT, Madras.

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Professional Elective-I: CH-3104 COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING

Course Objectives:

The objective of this course is to provide student with

- a sufficient background regarding the applications of computers in Chemical Engineering problems.
- The Knowledge of numerical integration, numerical differentiation, function approximations, solution of linear equations using matrix methods, solution of ordinary differential equations, initial value problems, boundary value problems and solution of partial differential equations by solving number of problems.

Course Outcome:

At the end of the course the student will be able to

- Learn the applications of computers in solving chemical Engineering problems
- Solve /write programs for Chemical Engineering problems

SYLLABUS

Roots of Algebraic and Transcendental Equations: Iteration methods, Regula-Falsi method, Newton Rapson method, roots of simultaneous sets of transcendental and algebraic equations,

System of linear equations and their solution by different techniques, numerical differential and integration, regression analysis, least squares and orthogonal polynomial approximation,

Numerical solution of ordinary differential equations,

Numerical solution of partial differential equations (simple case studies),

Application of the above Techniques to Problems of Interest in Chemical Engineering.

Text Book:

‘Digital computation for chemical engineers’ by Leaon Lapidus, McGraw Hill Book Company

Reference Books:

1. ‘Applied Numerical Methods’ by Camehanet, McGraw Hill Book Co.
2. ‘Applied Numerical Methods with Personal Computers, by Constantinides, McGraw Hill Book Co, New York

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<u>OPEN ELECTIVE-I:</u> Artificial Intelligence and Machine Learning

COURSE OBJECTIVES: From the course the student will learn

- Know user interfaces to improve human and AI interaction and decision making.
- Allows the students to develop AI skills.
- Introduce the concepts of expert systems and machine learning.
- To be able to apply machine learning algorithms to solve problems of moderate complexity.

COURSE OUTCOMES: At the end of the course, student will be able to

CO 1: Understanding Artificial Intelligence and different branches of Artificial Intelligence and demonstrate awareness of informed search and exploration methods.

CO 2: Understanding various Machine Learning Methods.

CO 3: Analyzing the different Classification and Regression Techniques.

CO 4: Familiarization of Architecture in Convolution Neural Networks.

CO 5: Understanding the concepts of different supervised learning methods and its Applications.

Syllabus

Unit I: Introduction to Artificial Intelligence: Biological Motivation for a Human Brain, Neural Network Representation, ANN Architecture, Perceptron, Multi-Layer Perceptron Structure, Back Propagation.

Unit II: Machine Learning: Introduction to Machine Learning, Different Types of Machine Learning Methods, Supervised, Semi Supervised, Unsupervised and Reinforcement Learning.

Unit III: Classification and Regression Algorithms: Difference Between Classification and Regression, Classification Algorithms, KNN, SVM Algorithms and its Applications, Regression Algorithm, Linear Regression, Decision Tree Regression and Random Forest Regression.

Unit IV: Convolution Neural Networks: Introduction to Convolution Neural Networks**,** Basic Principle, Architecture**,** Types of CNN Layers, Pooling Layers, Convolution Layers and Fully Connected Layers, Applications of CNN.

Unit V: Advanced Topics in Artificial Intelligence and Machine Learning: DNN Model, Significance, Overview of DNN Technique and its Applications, Generative Models, Working Principle of GAN and its Applications.

Text Books:

1. Artificial Intelligence and Machine Learning by Vinod Chandra SS and Anand Hareendran S, PHI Publications.
2. Artificial Intelligence – A Model Approaceh Stuart Russel and Peter Norvig.

Reference Books:

1. Introduction to Artificial Intelligence by Ertel W (2018) Springer International Publishing.
2. Machine Learning and Artificial Intelligence by Joshi and Ameet V (2022) Springer International Publishing.

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CH-3101

Model Question Paper

III/IV B. Tech DEGREE EXAMINATION

Chemical Engineering

First Semester

PROCESS INSTRUMENTATION AND CONTROL

(With effective from the admitted batch of 2022-2023)

Time: 3 hours **Max. Marks: 70**

Q. No. 1 is compulsory. Answer any **FOUR** from the remaining. All questions carry equal marks.

1. Explain the following
   (i) Pressure gauge [14]
   (ii) Thermocouple
   (iii) Negative feedback
   (iv) Regulatory system
   (v) Corner frequency
   (vi) Rate control
   (vii) Transportation Lag

2. (a) Describe inclined tube manometer with a neat sketch [9+5]
   (b) Write the applications of inclined tube manometer

3. (a) Describe Optical Pyrometer with a neat sketch [5+9]
   (b) Write the use of Level Control Trainer in industry

4. (a) Derive the transfer functions for P,P-D,P-I,P-I-D controllers. [7+7]
   (b) Show typical feedback control system and explain the different components involve

5. (a) Discuss the Bode stability criteria
   (b) Sketch the Root locus for the following equation [6+8]

$$G = \frac{K}{(S+4)(S+2)(S+3)}$$

On your sketch you should locate quantitatively all poles, zeroes and asymptotes

6. (a) Explain the Cascade controller
   (b) Explain the F-F controller [7+7]

7. (a) Describe completely the Internal model control structure
   (b) Design an IMC controller for the process which is first order

$$G_m = \frac{K}{(\tau S + 1)}$$ [7+7]

8. (a) Explain the Cascade controller
(b) Write notes on Control valve characteristics [7+7]

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CH-3102

III/IV B. Tech DEGREE EXAMINATION

I- Semester

Chemical Engineering

MASS TRANSFER - I

(With effective from the admitted batch of 2022-2023)

Time: 3 hours Max. Marks: 70

Model Question Paper

Q. No. 1 is compulsory. Answer any **FOUR** from the remaining. All questions carry equal marks.

Max Marks: 70 Time: 3 hours

1. Write short notes on the following: 7X2=14
   a) Fick's law of diffusion
   b) Schmidt number
   c) Overall gas mass transfer coefficient
   d) Loading in packed towers
   e) Dry bulb temperature
   f) Absorption factor
   g) Relative
2. a) Calculate the rate of diffusion of acetic acid across a film of non-diffusing water solution of 2 mm. thickness at 290K. The concentration on opposite sides of the film is respectively 8% and 4% by weight of acid respectively. The diffusivity of acetic acid in the solution is $0.95\times10^{-9}m^2/s$. The densities of 8% and 4% by weight acid solutions are $1.01g/cm^3$ mid $1.004\ g/cm^3$ respectively.

   (7)

   b)Obtain the equation for flux in case of one component (A) diffusing in non-diffusing component (B). (7)
3. Explain the film theory and penetration theory with the relation to obtain the mass transfer coefficient. (14)
4. a) Differentiate between tray towers and packed towers. (8)
   b) Derive the relation between overall liquid mass transfer coefficient and individual mass transfer coefficients. (6)
5. a) Difference between forced draft and induced draft cooling towers with neat sketch. (6)

b) Determine the following psychometric properties of moist air sample having a dry-bulb temperature 27^0c and absolute humidity of 0.015 kg/kg dry air using psychometric chart. Vapor pressure of water at 27^0c is p_A=0.0357 bar. Total pressure=1atm. (i) relative humidity from partial pressure and vapor pressure data (ii) dew point (iii) wet bulb temperature.

(8)

6. In a petrochemical plant, a gas containing 3% cyclo-hexane and 97% inerts has to be treated with a non-volatile absorption oil in a tray. It is required to remove 98% of the cyclo-hexane of the feed gas. The feed solvent is free from cyclo-hexane. If the feed gas rate is 80 kmol per hour. Calculate the minimum solvent rate. The equilibrium relation is given as Y=(0.2X)/(1+0.8X). (14)
7. a) A liquid mixture of 50 mole% n-heptane (A) and 50 mole% n-octane (B) is subjected to differential distillation at atmospheric pressure with 70mole% of the liquid distilled. Compute the composition of the composite distillate and the residue. Equilibrium data is given as follows: (8)

x	0	0.497	0.523	0.608	0.648	0.689	1.0
y	0	0.32	0.34	0.38	0.42	0.5	1.0

b) Explain about the extractive distillation operation with neat sketch.

(6)

8. 1000 kg moles/hr of an ethanol propanol mixture containing 65 mole% ethanol is to be separated in continuous plate column operating at 1atmospheric total pressure. The desired terminal compositions in units of mole fractions of ethanol are XD=0.92 and XW=0.07. The feed is a saturated vapor and total condenser is used. When the reflux rate is four times the amount of top product, find the number of theoretical plates required for separation Relative volatility of ethanol propanol system may be taken as 2.10. (14)

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CH-3103
III/IV B. Tech DEGREE EXAMINATION
I- Semester
Chemical Engineering

CHEMICAL REACTION ENGINEERING-I

(With effective from the admitted batch of 2022-2023)

Time: 3 hours Max. Marks: 70

Answer the following questions
Question No. 1 is compulsory and Answer any 4 from the remaining

1. Write briefly about the following: (7 x 2 =14)

(a) Law of mass action
(b) Recycle reactors
(c) Heterogeneous reactions
(d) Arrhenius theory
(e) Pseudo first order
(f) Space time and residence time
(g) Non elementary reactions

2. (a) Explain the salient features of the three theories that are proposed to explain the temperature dependence of a reaction. (7)

(b) Derive the Michelis and Menten rate expression for enzyme substrate reaction. (7)

3. (a) Derive the performance equations(for constant density system) for an ideal plug flow reactor and discuss the design procedure. (7)

(b) A zero order homogeneous gas reaction ,a$\rightarrow rR$ proceeds in constant volume batch reactor, 20% inerts, and the pressure rises from 1 to 1.3 atm in 2 minutes. If the same reaction takes place in a constant pressure batch reactor, what is the fractional volume change in 4 minutes, if feed is at 3 atm and consists of 40% inerts. (7)

4. A series reaction, $A \rightarrow R \rightarrow S$, with k_1 and k_2 as rate constant for the first and second steps respectively with $C_{RO} = C_{SO} = 0$ is to be conducted in plug flow reactor. Both steps are of first order. Obtain an expression for optimum space time corresponding to

maximum concentration of R . also find C_{Rmax} if $k_1 = k_2$.

(14)

5. (a) discuss the integral and differential methods of analyzing kinetic data with their limitations.

(7)

(b) a homogeneous liquid phase second order reaction $A \rightarrow R$ takes place with 50% conversion in a CSTR, if this CSTR is replaced by another CSTR having volume 2 times more than that of earlier one. How much enhancement in conversion will be possible?

(7)

6. (a) A is decomposed according to the following scheme:

$$A \rightarrow R, r_R = 1;\ \ A \rightarrow S, r_S = 2C_A;\ A \rightarrow T, r_T = C^2{}_A$$

If C_{A0} is 4, find the maximum expected C_S for isothermal operation in (i) plug flow reactor (ii) mixed flow reactor. (14)

7. (a) A first order reaction is to be treated in series of mixed flow reactors. Show that the total volume of the mixed flow reactors is minimum, when the reactors are in equal in size.(7)

(b) a liquid reactent stream (1 mol/lit) passes through two mixed flow reactors in series. The concentration of A in the exit of the first reactor is 0.5 mol/lit. find the concentration in the exit stream of the second reactor . the reaction is second order with respect to A and $\frac{V_2}{V_1} = 2$. (7)

8. (a) explain the recycle reactor and the governing equations. (7)

(b) at present conversion is 2/3 for our elementary second order liquid reaction. $2A \rightarrow 2R$, when operating in an isothermal plug flow reactor with a recycle ratio of unity, what will be the conversion if the recycle stream is shut off ? (7)

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CH-3104

III/IV B. Tech DEGREE EXAMINATION

I- Semester

Chemical Engineering

FERTILIZER TECHNOLOGY

(PROFESSIONAL ELECTIVE- I)

(With effective from the admitted batch of 2022-2023)

Time: 3 hours **Max. Marks: 70**

Model Question Paper

Q. No. 1 is compulsory. Answer any **FOUR** from the remaining. All questions carry equal marks.

Max Marks: 70 Time: 3 hours

1. Answer the following (7x2 = 14)

   a) Different forms of nitrogen in fertilizer
   b) FACT
   c) Grade of a fertilizer
   d) Rock beneficiation
   e) Uses of ammonia
   f) Handling of Ammonium nitrate
   g) SSP

2. a) Explain the role and importance of primary nutrients in the plant growth. (7)
   b) Explain in detail with a neat flow diagram, the production of ammonia from natural gas using steam reforming (7)

3. a) Which is known as oil of vitriol? Explain the most advanced manufacturing process of it. (7)
   b) Explain in detail the wet process of phosphoric acid manufacture. (7)

4. Give complete account of ammonium sulphate manufacture with neat flow diagrams. (14)

5. Explain the manufacture of ammonia from natural gas using steam reforming process. (14)

6. Discuss the method of manufacturing of Phosphoric acid by dihydrate process and highlight the merits and demerits of it. (14)

7. Describe the production of CAN with a neat flow diagram. (14)

8. Write notes on the following (14)
   a) Nitro phosphates
   b) Rock beneficiation
   c) APS

CH-3104

Chemical Engineering

III/VI B. Tech DEGREE EXAMINATION

I- Semester

COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING

(PROFESSIONAL ELECTIVE- I)

(With effective from the admitted batch of 2022-2023)

Time: 3 hours **Max. Marks: 70**

Model Question Paper

Q. No. 1 is compulsory. Answer any **FOUR** from the remaining.

All questions carry equal marks.

1. Answer the following in brief $7\times2=14M$
   (a) Simpson's $1/3^{rd}$ rule
   (b) Eluer Integration
   (c) Numerical differentiation
   (d) Lagrange interpolation
   (e) Implicit function
   (f) Advantages and disadvantages of Newton method
   (g) Give one physical examples for partial differential equation

2. Experimental data on constant pressure filtration of $169.8Kg/m^3$ $CaCO_3$ slurry through a canvas medium of area $5.48\times10^{-4}m^2$ is given below

x	10	15	20	25	30	35	40
y	0.716	0.806	0.869	0.943	1.013	1.096	1.16

   In this process y is represented by $y=a_0+a_1x$. Find a_0 and a_1. 14M

3. Solve the following linear equations by Gauss Siedel method. 14M

$$17x - 2y - 3z = 500$$
$$-5x + 21y - 2z = 200$$
$$-5x - 5y + 22z = 30$$

4. (a)The function y=sin(x) is tabulated below.

x	0	π/4	π/2
y=sin(x)	0	0.70711	1.0

Using Lagrange's interpolation formula, find the value of sin(π/6) 7M

(b) Use Runge Kutta method to solve $10\frac{dy}{dx} = x^2 + y^2$ with y(0)=1 for the interval 0<x≤0.3 with h=0.1 7M

5. The following table of values of x and y is given

x	0	1	2	3	4	5	6
y	6.9897	7.4036	7.7815	8.1291	8.451	8.7506	9.0309

Find $\frac{dy}{dx}$ when (i) x=1, (ii) x=3, (iii) x=6. Also find $\frac{d^2y}{dx^2}$ when x=3. 14M

6. (a) Evaluate $\int_0^{\pi} t\ sint\ dt$ using Trapizoidal rule 7M

(b)The velocities of a car (running on a straight road) at intervals of 2 minutes are given below.

Time in minutes	0	2	4	6	8	10	12
Velocity in km/hr	0	22	30	27	18	7	0

Apply Simpson's rule to find the distance covered by the car. 7M

7. (a) Solve $\frac{1}{\sqrt{f}} = 2log_{10}\left(N_{Re}\sqrt{f}\right) - 0.8$ by Newton Raphson method. Assume N_{Re}=10^4 7M

(b) Find the root of the equation $x^3 + 2x^2 + 4x + 7 = 0$ in the vicinity of x=-1.5 7M

8. A solid body occupying the space between x=0 to x=∞ is at a temperature T_0. At time t=0, the surface at x=0 is suddenly raised to a temperature T_1 and maintained at that temperature for t>0. Find the time dependent temperature profile T(x,t). 14M

CH-3105

Artificial Intelligence and Machine Learning

(OPEN ELECTIVE- I)

Chemical Engineering

III/VI B. Tech DEGREE EXAMINATION

I Semester

Time: Three hours **Maximum: 70 Marks**

Question No.1 is compulsory

Answer any FOUR questions from the remaining

All questions carry equal marks

1. a) What is the perceptron model in artificial neural networks? [3]

b) What are the advantages and disadvantages of supervised learning? [3]

c) What types of data are well-suited for SVM classification? [3]

d) What are the main components of a typical CNN architecture? [3]

e) Discuss the application of DNNs in image classification tasks. [2]

2 a) What are the differences between the human brain's neural networks and artificial neural networks? [7]

b) What is the basic architecture of an artificial neural network? [7]

3 a) What are the ethical considerations in developing and deploying machine learning systems? [7]

b) What is reinforcement learning, and how does it differ from other machine learning methods? [7]

4 a) What is the K-Nearest Neighbors (KNN) algorithm, and how does it work for classification tasks? [7]

b) Describe the random forest regression algorithm and its advantages over individual decision trees. [7]

5 a) How do the depth and width of a CNN affect its performance and ability to learn complex features? [7]

b) How do filters (kernels) in convolutional layers learn to detect features in the input data? [7]

6 a) How does the adversarial training process in GANs help generate realistic samples? [7]

b) How do regularization methods, such as dropout and L1/L2 regularization, help prevent overfitting in DNNs? [7]

7 a) How does back propagation help in training neural networks? [7]

b) What is the purpose of pooling layers in CNNs, and how do they contribute to the network's performance? [7]

8 a) How does the multilayer perceptron model improve upon the perceptron model? [7]

b) What are the main applications of machine learning in real-world scenarios? [7]

B.Tech. (Biotechnology)
Scheme & Syllabi
Effective from 2022-23 Admitted Batch

ANDHRA UNIVERSITY
DEPARTMENT OF CHEMICAL ENGINEERING

SCHEME AND SYLLABI
(with effect from 2022-23)

B.Tech. (Biotechnology)
III Year - I Semester

Course code	Category	Course Title	Hours per week		Internal Marks	External Marks	Total Marks	Credits
			L	P				
BT-3101	PC	Heat and Mass Transfer	4	0	30	70	100	3
BT-3102	PC	Enzyme Engineering	4	0	30	70	100	3
BT-3103	PC	Cell and Molecular Biology	4	0	30	70	100	3
BT-3104	PE	Professional Elective -I	4	0	30	70	100	3
BT-3105	OE	Open Elective-I	4	0	30	70	100	3
BT-3106	PC	Heat and Mass transfer Lab	0	3	50	50	100	1.5
BT-3107	PC	Cell and molecular biology Lab	0	3	50	50	100	1.5
BT-3108	SC	Bio Instrumentation	1	2	50	50	100	2
BT-3109	INT	Internship – I			50	50	100	2
							Total Credits	**22**

BT-3101 HEAT AND MASS TRANSFER

Course Objectives:

- To explain the students with the basic principles of heat and mass transfer operations
- To impart knowledge on how certain substances undergo the physical change with diffusion/mass transfer components from one phase to other phases.
- To describe the students with equipment used in operations involving heat and mass transfer and their advantages and disadvantages.
- To focus on heat exchangers and distillation operations and the process design aspects of the same operations.

Course Outcomes:

At the end of the course, the student will be able to

- Define the basic principles of heat and mass transfer operations and other thermal and separation processes.
- Identify the basic techniques for measurement of diffusivity, mass transfer coefficient, heat transfer coefficients.
- Understand the importance of heat and mass transfer phenomena in the design of process equipment
- Understand the VLE concepts and its application to various types of distillation.
- Identify the major parts of various Heat and mass transfer equipments.

SYLLABUS:

Nature of heat flow - Conduction, convection and radiation

Heat transfer by Conduction: Basic law of conduction, thermal conductivity, steady state conduction, compound resistances in series, heat flow through a cylinder and a sphere, unsteady state conduction – one dimensional heat flow

with constant surface temperature.

Principles of heat flow in fluids: countercurrent and parallel flows, energy balances, heat flux and heat transfer coefficients, overall heat transfer coefficients, LMTD, individual heat transfer coefficients, fouling factor.

Heat exchange equipment: Double pipe heat exchanger and 1-2 Shell and tube heat exchanger

Molecular diffusion in fluids: Binary solutions, Fick's law, Steady state diffusion in A diffusing through non-diffusing B and equimolal counter diffusion, application of molecular diffusion.

Mass transfer coefficients, theories of mass transfer, analogy between momentum, heat,

and mass transfer. Concept of equilibrium, diffusion between phases, two resistance

theory.

Absorption: Solubility's of gases in liquids, ideal and non-ideal solutions, choice of solvent for absorption,.

Distillation: Principles of VLE for binary systems, relative volatility, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation, McCabe- Thiele method, Murphy stage efficiency.

Equipment for gas-liquid operations: Sparged vessels, mechanically agitated vessels for single phase liquids and gas-liquid mixtures, spray towers, sieve tray for absorption and distillation, packed towers for absorption and distillation, tray towers versus packed towers.

Text Book:

1."Unit Operations of Chemical Engineering" Seventh Edition, by W.L. McCabe, J C Smith and P Harriot, Mc Graw Hill

2. Mass transfer Operations, Robert E. Treybal, 3rd edition, McGraw-Hill Book Co.,

Reference Books:

1. Process Heat Transfer, by D. Q. Kern, Tata McGraw Hill, New Delhi.

2.“Unit Operations in Chemical Engineering” by Mc Cabe,W.L.,Smith,J.C.and Harriot,P., 5th Edition, McGraw-Hill Book Co.,

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BT-3102 ENZYME ENGINEERING

Course Objectives:

- To understand the IUBMB system of enzyme classification and to know the catalytic activity and its regulation.
- To identify the sources and produce the enzymes with greater concentration.
- To learn the kinetics of single enzyme substrate catalyzed reactions, enzyme inhibition kinetics and the factors affecting the enzyme activity.
- To gain knowledge in the enzyme immobilization methods and their kinetics.
- To design the reactors.
- To use the enzymes in various industries.

Course Outcomes:

At the end of the course, the student will be able to

- Understand the enzyme structure and classify them.
- Produce the enzyme with high purity.
- Identify the kinetics and optimize the factors that affect the enzyme activity for maximum production.
- Describe the immobilization of the enzymes to produce an enzyme for industrial and other applications.

SYLLABUS

Introduction: Catalysis and biocatalysis, enzyme structure functionality and relationship, enzyme activity, classification of enzymes, enzymes as process catalysts.

Enzyme Production: Enzyme sources, synthesis, recovery, purification, and

formulation of enzymes,

Homogeneous Enzyme Kinetics: Hypothesis of enzyme kinetics, rapid equilibrium and steady-state hypothesis, determination of kinetic parameters, various types of enzyme inhibitions, effect of pH andtemperature.

Heterogeneous Enzyme Kinetics: Various methods of enzyme immobilization, mass transfer effects in heterogeneous biocatalysis, partition effects, external (film) diffusion, internal (pore) diffusion.

Enzyme Reactors: Design of ideal reactors with enzymes (Batch, CSTR, PFR), effect of diffusion on enzyme reactor design, effectiveness factor, thermal inactivation.

Application of Enzymes: Application in biosensors, Food processing applications, Medical and pharmaceutical applications, application of immobilized enzymes.

Text Books:

1. "Enzyme Technology" by M.F.Chaplin and C.Bucke, Cambridge University press, 1990.
2. Bioprocess Engineering 2nd edition, M. L. Shuler and F. Kargi, Prantice Hall India, New Delhi, 2002.

Reference Books:

1. "Biocatalysts and Enzyme Technology" by K. Buchholz,V.Kasche and U.T. Bornscheur, Wiley,2005
2. "Enzyme Technology", by Shanmugam,S. and Satish Kumar,T.,IK International Pvt. Ltd, New Delhi, 2008
3. "Biochemical Engineering Fundamentals' by Bailey,J.E., and Ollis,D.F., McGraw- Hill,1986.
4. "Enzyme Biocatalysis: Principles and Applications' by A.Illanes, Springer.

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BT-3103 CELL AND MOLECULAR BIOLOGY

Course Objectives:

- The main objective is to prepare the students for career in fields that require advance knowledge of cell and molecular biology.
- With the application of study in cell and molecular biology, the student can also provide services and economic opportunities to the communities.

Course Outcomes:

At the end of the course, the student will be able to

- Understand and utilize the scientific vocabulary used in communicating information in Cell & Molecular Biology.
- Represent and illustrate the structural organization of genes and the control of gene expression.
- Develop basic knowledge and skills in Cell & Molecular Biology
- Outline the processes that control eukaryotic cell cycle and cell death.
- Conduct research in the frontier and multi disciplinary areas of modern biology.

SYLLABUS

The nucleus, chromatin and the chromosome: structure and function of nucleus; organization of genetic material – Packing of DNA into chromatin, Nucleosome organization; Chromosome structure; Cell cycle – Check points, Cdks and regulation.

The biochemical basis of Inheritance: DNA as the genetic material, DNA structure and replication in prokaryotes and eukaryotes – Enzymes involved and mechanism, including replication at telomere.

Genetic code: properties of genetic code, Wobble hypothesis.

Gene Expression:Transcription in prokaryotic and eukaryotic systems – enzymes and factors involved and mechanism; RNA processing in eukaryotes – capping, addition of poly(A) and removal of introns; **Translation** in prokaryotes and eukaryotes – machinery involved and mechanism;

Regulation of gene expression in prokaryotes – Lac operon concept in *E.coli* ; regulation of gene expression in eukaryotes by promoters, enhancers, silencers and transcription factors.

Mutations – Terminology, types of mutations, Biochemical basis of mutants, Mutagenesis, Chemical mutagens - base analogues - Intercalating substances, Physical mutagens- U.V radiation and ionization radiation, AMES test - Repair of DNA damage.

Text Book:

"The world of the cell" Becker, Klein smith &Hordin, Pearson education

Reference Books:

1. Molecular cell biology by Lodishet.al . Freeman Publications
2. "Cell & Molecular Biology", De.Roberties. E.D.P., International Edition
3. "Molecular Biology", Friefelder, D., Narosa publications
4. "Molecular Biology of the Gene", J.D.Watson et.al, Banzamin

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BT – 3104 Professional Elective –I: FOOD TECHNOLOGY

Course Objectives:

- To identify Pathogenic and spoilage microorganisms in foods, the important pathogens and spoilage microorganisms in foods and the conditions under which they will grow, the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods, laboratory techniques to identify microorganisms in foods, beneficial microorganisms in food systems ,understand the principles involving food preservation via fermentation processes, influence of the food system on the growth and survival of microorganisms, understand the role and significance of microbial inactivation, adaptation and environmental factors (i.e., pH, temperature) on growth and response of microorganisms in various environments, Understand the principles involving food preservation via fermentation processes.

Course Outcomes:

At the end of the course, the students will be able to

- Identify the good manufacturing conditions, including sanitation practices, under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in

foods.

- Understand the elements of food processing and preservation
- Explain the techniques of food processingoperations.

SYLLABUS

Food processing and preservation: Biotechnology in relation to the food industry, nutritive value of the food, types of microorganisms associated with the food, food colors and flavors, enzymes and chemicals used in food processing, food preservation.

Fermented food products: Microbial culture used in food industry, fermentation technology for food industry & waste utilization. Bioprocessing and fermentation of meat, vegetables, fruits, dairy products, non-beverage plant products, beverages and related products of baking.

Food spoilage and Food Microbiology: Food spoilage, food borne illness, food quality and quality control, HFCS (High Fructose Corn Syrup), single cell protein production.

Food processing operations: Food engineering operations: characteristics, cleaning, sorting and grading of food raw materials, food conversion operations, size reduction, mixing, emulsification, filtration, membrane separation, centrifugation, extraction, and crystallization, microwave heating, thermal inactivation of microorganisms, freezing and thawing of foods.

Text Books:

1. "Biotechnology: Food fermentation", by V.K. Joshi & Ashok pandey.
2. "Food processing and preservation", by B. Sivasankar

Reference Books:

1. "Food Biotechnology", by Roger Angold, Gordon Beech & Taggart 2. "Basic Food Microbiology", by George J Banward, CBS publishers

2. "Modern Food Microbiology", by James M Jay, CBS publishers.

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BT-3105 OPEN ELECTIVE-I: Artificial Intelligence and Machine Learning

COURSE OBJECTIVES: From the course the student will learn

- Know user interfaces to improve human and AI interaction and decision making.
- Allows the students to develop AI skills.
- Introduce the concepts of expert systems and machine learning.
- To be able to apply machine learning algorithms to solve problems of moderate complexity.

COURSE OUTCOMES: At the end of the course, student will be able to

CO 1: Understanding Artificial Intelligence and different branches of Artificial Intelligence and demonstrate awareness of informed search and exploration methods.

CO 2: Understanding various Machine Learning Methods.

CO 3: Analyzing the different Classification and Regression Techniques.

CO 4: Familiarization of Architecture in Convolution Neural Networks.

CO 5: Understanding the concepts of different supervised learning methods and its Applications.

Syllabus

Unit I: Introduction to Artificial Intelligence: Biological Motivation for a Human Brain, Neural Network Representation, ANN Architecture, Perceptron, Multi-Layer Perceptron Structure, Back Propagation.

Unit II: Machine Learning: Introduction to Machine Learning, Different Types of Machine Learning Methods, Supervised, Semi Supervised, Unsupervised and Reinforcement Learning.

Unit III: Classification and Regression Algorithms: Difference Between Classification and Regression, Classification Algorithms, KNN, SVM Algorithms and its Applications, Regression Algorithm, Linear Regression, Decision Tree Regression and Random Forest Regression.

Unit IV: Convolution Neural Networks: Introduction to Convolution Neural Networks**,** Basic Principle, Architecture**,** Types of CNN Layers, Pooling Layers, Convolution Layers and Fully Connected Layers, Applications of CNN.

Unit V: Advanced Topics in Artificial Intelligence and Machine Learning: DNN Model, Significance, Overview of DNN Technique and its Applications, Generative Models, Working Principle of GAN and its Applications.

Text Books:

3. Artificial Intelligence and Machine Learning by Vinod Chandra SS and Anand Hareendran S, PHI Publications.
4. Artificial Intelligence – A Model Approaceh Stuart Russel and Peter Norvig.

Reference Books:

3. Introduction to Artificial Intelligence by Ertel W (2018) Springer International Publishing.
4. Machine Learning and Artificial Intelligence by Joshi and Ameet V (2022) Springer International Publishing.

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BT-3101
Model Question Paper
B.Tech. Degree Examination
3/4 B.Tech (Biotechnology)
First Semester
Heat Transfer and Mass Transfer
(With effective from the admitted batch of 2022-2023)

Time: 3 Hours **Maximum marks: 70**

Answer Question no. 1 and any other FOUR questions from the remaining

All Questions carry equal marks

1) Explain the following
   a) Thermal radiation
   b) Effectiveness of heat exchanger
   c) Thermal conductivity
   d) Counter current and parallel flow
   e) Differential distillation
   f) Packings
   g) Tray spacing
2) A vapor stream containing 3 mole percent benzene is scrubbed with wash oil in a packed absorber to reduce the benzene concentration in gas to 0.02 percent. The oil has an average molecular weight of about 250 and density of 54.6 lb/ft^3 and contains 0.015 percent benzene. The gas flow is 1500 ft^3/min at 25°C and 1atm.

a) If the scrubber operates isothermally at 25°C with a liq rate of 14000lb/h, how many transfer units are needed?
b) If the scrubber operates adiabatically , how many transferunits are needed?
c) What would be the major effect of operating with an oil oflower molecular weight, say M=200?

3) carbon tetrachloride flowing at 19,000 kg/h is to be cooled from85 to 40 °C using 13,500 kg/h of cooling water at 20 °C . The filmcoefficient for carbon tetrachloride, outside the tubes, is 1,700W/m^2.°C. The wall resistance is negligible , but hi, on the water side, including fouling factors, is 11,000W/m^2°.C.

a) What area is needed for a counter flow exchanger ?
b) By what factor would the area be increased if parallel flowwere used to get more rapid initial cooling of the carbon tetrachloride?[for CCL4 Cp=0.837 J/g-c]

4) Explain the step-by-step procedure for the calculation of theoretical number of plates of distillation column by McCabe-Thiele method. Mention the assumption made and itslimitations.
5) Derive the LMD expression for counter flow double pipe heat exchanger, where the capacity rates for the cold and hot fluids aresame.

6) Derive the relation between overall mass transfer coefficient and individual mass transfer coefficients for liquid and gas.
7) Describe the working procedure and the application for 1-2 shelltube heat exchanger.
8) (a) with the help of a neat sketch , explain the functioning of traycolumn for distillation operation.
   (b) Discuss the different tray columns.
   (c) Discuss the merits and demerits of plate column over packedcolumn.

BT-3102

III/IV B. Tech DEGREE EXAMINATION

I- Semester

(BIOTECHNOLOGY)

ENZYME ENGINEERING

(With effective from the admitted batch of 2022-2023)

Time: 3 hours **Max. Marks: 70**

Model Question Paper

Q. No. 1 is compulsory. Answer any **FOUR** from the remaining. All questions carry equal marks.

1. Write short notes on: (7X2=14M)
   a) Turnover number
   b) Allosteric enzymes
   c) Co-enzymes
   d) Significance of V_{max} and K_m
   e) Inhibitor
   f) Effectiveness factor
   g) Catalysis

2. a) Explain the mechanism of catalysis with a neat diagram. (7M)
   b) Explain the advantages and drawbacks of enzyme as a catalysts. (7M)

3. Explain the stages involved in the production of enzymes. (14M)

4. Explain the kinetics of single substrate enzyme catalyzed reactions using L-B, Eadie-Hofstee and Hanes plots. (14M)

5. What is reversible inhibition? Describe the various types of reversible inhibitions. (14M)

6. What is enzyme immobilization? Describe the various methods and also the advantages and disadvantages of enzyme immobilization? (14M)

7. Explain the mass transfer limitation on design and performance of an enzyme reacto (14 M)

8. Write on: (14M)

a) Biosensors

b)Food Processing

c)Medical and Pharmaceutics

BT-3103

III/IV B. Tech DEGREE EXAMINATION

I- Semester

BIOTECHNOLOGY

CELL AND MOLECULAR BIOLOGY

(With effective from the admitted batch of 2022-2023)

Time: 3 hours **Max. Marks: 70**

Model Question Paper

Q. No. 1 is compulsory. Answer any **FOUR** from the remaining. All questions carry equal marks.

1. Write short notes on: (7X2=14M)
   a) Cell cycle
   b) Wobble hypothesis
   c) Nucleosome
   d) Mutation
   e) Translation
   f) AMES Test
   g) Telomere
2. Describe the nucleosome organization in eukaryotic cell. (14M)
3. What is genetic material? Explain the double helical structure and functions of DNA. (14M)
4. a) Explain briefly the enzymes involved during the replication in prokaryotes and eukaryotes. (07M)
   b) RNA processing in eukaryotes. (07M)
5. a) Describe briefly the Genetic Code. (07M)
   b) Describe briefly about protein synthesis in prokaryotes. (07M)
6. Describe the translation mechanism in eukaryotes. (14M)
7. Define Lac operon. Explain in detail about the regulation of Lac operon in *E.coli.* (14M)
8. a) Describe the mechanism for repair of DNA damage. (07M)
   b) Explain about biochemical basis of mutants. (07M)

BT-3104

III/IV B. Tech DEGREE EXAMINATION

I- Semester

BIOTECHNOLOGY

(PROFESSIONAL ELECTIVE-I) FOOD TECHNOLOGY

(With effective from the admitted batch of 2022-2023)

Time: 3 hours **Max. Marks: 70**

Model Question Paper

Q. No. 1 is compulsory. Answer any **FOUR** from the remaining. All questions carry equal marks.

1. Write a short note on the following : (7X2=14)
   a. Food preservation
   b. Pasteurization
   c. Fermentation of meat
   d. Storage of fruits and dairy products
   e. Botulism
   f. Canning
   g. Waste utilization
2. Explain the basic procedure for the manufacture of Wine and HFCS (high fructose corn syrup). (14)
3. Explain in detail : (2X7=14)
   a. Nutritive value of food
   b. Food colors & flavors.
4. Describe different classes of preservatives and food spoilage. (14)
5. Explain in detail about various food processing operations. (14)
6. Describe food borne diseases and micro organisms associated with food. (14)
7. Define Single Cell Protein and explain their production. (14)
8. a. Describe food conservation operations. (7)
   b. Describe enzymes used in food processing (7)

BT-3105

Artificial Intelligence and Machine Learning

(OPEN ELECTIVE- I)

Biotechnology

III/VI B. Tech DEGREE EXAMINATION

I Semester

Time: Three hours **Maximum: 70 Marks**

Question No.1 is compulsory

Answer any FOUR questions from the remaining

All questions carry equal marks

1. a) What is the perceptron model in artificial neural networks? [3]

b) What are the advantages and disadvantages of supervised learning? [3]

c) What types of data are well-suited for SVM classification? [3]

d) What are the main components of a typical CNN architecture? [3]

e) Discuss the application of DNNs in image classification tasks. [2]

2 a) What are the differences between the human brain's neural networks and artificial neural networks? [7]

b) What is the basic architecture of an artificial neural network? [7]

3 a) What are the ethical considerations in developing and deploying machine learning systems? [7]

b) What is reinforcement learning, and how does it differ from other machine learning methods? [7]

4 a) What is the K-Nearest Neighbors (KNN) algorithm, and how does it work for classification tasks? [7]

b) Describe the random forest regression algorithm and its advantages over individual decision trees. [7]

5 a) How do the depth and width of a CNN affect its performance and ability to learn complex features? [7]

b) How do filters (kernels) in convolutional layers learn to detect features in the input data? [7]

6 a) How does the adversarial training process in GANs help generate realistic samples? [7]

b) How do regularization methods, such as dropout and L1/L2 regularization, help prevent overfitting in DNNs? [7]

7 a) How does back propagation help in training neural networks? [7]

b) What is the purpose of pooling layers in CNNs, and how do they contribute to the network's performance? [7]

8 a) How does the multilayer perceptron model improve upon the perceptron model? [7]

b) What are the main applications of machine learning in real-world scenarios? [7]