

Chaudhary Ranbir Singh University, Jind

Scheme of Examination for Under Graduate Programme

Bachelor of Technology (Computer Science - Artificial Intelligence and Machine Learning)

1st Semester

Course Code	Nomenclature	Credit	Contact Hours Per Week			Internal Assessment			External Assessment			Total Marks			Min Pass Marks		
			L	T	P	CH	T	P	Ext	T	P	Ext	T	P	Ext	Int	Ext
24-BTHS-101	Communication Skills	4	2	1	2	5	15	5	20	60	20	75	25	10	30		
24-BTBS-101	Mathematics - I	4	3	1	0	4	20	0	80	0	100	0	0	08	32		
24-BTBS-102	Physics	4	3	0	2	5	15	5	60	20	75	25	10	30			
24-BTES-101	Mathematical Concepts for AI	4	3	1	0	4	20	0	80	0	100	0	08	32			
Semester Total		16	11	3	4	18											

In addition to above said courses, student need to undergo mandatory induction programme in 1st Year as per AICTE norms.

2nd Semester

Course Code	Nomenclature	Credit	Contact Hours Per Week			Internal Assessment			External Assessment			Total Marks			Min Pass Marks		
			L	T	P	CH	T	P	Ext	T	P	Ext	T	P	Ext	Int	Ext
24-BTHS-201	Design Thinking	1	0	0	2	2	0	25	0	0	25	0	10	0			
24-BTBS-201	Mathematics - II	4	3	1	0	4	20	0	80	0	100	0	08	32			
24-BTBS-202	Chemistry	4	3	0	2	5	15	5	60	20	75	25	10	30			
24-BTES-201	Problem Solving and Programming	4	3	0	2	5	15	5	60	20	75	25	10	30			
24-BTES-202	Modern Computer Architecture	3	3	0	0	3	15	0	60	0	75	0	06	24			
24-BTCS-201	Discrete Mathematical Structures	4	3	1	0	4	20	0	80	0	100	0	08	32			
24-BTCS-202	Software Engineering	4	3	0	2	5	15	5	60	20	75	25	10	30			
Semester Total		24	18	2	8	28											



3rd Semester

Course Code	Nomenclature	Credit	Contact Hours Per Week					Internal Assessment		External Assessment		Total Marks		Min Pass Marks	
			L	T	P	CH	T	P	T	P	T	P	Int	Ext	
24-BTPC-301	Object Oriented Programming	4	3	0	2	5	15	5	60	20	75	25	10	30	
24-BTPC-302	Data Structures	4	3	0	2	5	15	5	60	20	75	25	10	30	
24-BTPC-303	Artificial Intelligence	4	3	0	2	5	15	5	60	20	75	25	10	30	
24-BTPC-304	Machine Learning	4	4	0	0	4	20	0	80	0	100	0	20	80	
24-BTHS-301	Universal Human Values	3	2	1	0	3	15	0	60	0	75	0	06	24	
24-BTPE-301	Programming with Python	4	1	0	6	7	5	15	20	60	25	75	10	30	
Semester Total		23	16	1	12	31									

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4th Semester

Course Code	Nomenclature	Credit	Contact Hours Per Week				Internal Assessment		External Assessment		Total Marks			Min Pass Marks	
			L	T	P	CH	T	P	T	P	T	P	Int	Ext	
24-BTPC-401	Operating System	4	3	0	2	5	15	5	60	20	75	25	10	30	
24-BTPC-402	Computer Networks	4	3	0	2	5	15	5	60	20	75	25	10	30	
24-BTPC-403	Data Science	4	3	0	2	5	15	5	60	20	75	25	10	30	
24-BTPC-404	Data Base Management System	4	3	0	2	5	20	0	60	20	75	25	10	30	
24-BTPC-405	Advanced Machine Learning	4	3	0	2	5	20	0	60	20	75	25	10	30	
24-BTEEC-401	Minor Project	3	3	0	6	6	0	15	0	60	0	75	06	24	
24-BTAU-401	Environmental Science	0	3	0	0	3	15	0	60	0	75	0	06	24	
Semester Total		23	21	2	1	33									

Environmental Science Paper is Zero Credit Paper but essential to pass to be eligible for award of the degree.



With effect from the Session: 2024-25

Part A - Introduction

Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	2nd
Name of the Course	Design Thinking
Course Code	24-BTHS-201
Course Type	Humanities and Social Science
Course Objectives	The objective of this Course is to provide the new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products which useful for a student in preparing for an engineering career.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1. Compare and classify the various learning styles and memory techniques and Apply them in their engineering education. CLO-2 Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products. CLO-3 Develop new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products. CLO-4 Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, techniques during prototype development. CLO-5 Perceive individual differences and its impact on everyday decisions and further Create a better customer experience

Max. Marks	Pr. 25
Internal Assessment Max Marks	Pr. 25
End Term Exam Max Marks	Pr. 0
Internal Min Pass Marks	Pr. 10
External Min Pass Marks	Pr. 0
Examination Time	Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics
I	An Insight to Learning Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting Remembering Memory: Understanding the Memory process, Problems in retention, Memory enhancement techniques Emotions: Experience & Expression Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers



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- II Basics of Design Thinking: Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test
Being Ingenious & Fixing Problem: Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving
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- III Prototyping & Testing: What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing
Celebrating the Difference: Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences
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- IV Design Thinking & Customer Centricity: Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design
Feedback, Re-Design & Re-Create Feedback loop, Focus on User Experience, Address “ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation – “Solving Practical Engineering Problem through Innovative Product Design & Creative Solution”.
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Part C-Learning Resources

Reference Books:

- 1) Experiential Learning , David A. Colb, Prentice Hall, 2013
 - 2) Why we Remember, Charan Ranganathan, Random House, 2024
 - 3) Design Your Thinking, Pavan Soni, 2020
 - 4) Design Thinking, E Balagurusamy, McGraw Hill, 2024
 - 5) Master Your Thinking, Thibaut Meurisse, Wisdom Tree, 2022
 - 6) Rapid Prototyping, Chua Chee Kai, World Scientific Publishing Co., 3rd Edition
 - 7) Innovative Engineering Product Design, Diana Starovoytova, LAP Lambert, 2019
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Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	2 nd
Name of the Course	Mathematics - II
Course Code	24-BTBS-201
Course Type	Basic Science
Course Objectives	To make the students understand the behaviour of various series. They should also be able to calculate probabilities and statistics of different datasets.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1. Understand the behavior of series and their applications. CLO-2. Understand number system and its applications. CLO-3. Understand the concept of probability and apply in real life. CLO-4. Understand and apply the concept of statistics.
Max. Marks	Th. 80
Internal Assessment Max Marks	Th. 20
End Term Exam Max Marks	Th. 60
Internal Min Pass Marks	Th. 8
External Min Pass Marks	Th. 24
Examination Time	Th. 3 Hrs

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics
I	Sequences and Series Limit of a sequence, monotone and Cauchy sequences and properties of convergent sequences, examples. Infinite series, positive series, tests for convergence and divergence, integral test, alternating series, Leibnitz test.
II	Functional Series Pointwise and uniform convergence, basic aspects of Power series, Fourier series Math Foundation Statements, Quantifiers, Operation on sets and functions, Relations, Proofs.
III	Number System Countability of algebraic numbers, Transcendental numbers and construction of Liouville's number, Equivalence classes, construction of real numbers (using Cauchy sequences), Fermat's little theorem and using it for Miller-Rabin primality test, Wilson's theorem and Primitive root theorem.



IV Probability

Sample space and events, definitions of probability, properties of probability, conditional probability. Random variables: distribution functions, discrete and continuous random variables, moments of random variables, conditional expectation, Chebyshev inequality, functions of random variables. Special Distributions: Bernoulli, Binomial, Geometric, Pascal, Poisson, Exponential, Uniform, Normal distributions, Limit Theorems: Law of large numbers

Part C-Learning Resources

Reference Books:

- 1) Probability and statistics for Engineers and Scientists, Walpole, Myers, Myers and Ye, Pearson Education, 2012
 - 2) Advanced Engineering Mathematics, Reena Garg, Khanna Book Publishing Co., Delhi.
 - 3) Advanced Engineering Mathematics, Wylie and Barrett, McGraw Hill, 1995
 - 4) Advanced Engineering Mathematics, M.D. Greenberg, Pearson Education Asia, 2002
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Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	2 nd
Name of the Course	Software Engineering
Course Code	24-BTCS-202
Course Type	Computer Science
Course Objectives	Students should learn the concept and importance of Software Engineering. They should be able to construct software that is reasonably easy to understand, modify, maintain and reliable. They should learn strengths and weaknesses of various Software Engineering Techniques used in industrial applications.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1. Understand the process of designing, creating and maintaining software. CLO-2. Create softwares for various application domains. CLO-3. Understand the challenges of large scale software development. CLO-4. Understand the importance of software design and development practices.

Max. Marks	Th. 75	Pr. 25
Internal Assessment Max Marks	Th. 15	Pr. 5
End Term Exam Max Marks	Th. 60	Pr. 20
Internal Min Pass Marks	Th. 6	Pr. 2
External Min Pass Marks	Th. 24	Pr. 8
Examination Time	Th. 3 Hrs	Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics
I	Software, Software Engineering, Myths, Software Process, Work Products, Importance of Software Engineering, Standard for Software Process, Waterfall Model, Prototyping Model, Iterative Enhancement Model, Spiral Model, RAD model, 4th Generation models, Formal Methods, Agile Development Software Requirements, Types of Requirements, Requirement Engineering Cycle, Requirements Specification document, Characteristics of Requirements, Requirement verification and validation



II Role of Management in Software Development, Project Estimation Techniques, Staffing, Scheduling, Earned Value Analysis, Software Risks, Software Configuration Management, Software Process and Project metrics.

Process, Data and Behavioural Modelling, Design Concepts, Modularity, Architectural design, Coupling and Cohesion, Top-down and bottom-up design, Object-oriented Analysis, Function oriented and Object-Oriented Design approach, Software Design Document, Coding styles and documentation,

III Testing principles, testing strategies, Black-box and White-box Testing Techniques, Levels of testing -unit, integration, system, regression, Test Plan, Test Cases Specification, Software debugging, Software Maintenance, Software Quality Assurance (SQA), SQA tasks, Software amplification and removal, Formal Technical Reviews, Software Quality Factors, ISO 9126, SEI CMM, CMMI, Software Reliability. Software Availability.

IV Computer Aided Software Engineering (CASE) and its Scope, CASE support in Software Life Cycle, Architecture of CASE Environment, Upper CASE and Lower CASE, Exposure to CASE tools. Software Process Improvement, Component Based Software Engineering, Web Engineering, Reverse Engineering, Software Engineering challenges of Big Data, Mobile Applications.

Part C-Learning Resources

Reference Books:

- 1) Software Engineering-A Practitioners Approach, By R. Pressman, McGraw Hill International edition, 2004
 - 2) Software Engineering, N.S. Gill, Khanna Publishing Co., Delhi 2018.
 - 3) Software Engineering, Ian Sommerville, Addison-Wesley, 2010
 - 4) An Integrated Approach to Software Engineering, Pankaj Jalote, Narosa, 2014
 - 5) Fundamentals of Software Engineering, By Rajib Mall, PHI Learning Pvt. Ltd, 2014
 - 6) Software Engineering (3rd ed.), By K.K Aggarwal & Yogesh Singh, New Age International Publishers, 2007
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Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	3 rd
Name of the Course	Artificial Intelligence
Course Code	24-BTPC-303
Course Type	Programme Core
Course Objectives	Students should learn the concept and importance of Artificial Intelligence. They should be able to develop a solid understanding of core algorithms and models used in Artificial Intelligence. They should learn strengths and weaknesses of various Artificial Intelligence Techniques used in industrial applications.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1. Explain fundamental concepts, types, and techniques of Artificial Intelligence. CLO-2. Apply appropriate supervised and unsupervised learning algorithms to solve real-world problems. CLO-3. Analyze and evaluate machine learning models using performance metrics. CLO-4. Demonstrate an understanding of ethical and societal considerations in the design and deployment of machine learning systems.

Max. Marks	Th. 75	Pr. 25
Internal Assessment Max Marks	Th. 15	Pr. 5
End Term Exam Max Marks	Th. 60	Pr. 20
Internal Min Pass Marks	Th. 6	Pr. 2
External Min Pass Marks	Th. 24	Pr. 8
Examination Time	Th. 75	Pr. 25

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics
I	Artificial Intelligence and its applications, Artificial Intelligence Techniques, Level of models, criteria of success, Intelligent Agents, Nature of Agents, Learning Agents. AI Techniques, advantages, and limitations of AI, Impact and Examples of AI, Application domains of AI. The AI Ladder - The Journey for Adopting AI Successfully, Advice for a career in AI, Hotbeds of AI Innovation. State space search, control strategies, heuristic search, problem characteristics, production system characteristics., Generate and test, Hill climbing, best first search, A* search, Constraint satisfaction problem, Mean-end analysis, Min-Max Search, Alpha-Beta Pruning, Additional refinements, Iterative Deepening.
II	Propositional logic, predicate logic, Resolution, Resolution in propositional logic and predicate logic, Clause form, unification algorithm,

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III Mapping between facts and representations, Approaches to knowledge representation, procedural vs declarative knowledge, Forward vs. Backward reasoning, Matching, conflict resolution, Non-monotonic reasoning, Default reasoning, statistical reasoning, fuzzy logic Weak and Strong filler structures, semantic nets, frame, conceptual dependency, scripts

IV The Planning problem, planning with state space search, partial order planning, planning graphs, planning with propositional logic, Analysis of planning approaches, Hierarchical planning, conditional planning, Continuous and Multi Agent planning.

Part C-Learning Resources

Reference Books:

- 1) Trivedi M.C., *A Classical Approach to Artificial Intelligence*, Khanna Book Publishing Co., 2019
 - 2) R.Stuart, *Artificial Intelligence : A Modern Approach*, Pearson Education, 2010
 - 3) Rich & Knight, *Artificial Intelligence*, McGraw Hill, 2017
 - 4) Nils & Nilson, *Artificial Intelligence : A New Synthesis*, Elsevier, 1997
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Part A - Introduction

Name of the Programme	B.Tech. (Computer Science – AI & ML)	
Semester	3 rd	
Name of the Course	Programming with Python	
Course Code	24-BTPE-301	
Course Type	Professional Elective	
Course Objectives	<i>To understand the basics of Python programming, detail of various components of Python, strings and lists in Python, working of dictionaries and tuples, files in Python. To work with Python Libraries and execute Data Analytics Programs with Python.</i>	
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1. Student will be able to make basic programs in Python. CLO-2. Student will be able to handle strings, lists, dictionary, tuples and files in python. CLO-3. Student will have knowledge about python libraries. CLO-4. Student will be able to analyze pattern among various data sources through Data Analytics.	
Max. Marks	Th. 25	Pr. 75
Internal Assessment Max Marks	Th. 5	Pr. 15
End Term Exam Max Marks	Th. 20	Pr. 60
Internal Min Pass Marks	Th. 2	Pr. 6
External Min Pass Marks	Th. 8	Pr. 24
Examination Time	Th. 1Hr 30 Min	Pr. 3 Hrs

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics
I	Overview of Python, Comments, Reserve Keywords, Identifiers, Variables, Constants, Standard Data types, Operators, Control Statements, Iterative Statements.. Functions: Built in functions, Composition of functions, User defined Functions, Parameters, Function call, Return statement, Recursive function. Strings: Compound Data Type, Len function, Slices, Traversal, Escape Character, Formatting Operator, Formatting Functions. Lists: Values & Accessing Elements, Traversal, Deleting Element, Built-in Operators, Built-in Methods.



II Tuples: Creating, Accessing Values in Tuples, Tuples Assignment, Tuples as Return Values, Variable length Argument Tuple, Basic Operations, Built-in-Tuple Function.

Dictionaries: Creating, Accessing Values, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary Keys, Operations in Dictionary, Built-in Dictionary Methods

Text Files and Exceptions: Text Files, Dictionaries, Exceptions, Exception with arguments, User defined exceptions.

Applications in Python: Managing Database using SQL: Database concept, Creating database & tables, Inserting data into tables, Retrieving data from table, Deleting data from table & deleting table.

III Introduction: Data analysis: Ideation, Retrieval, Preparation, Exploration, Modeling, Presentation, Reproduction.

Importing pandas. Panda series, Panda data frames, Loading data from files into a dataframe.

Representing Univariate data with the series: Configuring pandas, Creating a series, Size and shape of a series, Retrieving value in a series by label or position.

IV Manipulating data frame structure: Renaming columns, Adding new column with: [] and insert{}, through enlargement, concatenation, Replacing the content of column, Deleting column, Appending new rows, Concatenating rows.

Numerical and Statistical Method: Performing arithmetic on a data frame or series, Getting the count of values, Determining unique values, Finding minimum and maximum values, Locating n smallest and n largest values, Calculating the accumulated values

Calculating mean, Finding median, Determining the mode, Measuring variance, Finding the standard deviation, Calculating covariance and determining correlation. Executing random sampling of data.

Part C-Learning Resources

Reference Books:

1. Sheetal Taneja, Naveen Kumar, "Python Programming A Modular Approach", Pearson, 2017.
 2. Rao R. Nageswara, "Core Python Programming", Dream Tech, New Delhi, 2018.
 3. Satyanarayana, Mani M. Radhika, Jagadesh B.N, "Python Programming", India University Press, 2018.
 4. Cassell Laura, Gauld Alan, "Python Projects", , Wiley Publication, New Delhi, 2014
 5. Michael Heydt, "Learning Pandas: High performance data manipulation and analysis using Python", Packt Publishing Limited, 2nd Edition.
 6. Fabio Nelli, "Python Data Analytics", A Press, 1st Edition.
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Part A - Introduction	
Name of the Programme	B.Tech. (Computer Science – AI & ML)
Semester	4 th
Name of the Course	Environmental Science
Course Code	24-BTAU-401
Course Type	Audit Course
Course Objectives	<p>People working in industries or elsewhere essentially require the knowledge of environmental science so as to enable them to work and produce most efficient, economical and eco-friendly finished products.</p> <p>Solve various engineering problems applying ecosystem to produce eco – friendly products.</p> <ul style="list-style-type: none"> • Use relevant air and noise control method to solve domestic and industrial problems. • Use relevant water and soil control method to solve domestic and industrial problems. • To recognize relevant energy sources required for domestic and industrial applications. • Solve local solid and e-waste problems.
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	<p>At the end of the course student will be able to</p> <p>CLO - 1. Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco – friendly products.</p> <p>CLO - 2. Understand the suitable air, extent of noise pollution, and control measures and acts.</p> <p>CLO - 3. Understand the water and soil pollution, and control measures and acts.</p> <p>CLO - 4. Understand different renewable energy resources and efficient process of harvesting.</p> <p>CLO - 5. Understand solid Waste Management, ISO 14000 & Environmental Management.</p>

Max. Marks	Th. 75
Internal Assessment Max Marks	Th. 15
End Term Exam Max Marks	Th. 60
Internal Min Pass Marks	Th. 6
External Min Pass Marks	Th. 24
Examination Time	Th. 75

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics

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I Structure of ecosystem, Biotic & Abiotic components, Food chain and food web, Aquatic (Lentic and Lotic) and terrestrial ecosystem, Carbon, Nitrogen, Sulphur, Phosphorus cycle, Global warming - Causes, effects, process, Green House Effect, Ozone depletion.

Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler), Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator).

Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler.

Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution, Noise pollution (Regulation and Control) Rules, 2000.

II Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition, calculation.

Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis).

Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.

III Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills.

Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas.

Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy.

New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin and power plants of geothermal energy.

IV Solid waste generation- Sources and characteristics of: Municipal solid waste, E-waste, biomedical waste.

Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste.

Air quality act 2004, air pollution control act 1981 and water pollution and control act 1996. Structure and role of Central and state pollution control board.

Concept of Carbon Credit, Carbon Footprint.

Environmental management in fabrication industry.

ISO14000: Implementation in industries, Benefits.

Part C-Learning Resources



Reference Books:

1. Rao C.S., "*Environmental Pollution Control and Engineering*", New Age International 2007.
2. Sharma S.C. & Poonia M.P., "*Environmental Studies*", Khanna Book Publishing, 2021.
3. Rao M.N., Rao H.V.N., "*Air Pollution :*", Tata McGraw Hill, 1988.
4. Vieira A, Rosa D., "*Fundamentals of Renewable Source Energy*", Academic Press, Oxford, 2013.
5. Patvardhan A.D., "*Industrial Solid Waste*", Teri Press, 2013.
6. Gupta O.P., "*Elements of Environmental Pollution Control*", Khanna Book Publishing, 2023.

