Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Second Year Bachelor of Engineering

in

Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ
अंतरी पेटवू ज्ञानज्योत
1990
'A' Grade
NAAC Re-Accredited
(4th Cycle)

SYLLABUS STRUCTURE

For Affiliated Colleges

Semester – III to IV

W.E.F. 2025 – 26

Syllabus Structure for Second Year Engineering (Semester – III, Level – 5.0) (Artificial Intelligence & Data Science) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -301	Discrete Mathematics	PCC	3			3	40	60			100	3
AIDS -302	Discrete Mathematics Lab	PCC			2	2			25	25 (PR)	50	1
AIDS -303	Data Structure and Algorithms	PCC	3			3	40	60			100	3
AIDS -304	Data Structure and Algorithms-Lab	PCC			2	2			25	25 (PR)	50	1
AIDS -305	Python Programming Lab	PCC	1		2	3			25	25 (PR)	50	2
AIDS -306	Biology for Engineers	MD M	2			2	40	60	25		125	2
OE -307	Open Elective – I	OE	3			3	40	60			100	3
AIDS -308	Principles of Economics	HSSM	2			2						2
AIDS -309	Universal Human Values	HSSM	1		2	3			25		25	2
AIDS -310	Community Engagement Project / Field Project	ELC			4	4			50		50	2
			15		**12**	**27**	**160**	**240**	**175**	**75**	**650**	**21**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

CA: College Assessment UA: University Assessment

Syllabus Structure for Second Year Engineering (Semester – IV, Level – 5.0) (Artificial Intelligence & Data Science) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -401	Operating Systems	PCC	3			3	40	60			100	3
AIDS -402	Operating Systems Lab	PCC			2	2			25	25 (PR)	50	1
AIDS -403	Database Management Systems	PCC	3			3	40	60			100	3
AIDS -404	Database Management Systems-Lab	PCC			2	2			25	25 (PR)	50	1
AIDS -405	Object Oriented Programming Lab	PCC	1		2	3			25	25 (PR)	50	2
AIDS -406	Analog Electronics and Signal System	MD M	2			2	40	60	25		125	2
OE -407	Open Elective – II	OE	3			3	40	60			100	3
AIDS -408	Web Designing and Publishing	VSEC			2	2			25		25	1
AIDS -409	Ability Enhancement Course	AEC			2	2			25		25	1
AIDS -410	Innovation and Entrepreneurship	HSSM	2			2						2
AIDS -411	Environmental Sciences	HSSM	2			2		25			25	2
			16		**10**	**26**	**160**	**265**	**150**	**75**	**650**	**21**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment

CA: College Assessment UA: University Assessment

EXIT COURSE FOR U. G. DIPLOMA in Artificial Intelligence & Data Science (DURATION 8 WEEKS)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -412	Internship / Apprenticeship	OJT							125			4
AIDS -413	Mini Project	Project							25			4
									150			8

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COURSE OUTLINE

For Affiliated Colleges

Semester – III

W.E.F. 2025 – 26

DISCRETE MATHEMATICS (PCC)					
COURSE OUTLINE					
Course Title:	**DISCRETE MATHEMATICS (PCC)**	**Short Title:**	DM	**Course Code:**	**AIDS -301**

Course description:
Basic set theory and symbolic logic. Methods of proofs, including mathematical induction. Relations, functions, and partitions; modular arithmetic. Graph and Trees

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	**3**

Prerequisite course(s):
Basic Mathematics Concepts

Course objectives:
1. Learn the use of set, proof techniques and determine logical possibilities in a given situation.
2. Understand relations, functions among various entities in real world.
3. Think about relations and functions in real life.
4. Learn the problem mathematically using graph theory and trees.

Course outcomes:
After successful completion of this course the student will be able to:
1. Formulate the given logic sentence it in terms of predicates, quantifiers, and logical connectives
2. Formulate real life problems in terms of set theory concepts.
3. Analyze the solution using deductive logic and prove the solution based on logical inference for given problem
4. Describe given mathematical problem according to its algebraic structure
5. Analyze the given problem as graph networks and solve with techniques of graph theory.

COURSE CONTENT

DISCRETE MATHEMATICS		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Set, Relation and Function:
Operations and Laws of Sets, Cartesian Products, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Binary Relation, Partial Ordering Relation, Equivalence Relation, Functions, Bijective functions, Inverse and Composite Function

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Mathematical Induction, Counting
The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.
Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination. Number system and Inter conversion of number system.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Propositional Logic
Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical

Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers.
Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Algebraic Structures and Morphism

Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Graphs and Trees

Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Coloring, Coloring maps and Planar Graphs, Dijkstra's shortest path Algorithm, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Kruskal's and Prim's algorithm for minimum spanning tree

Text Books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill, 7th Edition
2. Susanna S. Epp, Discrete Mathematics with Applications, Wadsworth Publishing Co. Inc., 4th edition

Reference Books:

1. C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, Tata McGraw – Hill, 3rd Edition,
2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structure and It‟s Application to Computer Science, Tata Mcgraw-Hill, 1st Edition
3. Norman L. Biggs, Discrete Mathematics, Oxford University Press, 2nd Edition
4. Seymour Lipschutz, Marc Lipson Discrete Mathematics Schaum‟s Outlines Series,Tata McGraw – Hill ,2nd Edition.
5. Chakraborty&Sarkar, Discrete Mathematics and Its Applications, Oxford
6. S.B. Singh, Discrete Structures, Khanna Book Publishing, Delhi

NPTEL Links:

1. Discrete Mathematics by Prof A. K. Lal, https://nptel.ac.in/courses/111104026
2. Discrete Mathematics by Dr. Sugata Gangopadhyay, Dr. Aditi Gangopadhyay https://nptel.ac.in/courses/111107058

DISCRETE MATHEMATICS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**Discrete Mathematics Lab (PCC)**		**Short Title:**	DML	**Course Code:**	**AIDS -302**
	Hours/week	**No. of weeks**	**Total hours**		**Semester credits**
Practical	02	15	30		**1**

DISCRETE MATHEMATICS LAB			
DISCRETE MATHEMATICS LAB		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practicals:	**2 hours/week**	**End Semester Exam (ESE) UA (PR):**	**25 marks**
		Internal Continuous Assessment (ICA) CA:	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame at least THREE Laboratory assignments from Group - A and THREE Laboratory assignments from Group – B, using C/C++ programming language from the following list.

Group: A

1. A program for logical operations using bitwise operators.
2. A program for set operations: Union, Intersection, Difference, Symmetric difference.
3. A program for generation of Power set of a given set.
4. A program for inter conversion of number system.
5. A program for producing permutation set for given input set.
6. A program for producing combination set for given input set.

Group: B

1. A Program for Greatest Common Divisor using Euclidean Algorithm.
2. A Program for Binary search.
3. A Program for Shortest Path algorithm using Dijkstra's.
4. A program for implementation of Kruskal's algorithm.
5. A program for implementation of Prim's algorithm.
6. A Program to Construct a Tree & Perform Insertion, Deletion, Display

Note: Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of concern subject.

Guidelines for ICA

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

NPTEL Links:

1. Discrete Mathematics by Prof A. K. Lal, https://nptel.ac.in/courses/111104026
2. Discrete Mathematics by Dr. Sugata Gangopadhyay, Dr. Aditi Gangopadhyay https://nptel.ac.in/courses/111107058

DATA STRUCTURE & ALGORITHM (PCC)					
COURSE OUTLINE					
Course Title:	**DATA STRUCTURE & ALGORITHMS (PCC)**	**Short Title:**	DSA	**Course Code:**	**AIDS -303**

Course description:
The objective of this course is to introduce the students to the fundamentals of Data Structure with concepts of the C/C++/JAVA programming language and enable them to apply these concepts for solving real world problems.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	3	15	45	**3**

Prerequisite course(s):
Discrete Mathematics

Course objectives:
1. To study the basic concepts of linear data structures.
2. To study the basic concepts of nonlinear data structures.
3. To study the basic concepts of searching algorithms
4. To study the basic concept of heap sorting algorithm

Course outcomes:
After successful completion of this course the student will be able to:
1. Enumerate the concepts of data and data structure
2. Analyze linear data structures.
3. Analyze nonlinear data structure.
4. Enumerate sorting and searching algorithms
5. Analyze space and time complexity

COURSE CONTENT

DATA STRUCTURE & ALGORITHM		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Data Structure
Basic Terminology: Data, Data Item, Data type, Data Structure
Data Structures: Classification, Operations
Linear Arrays: Traversing, Insertion and Deletion
Pointers and Structures.
Static and Dynamic Memory Management

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Stacks and Queues
Introduction to Stacks and Queue
Stacks: Representation of Stack using Array
Applications of stack in Arithmetic expressions, recursion and Tower of Hanoi
Queue: Representation of Queue using Array
Circular Queue and its implementation

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Linked List
Concept of linked organization
Representation of Linked List in Memory

Singly, doubly and circular Linked List
Operations on singly and Doubly Linked List such as creation, traversing, searching, insertion, deletion.
Representation of Stack and Queue using Linked List

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Trees

Basic terminology of Trees
Binary trees and its representation in memory
Binary Search Trees: Searching, Inserting, Deletion and Traversals using Stacks.
Balanced Binary Trees: AVL Search Trees and Rotations
Heap and Heap sort

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Algorithms and Searching

Complexity of Algorithms: Asymptotic Notations
Linear Search Algorithm with time complexity
Binary Search Algorithm with time complexity
Hashing: Hash table, hashing functions, Collision Resolution Techniques

Text Books:

1. Seymour Lipschutz,"Data Structures", Schaums Outlines, Tata MacGraw Hill, 1st Edition
2. Ellis Horowitz and Sartaj Sahani,"Fundamentals of Data Structures", Galgotia Publication, 1st Edition.

Reference Books:

1. G.S.Baluja, "Data Structures through C", Dhanpatrai Publications, 2012
2. Ashok N. Kamthane, "Introduction to Data Structure in C", Pearson Publication, 2007 Edition
3. AaromTanenbaum, YedidyahLangsam, Moshe Augenstein, "Data structures using C", Pearson Publication, 2nd Edition
4. Alfred Aho, John Hopcroft, Jeffrey Ullman, "Data Structures and Algorithms" ,Pearson Publication
5. E.Balagurusamy, "Data Structures using C", Tata MacGraw Hill Publications.
6. P. S. Deshpande, O.G.Kakde, "C and Data Structure", DreamTech Press Publication.
7. R. S. Salaria, "Data Structures", Khanna Publishing House
8. Yashwant Kanetkar, "Data Structures through C", BPB Publications
9. R. B. Patel, "Expert Data Structures with C++", Khanna Publications

NPTEL Links:

1. Data Structure and Algorithm by Prof Naveen Garg, https://nptel.ac.in/courses/106102064 .
2. Programming and Data Structure by Prof. P. P. Chakraborty, https://nptel.ac.in/courses/106105085 .
3. Data Structure and Program Methodology by Dr. S. V. Rao, Dr. Pradip K. Das, https://nptel.ac.in/courses/106103069 .

DATA STRUCTURE AND ALGORITHMS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**DATA STRUCTURE AND ALGORITMS LAB (PCC)**		**Short Title:**	DSAL	**Course Code:**	**AIDS - 304**
	Hours/week	**No. of weeks**	**Total hours**		**Semester credits**
Practical	02	15	30		**1**

COURSE CONTENT			
DATA STRUCTURE AND ALGORITHMS LAB		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practicals:	**2 hours/week**	**End Semester Exam (ESE) UA (PR):**	**25 marks**
		Internal Continuous Assessments (ICA)CA :	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concern faculty member should suitably frame at least THREE laboratory assignments from the Group A and THREE experiments from the Group B using C/C++/JAVA from the following list.

(Group A)

1. Implementation of stack using array or linked list. Performing simple operations like push, pop and display with respect to stack.
2. Implementation of multi-stack / multi-queue in one array. Performing simple operations like push, pop and display with respect to multi-stack.
3. Implementation of queue using array or linked list. Performing simple operations like insertion and deletion of an element into the queue.
4. Implementation of circular queue using array or linked list. Performing simple operations like insertion and deletion of an element into the circular queue.
5. Conversion of infix expression to postfix expression. Performing simple conversions of given infix expression into postfix expression.
6. Conversion of postfix expression to infix expression. Performing simple conversions of given postfix expression into infix expression.

(Group B)

1. Implementation of double linked list & perform insertion, deletion and searching.
2. Performing the operations on double linked list like insertion, deletion and searching.
3. Creation of binary tree & perform all non-recursive traversals.
4. Create the binary tree and perform the In-order, Preorder and Post-order traversal.
5. Creation of binary search tree & perform insertion, deletion and printing in tree shape.
6. Create the Binary Search tree performing the operations on BST like insertion, deletion and printing in tree shape.
7. Create a hash table and handle the collision using linear probing with or without replacement
8. Creation of hash Table and handle the collision using linear probing with or without replacement.
9. Write a program to construct an AVL tree for the given set of keys. Also write function for deleting a key from the given AVL tree.
10. Implementation of Heap sort algorithm Sort the input data using Max-heap/Min-heap algorithm.

Note: Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of concern subject.
Guidelines for ICA
Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.
Guidelines for ESE:
ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification. Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.
NPTEL Links: 1. Programming and Data Structure by Prof. P. P. Chakraborty, https://nptel.ac.in/courses/106105085 2. Data Structure and Program Methodology by Dr. S. V. Rao, Dr. Pradip K. Das, https://nptel.ac.in/courses/106103069 .

PYTHON PROGRAMMING LAB (PCC)					
COURSE OUTLINE					
Course Title:	**PYTHON PROGRAMMING LAB (PCC)**	**Short Title:**	PPL	**Course Code:**	**AIDS -305**

Course description:

This course provides an in-depth introduction to Python programming with a focus on data science applications. It covers fundamental programming concepts, data structures, and problem-solving techniques, along with hands-on lab sessions for developing coding skills. The course emphasizes Python's role in data processing, analysis, and visualization.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	01	15	15	2
Practical	02	15	30	1

Prerequisite course(s):

Basic programming concepts and introductory knowledge of data structures.

Course objectives:

The objective of this course is to:

1. Gain proficiency in Python programming fundamentals.
2. Develop problem-solving skills with Python.
3. Understand and apply data structures, control structures, and functions in Python.
4. Work with file handling, exception handling, and object-oriented programming.
5. Apply Python libraries for data science, including NumPy, Pandas, and Matplotlib.

Course outcomes:

After successful completion of this course the student will be able to:

1. Write Python programs using control structures and data types.
2. Implement functions, modules, and exception handling.
3. Work with files and object-oriented programming (OOP) concepts.
4. Use Python for data science applications, including data processing and visualization.
5. Employ Python libraries for real-world data-driven tasks.

COURSE CONTENT

PYTHON PROGRAMMING LAB		**Semester:**	**III**
Teaching Scheme:			
Lectures:	**1 hours/week**		

Unit–I:	**No. of Lectures: 03 Hours**

Introduction to Python : Python features, installation, and IDEs, Writing and executing Python scripts, Variables, data types, and type conversions ,Input and output operations

Unit–II:	**No. of Lectures: 03 Hours**

Control Structures and Functions: Conditional statements (if, elif, else), Looping constructs (for, while, nested loops), Functions: defining, calling, passing parameters, return values, Built-in and user-defined functions

Unit–III:	**No. of Lectures: 03 Hours**

Unit–III: Data Structures and Manipulation: Lists, Tuples, Dictionaries, and Sets, String manipulation techniques, List and dictionary comprehensions, Introduction to NumPy for array-

Unit–IV:	**No. of Lectures: 03 Hours**

File Handling and Exception Handling: File operations: Reading, writing, and appending, Exception handling: try-except-else-finally blocks, Debugging techniques and error handling			
Unit–V:	**No. of Lectures: 03 Hours**		
Object-Oriented Programming and Data Science Libraries: Classes and objects, constructors, and destructors, Inheritance and polymorphism, Data Science libraries: NumPy, Pandas, Matplotlib ,Case studies on real-world data science applications			
LAB COURSE CONTENT			
Python Programming Lab		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**		
		End Semester Examination (ESE) UA (PR):	**25 marks**
		Internal Continuous Assessment (ICA) CA:	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Students must complete at least **SIX** of the following assignments:

1. Basic Python Programs:
   Write a Python program to take user input and display output.
   Implement arithmetic operations using variables.
2. Control Statements and Loops:
   Write a Python program to check whether a given number is prime.
   Implement a program for Fibonacci series generation using loops.
3. Functions and Recursion:
   Develop a program to find the factorial of a number using recursion.
   Write a program to calculate GCD using recursion.
4. File Handling:
   Write a program to read and write text files.
   Implement a CSV file reader and writer in Python.
5. Object-Oriented Programming:
   Implement a class with methods for student data management.
   Demonstrate the concept of inheritance with a real-world example.
6. Data Manipulation using Pandas:
   Read a CSV file using Pandas and display basic statistics.
   Perform data filtering and aggregation operations.
7. Data Visualization using Matplotlib:
   Generate bar charts, pie charts, and line graphs for given datasets.
   Customize plots with labels, legends, and colors.

Text Books:

1. Python Programming: An Introduction to Computer Science – John Zelle
2. Automate the Boring Stuff with Python – Al Sweigart

Reference Books:

1. Python Crash Course – Eric Matthes
2. Python for Data Analysis – Wes McKinney
3. Think Python – Allen B. Downey

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.
NPTEL Links: 1. Python for Data Science by Prof. Ragunathan Rangaswami, IIT Madras https://onlinecourses.nptel.ac.in/noc22_cs32/preview 2. Programming, Data Structures and Algorithms Using Python by Prof. Madhavan Mukund Chennai Mathematical Institute. https://onlinecourses.nptel.ac.in/noc24_cs45/preview

BIOLOGY FOR ENGINEERS (MD M)					
COURSE OUTLINE					
Course Title:	**BIOLOGY FOR ENGINEERS (MD M)**	**Short Title:**	BFE	**Course Code:**	**AIDS - 306**

Course description:

This course describes basics and introduction of Biology for various engineering disciplines. It enables students to identify different cell types, functions and biomolecules with their roles. The students were acquainted with the concept of Biomimicry in engineering. After studying the course, student is able to demonstrate the human organ systems and bio-designs.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	02	15	30	02

Course objectives:

Objectives of the course are:
1. To get introduced to different cell types and functions.
2. To understand the biomolecules and their roles.
3. To identify the concept of Biomimicry in engineering.
4. To demonstrate the knowledge of human organ system and bio-designs.
5. To analyze Bioengineering concepts.

Course outcomes:

After successful completion of this course the student will be able to:
1. Identify cell types and their functions and chemistry of cells.
2. Understand Biomolecules with their applications.
3. Identification & applications of Biomimicry in engineering.
4. Correlate the human organ system and bio-designs.
5. Analyze Bioengineering concepts and their applications across different engineering disciplines.

COURSE CONTENT

BIOLOGY FOR ENGINEERS		**Semester:**	**III**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**2 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**
		Internal Continuous Assessment (ICA) CA:	**25 marks**

Unit–I:	**No. of Lectures: 06 Hours**	**Marks: 12**

Introduction to Biology: The cell: the basics of a cell. Prokaryotic and Eukaryotic cell, The Plant Cell and animal cell, Chemistry of cells. Cell Division: Cell cycle, mitosis, meiosis, cell division, cell cycle check points, cell death.

Unit–II:	**No. of Lectures: 06 Hours**	**Marks: 12**

Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Application of Biomolecules in water filters production, Proteins in food production, lipids in biodiesel and detergents production, Enzymes in biosensors fabrication, food processing

Unit–III:	**No. of Lectures: 06 Hours**	**Marks: 12**

Biomimicry: Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning

surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).

Unit–IV:	No. of Lectures: 06 Hours	Marks: 12

Human Organ Systems and Bio Designs: Brain as a CPU system (signal transmission, BCI, EEG). Eye as a Camera system (rod and cone cells, optical corrections, lens materials, bionic eye). Heart as a pump system (electrical signaling - ECG monitoring, design of stents, pacemakers, defibrillators). Lungs as purification system (spirometry, Ventilators, Heart-lung machine, artificial lungs). Kidney as a filtration system.

Unit–V:	No. of Lectures: 06 Hours	Marks: 12

Bioengineering: Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis), scaffolds and tissue engineering, Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis.

Text Books:

1. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
2. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
3. Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023

Reference Books:

1. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
2. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008
3. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
4. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
5. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2000). Lehninger principles of biochemistry. New York: Worth Publishers.

NPTEL Links:

NPTEL Course on Biology for engineers and other non-biologists (4 weeks UG Course) By Prof. G.K. Suraish kumar & Prof. Madhulika Dixit (IIT. Madras)

Guidelines for ICA:

Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.

PRINCIPLES OF ECONOMICS (HSSM)					
COURSE OUTLINE					
Course Title:	**PRINCIPLES OF ECONOMICS**	**Short Title:**	**PE**	**Course Code:**	**AIDS -308**

Course description: This course introduces the core principles of microeconomics and macroeconomics, focusing on key economic concepts, theories, and their real-world applications. It develops students' critical thinking and analytical skills in market operations, pricing principles, resource allocation, and decision-making by households and firms. Topics include production, costs, market structures, output, income, and employment, along with their impact on inflation and other

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	02	15	30	02

Prerequisite course(s): NA

Course objectives:

The objective of this course is to:

1. To introduce fundamental economic principles
2. To develop an understanding of production and cost analysis
3. To examine market structures and pricing mechanisms
4. To explore macroeconomic indicators and policy frameworks
5. To connect economic theories with real-world applications

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand Fundamental Economic Concepts
2. Analyze Production and Cost Theories
3. Evaluate Market Structures and Pricing Mechanisms
4. Interpret National Income and Macroeconomic Policies
5. Apply Economic Theories to Real-World Scenarios

COURSE CONTENT

PRINCIPLES OF ECONOMICS	**Semester:**	**III**
Teaching Scheme:		
Lectures:	**2 hours/week**	

Unit–I:	**No. of Lectures: 06 Hours**	

Introduction to economics

Basic concepts of Economics , Understanding the philosophy o of economics , Nature of economics: Is economics a science or an art?, Definitional pluralities and distinctions such as micro-versus macro, theories versus models , A brief history of ideas in economics, Techniques of economic analysis: theories, models and tools

Unit–II:	**No. of Lectures: 06 Hours**	

Production and Cost

Production Theory, Production function and different forms, Short-run and long-run, production function, Isoquants, MRTS, Total, average, and marginal products Economies of scale and scope , Theory of cost, Short-run and long run costs, cost minimization, Total, average and marginal costs, Applications of production and costs theory

Unit–III:	**No. of Lectures: 06 Hours**	

Market structure and regulation
Market equilibrium and price determination under different market structure , Perfect and Imperfect market structure, welfare costs of monopoly , Market structure, efficiency, and regulation , Regulation of public monopolies , Application in case of infrastructure industries such as energy and water

Unit–IV:	No. of Lectures: 06 Hours	

National Income Accounting
Measuring national income, output, and employment – different approaches , Determination of aggregate output, price level and interest rate – classical, Keynesian, and modern theories and approaches

Unit–V:	No. of Lectures: 06 Hours	

Macro-economic policies
Policy effects: monetary and fiscal policy , Indian monetary and fiscal policies: evidence from its evolving dynamics, Open economy macro-economic: balance of payment, exchange rate, international trade, Indian case study , GDP estimation in India

Text Books:

1. **"Principles of Economics" – S. Chand & Sons (T.R. Jain & V.K. Ohri)** A student-friendly book covering both micro and macroeconomics with simplified concepts and real-world applications.
2. **"Principles of Economics" by N. Gregory Mankiw**
   A widely used introductory textbook that presents fundamental economic principles with clear explanations and real-life examples.

Reference Books:

1. **"Principles of Economics" by Alfred Marshall**
   A classic work that has significantly influenced economic thought, providing foundational insights into microeconomic and macroeconomic theories.
2. **"Advanced Economic Theory (Microeconomic Analysis)" – H.L. Ahuja**
   Provides an in-depth understanding of microeconomic principles, price determination, and market structures.
3. **"Managerial Economics" – D.N. Dwivedi**
   Focuses on the application of economic principles to business and managerial decision-making.
4. **"Public Finance" – B.P. Tyagi**
   A useful book for understanding government policies, fiscal policy, taxation, and public expenditure in the Indian economy.
5. **"Indian Economy: Performance and Policies" – Uma Kapila**
   A detailed analysis of India's economic growth, reforms, and sectoral developments.

NPTEL Links:
Principles of Economics, IIT Madras, Prof. Sabuj Kumar Mandal
https://nptel.ac.in/courses/130106118

Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.

UNIVERSAL HUMAN VALUES (HSSM)					
COURSE OUTLINE					
Course Title:	**UNIVERSAL HUMAN VALUES (HSSM)**	**Short Title:**	**UHV**	**Course Code:**	**AIDS - 309**

Course description:

Today, education has become more and more skill biased, and hence, the basic aspiration of a human being, that is to live with happiness and prosperity, gets defeated, in spite of abundant technological progress. This course is aimed at giving inputs that will help to ensure the right understanding and right feelings in the students in their life and profession, enabling them to lead an ethical life. In this course, the students learn the process of self-exploration, the difference between the Self and the Body, the naturally acceptable feelings in relationships in a family, workplace and society, the comprehensive human goal in the society, the mutual fulfilment in the nature and the co-existence in existence. As a natural outcome of such inputs, they are able to evaluate an ethical life and profession ahead.

Thus, this course is intended to provide a much-needed orientational input in value education to the young enquiring minds.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	01	15	15	02
Practical	02	15	30	

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course outcomes:

After successful completion of this course the student will be able to:

1. Become more aware of themselves, and their surroundings (family, society, nature);
2. Become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Have better critical ability.
4. Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning will be made in this direction.

COURSE CONTENT

UNIVERSAL HUMAN VALUES		**Semester:**	**III**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**1 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**
Practical:	**2 hours/week**		

Unit–I:	**No. of Lectures: 03 Hours**	
Introduction to Value Education		
Understanding Value Education Self-exploration as the Process for Value Education Basic Human Aspirations and their Fulfilment Right Understanding, Relationship and Physical Facility Happiness and Prosperity – Current Scenario Method to Fulfil the Basic Human Aspirations		
Unit–II:	**No. of Lectures: 03 Hours**	
Harmony in the Human Being		
Understanding the Human Being as Co-existence of the Self and the Body Distinguishing between the Needs of the Self and the Body The Body as an Instrument of the Self Understanding Harmony in the Self Harmony of the Self with the Body Programme to Ensure Self-regulation and Health		
Unit–III:	**No. of Lectures: 03 Hours**	
Harmony in the Family and Society		
Understanding Harmony in the Family – The Basic Unit of Human Interaction 'Trust' – The Foundational Value in Relationship Respect – As the Right Evaluation Other Values in Human-to-Human Relationship Understanding Harmony in the Society Vision for the Universal Human Order		
Unit–IV:	**No. of Lectures: 03 Hours**	
Harmony in the Nature (Existence)		
Understanding Harmony in Nature Interconnectedness, Self-regulation and Mutual Fulfilment among the Four Orders of Nature Realizing Existence as Co-existence at All Levels The Holistic Perception of Harmony in Existence		
Unit–V:	**No. of Lectures: 03 Hours**	
Implications of the Holistic Understanding – A Look at Professional Ethics		
Basis for Universal Human Values Definitiveness of (Ethical) Human Conduct Professional Ethics in the Light of Right Understanding A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order Holistic Technologies, Production Systems and Management Models-Typical Case Studies Strategies for Transition towards Value-based Life and Profession		
Text Books:		
1. R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 3rd Revised Edition, UHV Publications, 2023. 2. R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics – Teachers Manual, 3rd Revised Edition, UHV Publications, 2023 3. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022. 4. UHV-II: Universal Human Values: Understanding Harmony and Ethical Human Conduct https://fdp-si.aicte-india.org/UHVII.php 5. https://uhv.org.in/uhve		
Reference Books: 1. JeevanVidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.		

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Reports, Papers and Impact Studies on UHV Implementation,
    a. https://drive.google.com/drive/folders/1N_1Z1tIm8-iDfy9nQRcHbs_Bjtrk_d24
    b. https://fdp-si.aicte-india.org/Activity_and_Impact.php

Video Links:

1. About UHV Refresher for UHV-II – English, https://www.youtube.com/watch?v=NhFBzn5qKIM&list=PLWDeKF97v9SO8vvjC1KyqteziTbTjN1So
2. https://www.youtube.com/playlist?list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz

Guide lines for ICA:

Students must submit ICA in the form of journal with **FIVE** assignments / activities based on the practice sessions outlined in the Teacher's Manual (Text Book No. 2, https://uhv.org.in/frontend/download/Teachers%20Manual%20Foundation%20Course%20in%20Human%20Values%20and%20Professional%20Ethics%20(eBook).pdf), encompassing a process of self-investigation and self-exploration, suitably framed by concerned teacher / faculty mentor.

The assessment, in this course, is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. shall be used in evaluation. The evaluation criteria for assessment are as follows.

Assessment by Teacher / faculty mentor: 05 marks
Self-assessment: 05 marks
Assessment by peers: 05 marks
Socially relevant project/Group Activities/Assignments: 10 marks

Faculty in charge will assess the assignments continuously and grade or mark each assignment / activity on completion date declared for each assignment / activity.

COMMUNITY ENGAGEMENT PROJECT / FIELD PROJECT (ELC)					
COURSE OUTLINE					
Course Title:	**COMMUNITY ENGAGEMENT PROJECT / FIELD PROJECT (ELC)**	**Short Title:**	**CEP**	**Course Code:**	**AIDS - 310**

Course description:
The subject Community Engagement Project / Field Project involves activities that will expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.

	Hours/week	**No. of**	**Total hours**	**Semester credits**

		weeks		
Practical	04	15	60	02

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To develop an appreciation of rural culture, life-style and wisdom amongst students
2. To learn about the status of various agricultural and development programmes
3. To understand causes for distress and poverty faced by vulnerable households and explore solutions for the same
4. To apply classroom knowledge of courses to field realities and thereby improve quality of learning

Course outcomes:

After successful completion of this course the student will be able to:

1. Gain an understanding of rural life, Indian culture & ethos and social realities
2. Develop a sense of empathy and bonds of mutuality with local community
3. Appreciate significant contributions of local communities to Indian society and economy
4. Learn to value the local knowledge and wisdom of the community
5. Identify opportunities for contributing to community's socio-economic improvements

COURSE CONTENT

COMMUNITY ENGAGEMENT PROJECT / FIELD PROJECT		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practical:	**4 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**50 marks**

The course requires students to participate in any **TWO** field-based learning/projects as listed below under the supervision of faculty. This will help educate local communities about new technological innovations as well as aware students about ways to harness local technology and knowledge. In this approach, students apply their knowledge and skills in a chosen community to improve the lives of people in that community. The activities may also be conducted other than working hours.

Recommended field-based activities (Tentative):

1. Interaction with Self Help Groups (SHGs) women members, and study of their functions and challenges; planning for their skill building and livelihood activities
2. Visit Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGS) project sites, interact with beneficiaries and interview functionaries at the work site
3. Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
4. Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan (GPDP)
5. Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
6. Visit Rural Schools / mid-day meal centres, study academic and infrastructural resources and gaps
7. Participate in Gram Sabha meetings, and study community participation
8. Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
9. Visit to local Nagarpalika office and review schemes for urban informal workers and

migrants
10. Attend Parent Teacher Association meetings, and interview school drop outs
11. Visit local Anganwadi Centre and observe the services being provided
12. Visit local NGOs, civil society organisations and interact with their staff and beneficiaries,
13. Organize awareness programmes, health camps, Disability camps and cleanliness camps
14. Aware / conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys and guiding solar powered village
15. Raise understanding of people's impacts of climate change, building up community's disaster preparedness
16. Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
17. Formation of committees for common property resource management, village pond maintenance and fishing
18. Identifying the small business ideas for rural areas to make the people self-reliant.
19. Undertaking research projects in partnership with local community through community-based research methods
20. Social innovation projects with a social impact
21. Financial Literacy Awareness Programme
22. Digital Literacy Awareness Programme
23. Education Loan Awareness Programme
24. Entrepreneurship Awareness Programme
25. Awareness Programmes on Government Schemes
26. Products Market Awareness
27. Services Market Awareness
28. Consumer Awareness Programme
29. Accounting Awareness Programme for Farmers
30. Accounting Awareness Programme for Street Vendors etc.
31. Nutrition survey for mothers and children, and educate them about hygiene and nutrition.
32. Study / Survey / Field based project on contributions / implications / influence / impact of Indian Knowledge System on Indian society / community / life / values / practices / principles / technology / development etc.

Students must conduct comprehensive studies on various challenges that they face in their chosen field. Every work relevant to the subject matter should be compiled and documented.

Students should keep separate fieldwork diary or maintain journal in order to record their fieldwork experiences i.e. reading, e- contents, tasks, planning and work hours have to be recorded in the diary. Detailed work records report on students' fieldwork experiences and activities to be submitted and should be presented.

Every student shall submit a report in the form of journal that may include, but not limited to, the following.

1. A map (physical, visual or digital) of the village you visited and write an essay about inter-family relations in that village / community.
2. Videos and/or Geo-tagged photographs of events / activities conducted
3. Describe your analysis of rural household economy, its challenges and possible pathways to address them
4. How effectively are institutions functioning? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual).

5. Describe the benefits received and challenges faced in the delivery of one of these programmes in the local community; give suggestions about improving implementation of the programme for the community.
Guide lines for ICA:
Students must submit ICA in the form of journal. Faculty in charge will monitor and assess continuously with grade or mark each project on completion date declared for each of them. Assessments of students shall include review of their involvement and contributions to community engagement. It shall also include presentation of project findings as documented in the journal.

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Second Year Bachelor of Engineering

in

(Common for all)

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ
अंतरी पेटवू ज्ञानज्योत
1990
'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE FOR OPEN ELECTIVE - I

For Affiliated Colleges

Semester – III

W.E.F. 2025 – 26

Open Elective – I

A Student can opt for any one subject out of available institute wide subjects defined in the following list as Open Elective provided, he/she has not taken that particular subject in his/her Programme core, Programme elective, Multidisciplinary Minor, other Open elective and Vocational and Skill Enhancement courses etc. throughout his / her four years of UG Engineering Programme. The student must opt a subject that is compulsorily from faculty other than that of the Major discipline.

Course Code	Name of the Subject / Course	Faculty Offered by	Department Offered by
Open Elective - I (w.e.f. 2025 - 26 at Semester - III, Second Year Engineering)			
OE – 307 A	Quantitative Reasoning and Problem Solving	Sci. & Tech.	Mathematics
OE – 307 B	Management Science	Comm. & Mgmt.	Management
OE – 307 C	Business Ethics & Professional Values	Comm. & Mgmt.	Management
OE – 307 D	Plant Nursery and Management	Sci. & Tech.	Botany
OE – 307 E	General Clinical Pathology	Sci. & Tech.	Biochemistry
OE – 307 F	Herbal Home Remedies	Sci. & Tech.	Botany
OE – 307 G	Psychology of Well-being	Humanities	Psychology
OE – 307 H	Fundamentals of Banking	Humanities	Economics

QUANTITATIVE REASONING AND PROBLEM SOLVING (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**QUANTITATIVE REASONING & PROBLEM SOLVING**	**Short Title:**	**QRPS**	**Course Code:**	**OE - 307 A**
Course description:					
The Quantitative Reasoning course is designed to develop a student's ability to understand, analyze, and apply mathematical concepts and reasoning techniques to solve real-world problems. The course emphasizes critical thinking and logical analysis, focusing on the interpretation and manipulation of quantitative data.					

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	15	45	03

Prerequisite course(s):

Course objectives:

1. Use appropriate mathematical and statistical language in oral, written, and graphical forms.
2. Think critically about mathematical models for relationships between different quantities and use those models effectively and accurately to solve problems and reach sound conclusions about them.
3. Interpret and analyze various representations of data.

Course outcomes:

After successful completion of this course the student will be able to:

1. Perform arithmetic calculations on number system, HCF and LCM and age
2. Solve application problems involving Time, Distance, Speed.
3. Calculate the time required to do the work and fill the cistern.
4. Calculate problems based on percentage, average and simple interest.
5. Analyze and interpret data using statistical techniques

COURSE CONTENT

QUANTITATIVE REASONING AND PROBLEM SOLVING		Semester:	III
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of EE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Number System: Fundamental Concepts, Tests of Divisibility, Factorial of number, Modulus of a number, Greatest integral Value, Multiplication by Short cut method, Division algorithm.
Highest Common Factor and Least Common Factor: Factors and Multiples, Factorization method, Division Method, HCF and LCM of fractions, HCF and LCM of decimal Fractions. **Problems on Ages** : Ratio Based Age Problems, Equation Solving Type Age Problems, Finding Ratio Between Ages.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Time and Distance: Unit Conversion Time and Distance Problems, Average Speed When Travelling To A Place And Returning, Problems Based On Changing Time And Changing Speed.
Problem on Trains: Important facts and Formulae, Time taken by train to pass pole/standing man / Signal post, relative Speed of trains/ bodies moving in same direction, cross time of trains/bodies moving in opposite direction, Cross time trains/ bodies moving in same direction with different speed, reaching time of two trains/ bodies start at the same time from point A and B towards each other destination.

Problem on Boat: Speed of downstream, Speed of upstream, Speed in still water, Rate of stream, Speed of the man in still water.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Time and Work: Calculate Time to Complete Work by 2 or More People, Equations Based Time and Work Problems, Efficiency Based Time and Work Problems, Calculate Time When Efficiency is Given in Percentage, Calculate Time When Workers Leave in Between, Share of Salary Based on Work**.** **Pipes and Cisterns**: Important Facts and Formulae, Calculate Time Taken to Fill a Tank By 2 or More Pipes, Calculate Time Taken to Fill a Tank with Leakage, Equations Based Pipes and Cistern Problems, Calculate Time Taken When Pipes Are Opened for Different Periods, Calculate Number of Pipes.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Percentage: Concepts of percentage, Results on population, Result on depreciation, Salary Comparison percentage problems, Appreciation and depreciation based Percentage problems, Price and consumption based percentage problems **Average**: Number Series Summation based Averages, Consecutive Even/Odd Type Problems, Distance and Speed based Averages. **Simple Interest:** Important Fact and Formulae, Simple Interest Formula based Direct Problems, **Compound Interest** Formula based Direct Problems **Ratio and Proportion** : Combined Ratio Based on Individual Ratios, Distributing any Quantity Based on Ratios, Coins Based Ratio Problems, Mixtures & Replacement Based Ratio Problems		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Clocks: Finding angle between Minute and Hour Hands, Finding Time if angle is given, Correct Time on incorrect (Fast or Slow) Clocks. **Calendar:** Odd day, Leap year, Ordinary Year, Counting of Odd days, Day of the week related to odd days. **Data Interpretation**: Tabulation, Bar Graph, Pie Chart, Line graph, Problem on data Interpretation: Sum and Difference based, Average based questions, percentage-based questions.		
Text Books:		
1. Dr. R.S. Aggarwal "Quantitative Aptitude" S. Chand Publication, Revised Edition 2017		

MANAGEMENT SCIENCE (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**MANAGEMENT SCIENCE**	**Short Title:**	MS	**Course Code:**	**OE – 307 B**

Course description:

This course provides students with a fundamental understanding of Management Science, covering key concepts such as decision-making, organizational structure, operations and process management, project management, and modern management practices. The course focuses on essential management functions, managerial skills, quality control techniques, inventory management, and project planning tools like PERT and CPM. It aims to develop students' analytical and problem-solving skills, preparing them for effective decision-making and managerial roles in various industries.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	15	45	03

Prerequisite course(s):

Principles of Management, Quantitative Techniques for Management, Operations Management, Project Planning and Control and Business Analytics

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. To understand the fundamental principles and functions of management and their historical evolution.
2. To analyse organizational structures and evaluate their impact on business efficiency.
3. To apply quality management techniques and inventory control methods for process optimization.
4. To utilize network analysis techniques like PERT and CPM for project planning and management.
5. To implement modern management practices such as ERP, JIT, TQM, and Six Sigma for continuous improvement.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain core management concepts and their relevance in organizational success.
2. Evaluate and implement appropriate organizational structures based on business needs.
3. Apply inventory and quality management techniques to optimize business processes.
4. Demonstrate the use of project management tools for effective planning and execution.
5. Implement modern management methodologies such as Kaizen, Kanban, and Lean Manufacturing to improve organizational performance.

COURSE CONTENT

MANAGEMENT SCIENCE		Semester:	III
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Fundamentals of Management

Definitions, Nature, Importance, and Functions of Management
Historical Perspectives: Evolution of Management Thought
Levels of Management and their Functions, Decision-Making Types & Process
Managerial Skills and Roles (Mintzberg's)

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Organization and Structure

Concepts and Principles of Organization
Formal and Informal Organization, Authority, Responsibility, Delegation
Types of Organizational Structures: Line, Line and Staff, Matrix, and Team Structures
Departmentation: Need, Importance, and Bases of Departmentation

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Operations and Process Management

Fundamentals of Work Study: Time and Motion Study Techniques
Quality Management: Tools and Techniques (P-Chart, R-Chart, C-Chart)
Inventory and Material Management: Importance of Inventory Control
Economic Order Quantity (EOQ) Calculation
ABC Analysis and its Variants (HML, SDE, VED, FSN)

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Project Management

Introduction to Project Management: Objectives and Importance
Network Analysis: Concepts and Applications
PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method): Comparison and Implementation
Project Optimization: Cost-Time Trade-Off and Crashing Techniques

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Modern Management Practices

Materials Requirement Planning (MRP) and Enterprise Resource Planning (ERP)
Just-In-Time (JIT) and Lean Manufacturing
Total Quality Management (TQM): Principles and Implementation
Six Sigma: Concepts and DMAIC Process
Japanese Management Practices: Kaizen, Kanban, and 5S

Text Books:

1. Essentials of Management by Harold Koontz & Heinz Weihrich, 6th Edition, Tata McGraw-Hill (2005)

Reference Books:

1. Koontz & Weihrich: Essentials of Management, 6/e, TMII, 2005
2. Kanishka Bedi: Production and Operations Management, Oxford University Press, 2004
3. Samuel C. Certo: Modern Management, Pearson Education, 2005
4. Mahajan, M. (2015). Industrial engineering and production management. Dhanpat Rai & Co. (P) Limited.

NPTEL Links:

1. Principles of Management by Prof. Usha Linka
   https://archive.nptel.ac.in/courses/110/107/110107150/
2. Production and Operation Management by Prof. Rajat Agrawal
   https://archive.nptel.ac.in/courses/110/107/110107141/
3. Economic Order Quantity by Prof. Puran Singh
   https://www.youtube.com/watch?v=_h4i9C47rT8
4. Total Quality Management by Prof. Raghunandan Sengupta
   https://archive.nptel.ac.in/courses/110/104/110104080/

BUSINESS ETHICS & PROFESSIONAL VALUES (Open Elective – I)

COURSE OUTLINE

Course Title:	**BUSINESS ETHICS & PROFESSIONAL VALUES**	**Short Title:**	BE&PV	**Course Code:**	**OE – 307 C**

Course description:

This course provides students with a fundamental understanding of business ethics and professional values, focusing on ethical decision-making, corporate governance, workplace ethics, and corporate social responsibility (CSR). It explores ethical leadership, environmental sustainability, and the ethical challenges posed by emerging technologies.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Understand the principles and significance of business ethics in organizational success.
2. Analyse ethical theories and decision-making models in corporate environments.
3. Evaluate corporate governance, ethical leadership, and workplace ethics.
4. Explore ethical challenges in technology, globalization, and sustainability.
5. Develop a strong foundation in professional values and responsible business conduct.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply ethical principles and decision-making frameworks in business scenarios.
2. Assess the role of corporate governance and ethical leadership in business success.
3. Analyse workplace ethics and strategies for ethical corporate culture.
4. Evaluate ethical considerations in technology, cyber security, and sustainability.
5. Demonstrate professional values such as integrity, accountability, and transparency in decision-making.

COURSE CONTENT

BUSINESS ETHICS & PROFESSIONAL VALUES		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Fundamentals of Business Ethics

Definition, significance, and principles of business ethics
Ethical theories: Utilitarianism, Deontology, Virtue Ethics
Ethical decision-making models: Consequentialist, Non-consequentialist and Hybrid Approaches
Role and importance of ethics in achieving organizational goals
Corporate Governance and Ethical Business Practices
Ethical dimensions of corporate social responsibility (CSR)

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Ethical Leadership and Workplace Practices

Key aspects: Workplace ethics, confidentiality, and transparency
Ethical leadership: Traits, decision-making, and influence on organizational culture
Technology ethics: Privacy, cybersecurity, and AI-related challenges

Addressing dilemmas: Whistleblowing, conflicts of interest, and ethical challenges, Diversity, equity, and inclusion (DEI) in ethical decision-making, Corporate fraud and unethical business practices: Causes, consequences and Preventive measures

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Emerging Ethical Challenges and Trends

Ethical considerations in disruptive technologies: AI, blockchain, IoT, and robotics
Intellectual property rights (IPR): Significance and ethical dimensions of innovation
Ethical challenges in globalization: Cultural relativism and navigating cross-border practices
Future trends: Sustainable leadership, stakeholder capitalism, and Industry 4.0
Environmental ethics in business: Carbon footprint reduction, sustainable resource management and corporate environmental responsibility, Cyber security and ethical hacking: Digital ethics, protection against cybercrimes, ethical dilemmas in surveillance, and hacking ethics

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Environmental and Sustainability Ethics

Organizational responsibilities for health, safety, and the environment
Green engineering: Sustainable designs and renewable technologies, Case studies: Lessons from environmental disasters (e.g., Bhopal Gas Tragedy, Exxon Valdez oil spill)
Regulatory frameworks: Environmental laws, compliance, and ethical practices
Climate change and corporate responsibility: Strategies for sustainable business operations
Role of businesses in achieving Sustainable Development Goals (SDGs)

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Professional Values

Definition and relevance of professional values
Core values: Honesty, integrity, accountability, transparency, and respect
Workplace ethics: Building an ethical culture and promoting positive work environments
Professional codes of conduct: ASME, ASCE, IEEE, IETE Business etiquette and ethical decision-making in professional interactions, Role of mentorship and leadership in cultivating professional values

Text Books:

1. "Business ethics: Concepts and cases (9th ed.)" by Velasquez, M. G. (2020) Pearson.

Reference Books:

1. Crane, A., Matten, D., Glozer, S., & Spence, L. J. (2019). Business ethics: Managing corporate citizenship and sustainability in the age of globalization (5th ed.). Oxford University Press.
2. Fernando, A. C. (2019). Business ethics: An Indian perspective (4th ed.). Pearson Education India.
3. Saha, B. (2010). Environmental ethics: A practical approach. Aadi Publications.
4. Johnson, D. G., & Wetmore, J. M. (2008). Technology and society: Building our sociotechnical future. MIT Press.

NPTEL Links:

1. Business Ethics by Prof Susmita Mukhopadhyay
   https://archive.nptel.ac.in/courses/110/105/110105079/
2. Intellectual property rights By Dr. K. D. Raju
   https://archive.nptel.ac.in/courses/110/105/110105139/
3. Ethics in Engineering Practice by Prof Susmita Mukhopadhyay
   https://archive.nptel.ac.in/courses/110/105/110105097/
4. Introduction to Industry 4 0 and Industrial Internet of Things by a Prof. Sudip Misra
   https://archive.nptel.ac.in/courses/106/105/106105195/

PLANT NURSERY AND MANAGEMENT (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**PLANT NURSERY AND MANAGEMENT**	**Short Title:**	**PNM**	**Course Code:**	**OE – 307 D**

Course description:

This course is designed to provide students with an in-depth understanding of the processes, practices, and techniques involved in the establishment and management of plant nurseries. It covers various aspects of plant production, from seedling propagation to the management of nursery operations. Students will gain practical knowledge in selecting plant species, propagating plants, maintaining nursery health, and understanding the financial and operational considerations in managing a nursery.

	Hours/week	No. of weeks	Total hours	Semester credits
Lecture	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

1. To provide knowledge about basic concepts and principles of nursery techniques.
2. To impart basic and technical knowledge on nursery management for strengthening of horticulture sector.
3. To study the disease and pest controlling nursery with practical experience.
4. To help students to study marketing and management relating to nursery.
5. To help students to manage nurseries and propagate healthy plants on a commercial scale.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the importance of a plant nursery and basic infrastructure to establish it.
2. Explain the basic material, tools and techniques required for nursery.
3. Demonstrate expertise related to various practices in a nursery.
4. Comprehensive knowledge and skills to get an employment or to become an entrepreneur in plant nursery sector.
5. To know green house and playhouse technology.

COURSE CONTENT

PLANT NURSERY AND MANAGEMENT		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Plant nursery:

Introduction, definition and importance. Types of nurseries, Temporary (Features, Advantages and disadvantages). Permanent (Features, Advantages and disadvantages.) Ornamental, Vegetable, Fruit plant, Forest plant, Open field and High-tech nurseries. Selection of place, lay out and components of a good nursery. Important role of nursery in horticulture development.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Nursery Basic requirement and setup:

Nursery beds–types and precautions to be taken during preparation. Growing media, nursery tools and implements, and containers in brief. Soil and seed treatments sowing of seeds and planting material used for nursery.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Plant Propagation Technique:

Introduction, Sexual propagation (Advantages and dis-advantages) Cutting (Root, Stem and leaf cutting) Layering (Simple and Air layering) (Gootee) Budding (T and Patch budding) Grafting (Whip and tongue grafting). Green house and Polyhouse Types and importance.

Unit-IV:	No. of Lectures: 09 Hours	Marks: 12

Nursery Management practices:

Potting and repotting, application of manures and fertilizers. Plant bio-regulators and growth retardants, Water quality and management. Common diseases, pests, care and management of nursery plants. Seasonal activities and routine operations in a nursery. Common possible errors in nursery activity. Bureau of Indian Standards (BIS-2008) related to nursery. Economics of nursery development, pricing and record maintenance. Packing, transport, Branding and marketing of nursery plants. Entrepreneurship development through nursery.

Unit-V:	No. of Lectures: 09 Hours	Marks: 12

Vertical farming and Hydroponics:

Vertical Farming: Introduction, scope and importance. Plants suitable for vertical farming. Advantages of vertical farming. Hydroponics: Introduction, scope and importance. Basic concepts and designs, Importance of light, temperature and humidity. Nutrient film technique (NFT) Advantages and Plants suitable for hydroponics.

Text Books:

1. "Plant Nursery Management: Principles and Practices, Central Arid Zone Research Institute" by Ratha Krishnan, P. Kalia Rajwant K.Tewari, J.C., Roy M.M., (2014).

Reference Books:

1. Bose, T.K. Sanyal, Dand Sandhu, M.L. (1998) Propagation of Horticultural crops. Naya Prakash Publishers, Kolkatta.
2. K.K. Nanda and V.K. Kochhar (1985). Vegetative propagation of plants. Kalyani Publisher-NewDelhi-Ludhiana.
3. Kunte, Y.N.,Kawthalkar, M.P.andYawalkar,K.S.(2005).Principles of Horticulture and Fruit Growing. Agri-Horticultural Publishing House, Nagpur.
4. Rahudkar W.B., Bhujbal B.G.,Madhuri Sonawane, Hemraj Rajput ,(2010), CMOU, Text book Publication No. AGR 227Horticulture Nursery Management.
5. Randhawa G.S., A. Mukhopadhyay (2001). Floriculture in India. Book published by Allied Publishers Limited, New Delhi

NPTEL Links:

1. Basics of Crop Breeding and Plant Biotechnology (https://onlinecourses.nptel.ac.in/noc25_ag01/preview)
2. Plant Developmental Biology By Prof. Shri Ram Yadav | IIT Roorkee (Plant Developmental Biology - Course (nptel.ac.in))

GENERAL CLINICAL PATHOLOGY (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**GENERAL CLINICAL PATHOLOGY**	**Short Title:**	GCP	**Course Code:**	**OE - 307 E**
Clinical pathology is the second major subdivision of the discipline of pathology after anatomic pathology. It is concerned with laboratory investigations for screening, diagnosis, and overall management of diseases by analysis of blood, urine, body fluids, and other specimens. The specialties included under the discipline of clinical pathology are clinical chemistry, hematology, blood banking, medical microbiology, cytogenetics and molecular genetics.					

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To study the basic principles of laboratory medicine.
2. Laboratory examination of various body fluids for screening and diagnosis of diseases.
3. To study the tests required for assessing various organ functions.
4. Laboratory examination of formed elements of blood and to study different tests involved in the diagnosis of disorders of blood.
5. To study blood group systems, blood transfusion, screening tests for infections transmissible by transfusion and its adverse effects.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the significance of clinical pathology in screening and diagnosis of diseases.
2. Describe the role of laboratory in examination of various body fluids, metabolic disorders, gastric anatomy, pregnancy and reproductive system disorders.
3. Explain the structure and function of different organs present in clinical pathology setting and enlist the classification of tests required for evaluating those respective organ functions.
4. Enlist the components of blood and describe the role of several formed elements of blood in clinical pathology.
5. Describe the blood group systems, types of blood donors, screening and identification of antibody.

COURSE CONTENT

GENRAL CLINICAL PATHOLOGY		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Laboratory tests for organ function and examination of body fluids:

Basic principles of laboratory medicine, Examination of Urine, Kidney Function Tests, Laboratory test in Diabetes Mellitus, Liver Function test, Laboratory test in disorders of lipids, Biochemical Cardiac Markers, Examination of Cerebrospinal fluid, Examination of Synovial Fluid, Examination of Sputum.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Gastric system and reproductive system analysis:

Examination of Feces, Gastric Analysis, est for Malabsorption and Pancreatic function test, Thyroid

function test, Laboratory tests in pregnancy, Infertility, Semen Analysis, Pyrexia of unknown origin.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Methods for estimation of Blood cell count:		
Haematopoiesis, Collection of blood, Automated complete blood cell count, Estimation of Haemoglobin, Packed cell volume, Total leucocyte count, Reticulocyte count, Platelet count, Blood smear, Red cell indices, Erythrocyte sedimentation rate, Examination of bone marrow.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Laboratory test for disorders of Blood:		
Malignancy, Laboratory test in bleeding disorders, Laboratory test in Thrombophilia, Laboratory Hematology of infectious disease, Laboratory tests in anaemia, Laboratory test in Hematological test in porphyrias.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Blood group systems and Transfusion of blood:		
Blood Group systems, Blood grouping, Collection of donor blood, processing and storage, Screening tests for infections transmissible by transfusion, Antibody Screening and Identification, Compatibility Test, Whole blood, blood components and blood derivatives, Adverse effects of Transfusion.		
Text Books:		
1. "Essentials of Clinical Pathology" by Shirish M. Kawthalkar, JP Medical Ltd, 2018.		
Reference Books: 1. Clinical Pathology, Hematology & Blood banking, 3rd Edition, Nanda Maheshwari. 2. Clinical Pathology Interpretations, A.H.Nagi, Fourth Edition. 3. Essential textbook of Clinical Pathology with Practicals, Tapeshwar yadav & Asheshwar Yadav. 4. Consise text in Clinical pathology, Hematology & Blood banking, Surabhi Bansal, AITBS Publisher. 5. Laboratory Manual of clinical pathology and hematology, Santosh Kumar Mondal. 6. A consise textbook of Clinical Pathology, Hematology & Blood banking, Rakesh Joshi.		

HERBAL HOME REMEDIES (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**HERBAL HOME REMEDIES**	**Short Title:**	HHR	**Course Code:**	**OE – 307 F**

The herbal home remedies course is designed to introduce individuals to the power of natural, plant-based remedies that can be used for common ailments and overall health maintenance. Participants will learn the principles of herbal medicine, understand the therapeutic properties of different herbs, and explore how to incorporate them into daily life through simple, safe, and effective home remedies. The course will cover a wide range of herbs and their uses in treating various conditions, including digestive issues, skin problems, stress, sleep disturbances, and immune system support. By the end of the course, students will have the knowledge to prepare herbal teas, tinctures, salves, and other remedies.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. Understand the basics of herbal medicine and its history in various cultures.
2. Familiarize yourself with common medicinal herbs and their healing properties.
3. Gain hands-on experience in making teas, tinctures, syrups, salves, and poultices.
4. Discover herbal solutions for everyday health concerns like colds, headaches, digestive problems, and skin issues.
5. Learn how to incorporate herbs into your diet, beauty routines, and wellness practices.

Course outcomes:

After successful completion of this course the student will be able to:

1. Identify and classify common herbs and their medicinal uses.
2. Create their own herbal remedies such as teas, tinctures, and oils tailored to specific health needs.
3. Apply natural remedies to improve personal health and wellness in a safe and sustainable way.
4. Understand how to work with herbs to support emotional and physical balance in the body.
5. Integrate herbs into daily routines to enhance lifestyle, nutrition, and overall well-being.

COURSE CONTENT

HERBAL HOME REMEDIES		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Herbal Medicine:

Definition of herb, herbal medicine, Source of Herbs, Basic introduction of Ayurveda, Siddha, Unani and Homeopathy, Introduction of in cultivation of medicinal plants, Leaf, bark, root, seed, flowers, fruits & gums.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Herbal Identification and Properties:

Basic home remedies for general problem: Cold and Cough, Fever, Acidity, Itching, Constipation, Headache, Toothache, Vomiting.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Preparing Herbal Remedies:		
Source of minerals, vitamins, protein, Source of home spices & plant: honey, ashwagandha tulsi, shilagit, bhel, adulsa, pipal, black pepper , caraway seeds , cardamom seed powder , cayenne , celery seed , chives , chile peppers , Korintje cinnamon , Vietnamese cinnamon , cloves , cumin , dill seed , dill weed , garlic , gumbo filé , lemon , mace , marjoram , nutmeg , onion , oregano (Mediterranean).		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Herbal Remedies for Common Ailments:		
Herbal compound for oral care, skin care, sun care, hair care, decorative cosmetics, body care and perfumes.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Integrating Herbal Remedies into Daily Life:		
Preparation of Ayurvedic formulations viz powder, Ghutika, Churna and Bhasma.		
Text Books:		
1. “Textbook of Pharmacognosy” by Trease & Evans. 2. “Pharmacognosy” by Kokate, Purohit and Gokhale.		
Reference Books: 1. Pharmacognosy & Phytochemistry by V. D. Rangari. 2. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy).		

PSYCHOLOGY OF WELL-BEING (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**PSYCHOLOGY OF WELL-BEING**	**Short Title:**	POWB	**Course Code:**	**OE – 307 G**

The Psychology of Well-Being course explores the psychological factors that contribute to human flourishing, happiness, and life satisfaction. This course delves into the scientific study of well-being, examining how positive emotions, healthy relationships, resilience, and personal growth influence mental and physical health. Students will explore theories and research from positive psychology, focusing on practical strategies to enhance personal well-being and cultivate a meaningful life. By understanding the psychological principles behind well-being, students will be better equipped to foster positive mental health both in themselves and in others.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. The psychological and physiological benefits associated with experiencing positive emotions, such as improved resilience, mental health, and social connections.
2. The mindfulness and its components, including present-moment awareness, non- judgmental acceptance, and compassion.
3. The different strategies for developing and enhancing emotional intelligence skills, including mindfulness practices, self-reflection exercises, and social skill-building activities.
4. The important concepts of well-being like conflict resolution, reconciliation, and stress management
5. Include mindfulness practices, self-reflection exercises, and social skill-building activities.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the positive emotion and well-being, including the ability to define and differentiate these concepts from other affective states and mental health constructs.
2. Demonstrate an understanding of mindfulness principles and techniques, including the ability to define mindfulness and its components such as present-moment awareness, non-judgmental acceptance, and compassion.
3. Develop strategies for enhancing emotional intelligence competencies, including mindfulness practices, self-reflection exercises, and social skill-building activities.
4. Collaborate with peers to explore the application of gratitude and forgiveness principles in real-world scenarios, such as conflict resolution, reconciliation, and stress management, demonstrating the ability to work effectively with others and apply learned concepts in practical settings.
5. Developing personal tools and strategies for enhancing individual well-being.

COURSE CONTENT

PSYCHOLOGY OF WELL-BEING		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**

		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Positive emotion and well-being :

Positive Emotions: Meaning of Positive Emotions, Identifying Positive Emotions, Benefits of Positive Emotions Barbara Fredrickson's Broaden and Build Theory of Positive Emotions Positive Emotions and Health Resources: Physical, Psychological and Social Resources. Positive Emotions and Well-being: Happiness and Positive Behaviour, Positive Emotion and Success, Positive Emotion and Flourishing (PERMA Model)Cultivating Positive Emotions: Flow Experiences, savoring.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Mindfulness and well-being :

Mindfulness: Meaning, Mindfulness as an Antidote for Mindlessness, Mindfulness as Present-centered, Awareness and Attention Mindfulness Meditation ,Attributes of Mindful Awareness- Non-Judging, Patience, Beginner Mind, Trust, Non-Striving, Acceptance, Letting go. Benefits of Mindfulness, Mindfulness and Mental Health, Living with Mindfulness: Being Mindfulness of Emotion, Being Mindfulness of Eating, Being Mindfulness of Exercise, Mindfulness Breathing and sitting as a Meditation Mindfulness and Happiness.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Emotional intelligence:

Emotional Intelligence, Meaning, Nature and Definition Theories of EI, Peter Salovey and John D Mayre, Danial Golman, Bar-On Emotional Intelligence and Happiness Ways That Emotionally Intelligent People Choose for Happiness Factors - Emotional Intelligence Be Increased, Manage another Person's Emotions.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Gratitude and forgiveness :

Gratitude: Meaning and Concept, Characteristics of Gratitude People, Gratitude Physical and Mental Health, Gratitude and Happiness ,Ways to Practice Gratitude Forgiveness Meaning, Definition, Importance and Types ,Benefits of Forgiveness, Forgiveness is the key of Happiness.

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Happiness and the Facts of Life :

Happiness Across the Life-Span - Focus on Research: Happiness and Where we Live - Stability in Well-Being Despite Life Changes - Temperament and Subjective Well-Being - Frequency, Intensity and Balance of Positive and - Negative Emotions - Measurement and Definitional Issues -The Shifting Basis of Life Satisfaction - Gender and Happiness - Gender differences in Emotional Experience - Negative Emotions - Positive Moods and Behaviors - Explaining the Paradox of Gender Other Facts of Life - Physical and Mental Health ,Work and Unemployment , Intelligence and Education - Religion - Race, Ethnicity and Stigma.

Text Books:

1. "The Role of Positive Emotions in Positive Psychology: The Broadenand-Build Theory of Positive Emotions" by Fredrickson, B. L. (2001) American Psychologist, 56, 218-226.

Reference Books:

1. Steve B. & Marie, C. (2015). Positive Psychology. Pearson Education.
2. Snyder C.R., Lopez S.J., Pedrotti J.T. (2011) Positive Psychology. Sage Publication.

NPTEL Links:

1. Introduction to Psychology By Prof. Braj Bhushan, IIT Kanpur
   https://onlinecourses.nptel.ac.in/noc21_hs49/preview

FUNDAMENTALS OF BANKING (Open Elective – I)					
COURSE OUTLINE					
Course Title:	**FUNDAMENTALS OF BANKING**	**Short Title:**	FOB	**Course Code:**	**OE – 307 H**
This course provides a fundamental understanding of banking concepts, types of banks, negotiable instruments, banking operations, and remittance methods. It covers essential topics like account management, banking regulations, and digital banking services, equipping students with foundational knowledge for careers in banking and finance.					

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. Explain the basic concepts, evolution, and significance of banking.
2. Provide knowledge of different types of bank accounts and their operations.
3. Introduce negotiable instruments and their role in banking transactions.
4. Familiarize students with endorsements, remittances, and digital banking methods.
5. Develop an understanding of banking regulations, customer protection, and ethical banking practices.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the fundamental concepts and functions of banking.
2. Identify different types of bank accounts, cooperative banking structures, and their significance.
3. Analyze the characteristics and legal aspects of negotiable instruments and endorsements.
4. Evaluate different means of remittances and their role in modern banking.
5. Apply knowledge of banking regulations, digital banking, and financial security measures.

COURSE CONTENT

FUNDAMENTALS OF BANKING		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Banking

Meaning and definition of banking
Evolution of banking in the world and in India
Importance of banking in the Indian economy
Types of banks – Commercial Banks, Cooperative Banks, Development Banks, and Central Bank

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Banking Operations and Account Management

Types of bank accounts – Savings, Current, Fixed Deposit, Recurring Deposit, Non-Resident Accounts
Procedure for opening, operating, and closing accounts
KYC norms and customer due diligence

Role of banks in financial inclusion		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Negotiable Instruments and Endorsements		
Meaning, characteristics, and types of negotiable instruments – Promissory Notes, Bills of Exchange, Cheques Types of cheques – Bearer, Order, Crossed (General & Special) Endorsements – Definition, characteristics, types (Blank, Special, Partial, Restrictive, Conditional, Facultative) Rights and liabilities of parties to negotiable instruments		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Remittance Services and Digital Banking		
Different means of remittances – Demand Drafts, Letters of Credit Credit Cards, Debit Cards, ATMs – Advantages and Disadvantages MICR cheques and their significance Introduction to digital banking – NEFT, RTGS, UPI, Mobile Banking		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Banking Regulations and Ethical Practices		
Role of regulatory authorities – RBI, SEBI, and their functions in banking Consumer protection in banking – Banking Ombudsman Scheme Common banking frauds and security measures Ethical banking practices and financial literacy		
Text Books:		
1. "Basics of Banking and Finance" by K.M. Bhattacharya & O.P. Agrawal, Himalaya Publishing House. 2. "Fundamentals of Banking Theory and Practice" by A.K. Basu.		
Reference Books: 1. Elements Banking and Insurance – B. S. Shah Publication, Ahmadabad 2. Elements of Banking and Insurance – New Popular Publication, Surat 3. Banking Theory and Practice, Prem Kumar Srivastava, Himalaya Publishing House.		
NPTEL Links: 1. Management of Commercial Banking by Prof. Jitendra Mahakud, IIT Kharagpur https://nptel.ac.in/courses/110105143		

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Second Year Bachelor of Engineering

in

Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ
अंतरी पेटवू ज्ञानज्योत
1990
'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE

For Affiliated Colleges

Semester – IV

W.E.F. 2025 – 26

OPERATING SYSTEMS (PCC)					
COURSE OUTLINE					
Course Title:	**OPERATING SYSTEMS**	**Short Title:**	**OS**	**Course Code:**	**AIDS-401**

Course description:

This course is to introduce the concept of Operating System, process management, memory management, file management & disk management.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	3	15	45	3

Prerequisite course(s):

Computer Organization, System Programming

Course objectives:

1. To understand the concept of OS, Process and Threads.
2. To know the mechanism of Process Scheduling and Inter Process Communication.
3. To understand deadlock conditions and memory management concept.
4. To gain knowledge about Virtual memory and File management in OS.
5. To know Input Output System along with Mass storage Structure.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain concept of OS, Process and Thread.
2. Solve the problems on Process Scheduling and IPC.
3. Decide Deadlock conditions and memory management concept.
4. Describe mechanism of Virtual memory and File management in OS.
5. Select IO system and Mass storage structure.

COURSE CONTENT

OPERATING SYSTEMS		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):	**40 marks**

Unit–I	No. of Lectures: 09 Hours	Marks: 12

Introduction:
What is Operating Systems, Types of Operating System, Functions of Operating System, Operating-System Services, Structure of an OS – Layered, Monolithic, Microkernel OS, System Calls.

Process:
Process Concept, Different states of a Process, Process states transitions, Process Control Block, Context Switching

Thread: Definition, Various states, Benefits of threads, Types of threads

Unit–II	No. of Lectures: 09 Hours	Marks: 12

Process Scheduling: Scheduling, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time
Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR, Priority based Scheduling
Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion,
Hardware Solution, Peterson's Solutions, The Producer Consumer Problem, Semaphores, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem

Unit–III	No. of Lectures: 09 Hours	Marks: 12

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.
Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging, Segmentation

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Virtual Memory: Background, Demand paging, Page Replacement, Page Replacement algorithm: First in First Out (FIFO), Optimal, Least Recently used (LRU), Thrashing **File Management**: File concept: File Attributes, File operation, File types, File structure. Access methods, Directory structure, File system mounting, Allocation methods (contiguous, linked, indexed)		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
I/O System: I/O Hardware, Interrupts, Direct memory access **Mass storage structure:** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, LOOK. Disk Management, Swap Space Management, RAID Structure.		
Text Book:		
1. Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.		
Reference Books:		
1. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India. 2. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing 3. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley		

OPERATING SYSTEMS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**OPERATING SYSTEMS LAB (PCC)**	**Short Title:**	**COAL**	**Course Code:**	**AIDS - 402**

Course description:				
Laboratory	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	2	15	30	1

End Semester Exam (ESE) Pattern:	**Practical (PR)**

COURSE CONTENT			
OPERATING SYSTEMS LAB		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA (PR):**	**25 marks**
		Internal Continuous Assessment (ICA):	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the following list.

1. **Write a C program for File Handling for following File handling operation (Any three)**

a) Create
b) open
c) read
d) write
e) append
f) copy
g) rename

2. **Write a C program to implement CPU Scheduling algorithms(Any one)**
    a. FCFS
    b. SJF(Preemptive& non-preemptive)
    c. Round Robin
    d. Priority based (Preemptive& non-preemptive)
3. **Write a C program for Banker's algorithm for the purpose of Deadlock avoidance**
4. **Write a C program to simulate Producer-Consumer problem using Semaphore**
5. **Write a C program to simulate Dinning Philosopher problem**
6. **Write a C program to implement following Memory Management algorithms(Any one)**
    a. First Fit
    b. Best Fit
    c. Worst Fit
7. **Write a C program to simulate Paging technique of Memory management**
8. **Write a C program to simulate following file allocation strategies (Any one)**
    a. Sequential
    b. Linked

c. Indexed

9. Write a C program to simulate the following file organisation technique (Any one)

a. Single level directory
b. Two level directory
c. Hierarchical

10. Write a C program to implement Page Replacement algorithms(Any one)

a. FIFO(First In First Out)
b. LRU(Least Recently Used)
c. Optimal

11. Write a C program to demonstrate disk scheduling algorithms(Any one)

a. FCFS
b. SSTF
c. SCAN
d. C-SCAN

12. Write a C program for Inter-process communication.

Note: - Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on the practical assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.
Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

NPTEL Links:
Introduction to Operating Systems By Prof. Chester Rebeiro | IIT Madras
https://onlinecourses.nptel.ac.in/noc21_cs72/preview

DATABASE MANAGEMENT SYSTEMS (PCC)					
COURSE OUTLINE					
Course Title:	**DATABASE MANAGEMENT SYSTEMS (PCC)**	**Short Title:**	**DBMS**	**Course Code:**	**AIDS - 403**

Course description:
A database management system (**DBMS**) is software for creating and managing databases. The DBMS provides users and programmers with a systematic way to create, retrieve, update and manage the data.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	**3**

Prerequisite course(s):

Basic knowledge of Discrete Mathematics.

Course objectives:

1. To introduce the fundamental concepts of Database Management Systems and various data models.
2. To provide an understanding of formal relational query languages.
3. To understand and develop the skill in writing SQL queries.
4. To understand various storage strategies and relational database design principles, including normalization techniques.
5. To introduce transaction management concepts and provide an overview of NoSQL database.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the fundamental concepts of database management systems and design E-R diagram for a given database.
2. Formulate queries using relational algebra.
3. Construct and execute SQL queries using any RDBMS.
4. Explain indexing techniques and normalization principles in RDBMS.
5. Describe transaction management, concurrency control, recovery systems and compare SQL with NoSQL databases.

COURSE CONTENT

DATABASE MANAGEMENT SYSTEMS		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to DBMS

Database-System Applications, Purpose of Database Systems, View of Data: Data Abstraction, Instances and Schemas, data independence, Data Models: Relational Model, Entity-Relationship Model, Object-Based data model, Semi-structured Data Model, Database Languages, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators

Database Design and E-R Model: Overview of the Design Process, The Entity Relationship Model: Entity Sets, Relationship Sets, Attributes, Constraints, Entity-Relationship Diagram: Basic Structure, Mapping Cardinality, Weak Entity sets, Extended E-R Features: Specialization, Generalization, Attribute Inheritance, Constraints on Generalizations, Aggregation

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Formal Relational Query Language

The Relational Algebra: Fundamental Operations: The select Operation, The Project

Operation, The Union Operation, The Set-Difference Operation, The Cartesian-Product Operation, The Rename Operation, Additional Algebra Operations: The Set-Intersection Operation, The Natural-Join Operation, The Assignment Operation, Outer Join Operations, Extended Relational-Algebra Operations: Generalized Projection, Aggregation

Query Optimization: Overview.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Introduction to relational Model

Structure of relational Databases, Database Schema, Keys, Schema Diagrams, Codd's Rules

Introduction to SQL

SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set operations, Null Values, Aggregate Functions, Nested Subqueries, Modification of the Database

Intermediate SQL: Join Expressions: Join Conditions, Outer Joins, Views, Integrity Constraints

PL/SQL: Functions, Procedures and Triggers

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Storage strategies and Relational Database Design

Storage strategies - Indexing: Basic concepts, Ordered Indices

Relational Database Design: Features of Good Relational Designs, Normalization: Functional Dependency, Full Functional Dependency, Partial Dependency, Transitive Dependency, Types of Normal Forms: First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce-Codd Normal Form (BCNF), Fourth Normal Form (4NF).

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Transaction Management

Transaction: Transaction Concept, A simple Transaction Model, Transaction Atomicity and Durability

Concurrency Control: Lock-Based Protocols: Locks, Granting of Locks, The Two-Phase Locking protocol, Timestamp–Based Protocols: Timestamps, The Timestamps-Ordering Protocol

Recovery System: Failure Classification, Storage, Recovery and Atomicity: Log records, Database Modification, Concurrency Control and Recovery, Transaction Commit, Using the Log to Redo and Undo Transactions

Introduction to NoSQL: Introduction, Key Features of NoSQL, Advantages and Disadvantages of NoSQL, Types of NoSQL database, Difference between SQL and NoSQL**.**

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", 6th Edition, McGraw Hill Education (India) Private Limited.

Reference Books:

1. Raghu Ramkrishnan, Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw-Hill.
2. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson.
3. Ramez Elmasri and Shamkant B. Navathe "Fundamentals of Database Systems", 5th Edition, Pearson Education.
4. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", 5th Edition, McGraw Hill Higher Education.
5. S. K. Singh, "Database Systems Concepts, Design and Applications", 2nd edition Pearson.
6. Bipin C. Desai, "An Introduction to Database Systems", Galgotia Publications pvt ltd.

7. Dan McCreary, Ann Kelly, “Making Sense of NoSQL: A Guide for Managers and the Rest of us”, Manning Shelter Island.

NPTEL Links:

1. Database Management Systems, by Prof. Partha Pratim Das, IIT, Kharagpur
   https://nptel.ac.in/courses/106105175
2. Fundamentals of Database Systems, by Dr. Arnab Bhattacharya, IIT Kanpur
   https://nptel.ac.in/courses/106104135
3. Introduction to Database Systems, by Prof. P. Sreenivasa Kumar, IIT Madras
   https://nptel.ac.in/courses/106106220

Web Resources:

https://www.geeksforgeeks.org/dbms/
https://www.tpointtech.com/dbms-tutorial
https://www.geeksforgeeks.org/introduction-to-nosql/

DATABASE MANAGEMENT SYSTEM LAB (PCC)					
COURSE OUTLINE					
Course Title:	**DATABASE MANAGEMENT SYSTEM LAB (PCC)**	**Short Title:**	**DBMSL**	**Course Code:**	**AIDS - 404**
	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**	
Practical	02	15	30	**1**	

COURSE CONTENT			
DATABASE MANAGEMENT SYSTEM LAB		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE) PR:UA**	**25 marks**
		Internal Continuous Assessments (ICA):CA	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame **THREE** Laboratory assignments from Group - A and **THREE** Laboratory assignments from Group – B from the following list.

Group: A

1. Create a sample database using any RDBMS package with SQL DDL queries. It should demonstrate the use of various constraints such as Primary key, foreign key, Unique, Not Null, and Check.
2. SQL DML queries: Use of SQL DML queries to retrieve, insert, update and delete the database.
3. SQL Queries: The queries should involve SQL feature such as aggregate functions, group by clause, having clause, order by clause, set operations and set comparison.
4. SQL Queries: To demonstrate different types of Joins.
5. SQL Queries: To demonstrate the use of SQL window functions.
6. SQL Queries: To demonstrate the use of SQL subqueries.
7. Develop two tier architecture and use ODBC/JDBC connections to store and retrieve data from the database. You may consider any applications like employee management system, library management system etc.

Group: B

1. SQL Queries: To demonstrate the use of View.
2. SQL Queries: To demonstrate the use of function.
3. SQL Queries: To demonstrate the use of procedure.
4. SQL Queries: To demonstrate the use of trigger.
5. To demonstrate the use of cursor in a database.
6. Study and installation of any NOSQL database.
7. To perform the various operations on NOSQL database.

Note: - Use of Open-Source Software/Tool/Technology is recommended for laboratory assignments of the concern subject.

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", 6th Edition, McGraw-Hill.
2. Ivan Bayross, SQL, PL/SQL: The Programming Language of Oracle, BPB Publication.

Reference Books:

1. Rick F. Van der Lans, “Introduction to SQL”, Pearson education.
2. B. Rosenzweig, E. Silvestrova, “Oracle PL/SQL by Example”, Pearson education.
3. Steven Feuerstein, “Oracle PL/SQL Programming”, SPD, O‟Reilly.
4. Dr. P. S. Deshpande, “SQL& PL/SQL for Oracle 10g Black Book”, Dreamtech Press
5. M. McLaughlin, “Oracle Database 11g PL/SQL Programming”, TMH.
6. J. J. Patrick, “SQL Fundamentals”, Pearson Education.
7. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, 5th Edition, McGraw Hill Higher Education.

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1. Database Management Systems, by Prof. Partha Pratim Das, IIT, Kharagpur
   https://nptel.ac.in/courses/106105175
2. Fundamentals of Database Systems, by Dr. Arnab Bhattacharya, IIT Kanpur
   https://nptel.ac.in/courses/106104135
3. Introduction to Database Systems, by Prof. P. Sreenivasa Kumar, IIT Madras
   https://nptel.ac.in/courses/106106220

Web Resources:

https://www.w3schools.com/mysql/mysql_rdbms.asp
https://www.mysqltutorial.org/

OBJECT ORIENTED PROGRAMMING LAB (PCC)					
LAB COURSE OUTLINE					
Course Title:	**OBJECT ORIENTED PROGRAMMING LAB (PCC)**	**Short Title:**	**OOPL**	**Course Code:**	**AIDS - 405**

Course description:

This course provides students with a comprehensive study of the C++ programming. Topics includes in this course are basic concepts of C++ programming, The concept of Class and Object, polymorphism, overloading, inheritance, dynamic binding, message passing, class and function template.

Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**1**	**15**	**15**	**2**
Practical	**2**	**15**	**30**	

Prerequisite course(s):

C Language Programming

Course objectives:

1. To understand how C++ improves C with object-oriented features.
2. To learn the syntax and semantics of the C++ programming language.
3. To learn how to design C++ object-oriented features for code reuse.

Course outcomes:

After successfully completing the course, the students will be able to:

1. Explain the fundamentals of object-oriented design, including the principles of encapsulation, abstraction, inheritance, and polymorphism.
2. Develop, implement, test, and debug simple programs using an object-oriented programming language.
3. Analyze how the class mechanism in object-oriented programming supports encapsulation and information hiding.
4. Design and evaluate C++ and Java programming concepts through implementation and testing.
5. Apply templates, exception handling, and file handling techniques in object-oriented programming.

LAB COURSE CONTENT			
OBJECT ORIENTED PROGRAMMING LAB		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End semester exam (ESE) UA (PR):**	**25 Marks**
		Internal Continuous Assessment (ICA)CA:	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

LAB COURSE CONTENT

Introduction to Object Oriented Programming

1: Introduction to OOP

Understanding OOP concepts: Objects, Classes, Methods
Differences between procedural and object-oriented programming
Overview of the C++ standard library

2: Classes and Objects Function and Operator Overloading

Defining classes and objects
Member variables and member functions
Access specifiers: public, private, and protected
Friend classes and functions
Inline function
Constructors and destructors
Functions in C++

3: Inheritance

Understanding inheritance and its benefits
Types of inheritance: single, multiple, hierarchical, multilevel
Access control and member visibility
Virtual base classes

4: Polymorphism

Concept of polymorphism in C++
Function overloading and operator overloading
Runtime polymorphism through function overriding
Abstract classes and pure virtual functions

5: Introduction to templates, Exception Handling , File Handling

Creating and using function templates and class templates
Understanding exceptions and their types
Using try, catch, and throw
Reading from and writing to files
File streams, buffer, and formatting data

Practicals:-

Concerned faculty member should suitably frame at least **SIX** laboratory assignments

1. Design an EMPLOYEE class to contain
   Data members: Employee_Number, Employee_Name, Employee_Salary.
   Member functions: to read the data of an employee, to calculate salary and to print the values of all the data Members.
2. Write a C++ program to swap two variables using third variable and without using third variable.
3. Write a program in C++ to implement using default constructor, parameterized constructor and copy constructor.
4. Write a C++ program to implement function overloading.
5. Write a program in C++ for unary and binary operator overloading.
6. Write a program in C++ to implement using the inheritance.
7. Write a program in C++ for virtual base class.
8. Write a program for run time polymorphism using virtual functions.
9. Write a program in C++ to demonstrate Inline function.
10. Write a program in C++ to demonstrate the use of friend function.

11. Write Program to Traverse Array element using Pointer.
12. Write a program to overload binary + operator using member function for concatenation of two strings.
13. Write a program in C++ to demonstrate the use of function templates.
14. Write a program in C++ to demonstrate the use of class templates.
15. C++ program to demonstrate the use of try, catch and throw in exception handling.

Text Books:

1. E. Balagurusamy, Object Oriented Programming with C++, TataMcGraw Hill, 2011, Sixth Edition
2. Ashok N. Kamthane, "Object-Oriented Programming with ANSI and Turbo C++",Pearson Education, 2006, 1st Edition

Reference Books:

1. Yashavant P. Kanetkar, "Let Us C++", BPB Publications, 3rd Edition
2. Venugopal K.R., "Mastering C++", TMH, 2nd Edition.
3. Mahesh Bhave, Sunil Patekar, "Object Oriented Programming with C++", Second Edition, 2012.
4. Herbert Schildt, "The Complete Reference C++", TMH , Fourth Edition, , 2003.
5. R.S. Salaria, Mastering Object-Oriented Programming with C++, Khanna Book Publishing, N.Delhi
6. Balaguruswamy, Programming with Java, TMH
7. D.Samantha, Object Oriented Programming in C++ and Java, PHI
8. TanweerAlam, Internet and Java Programming, Khanna Publishing House
9. Rajesh K. Shukla, "Object-Oriented Programming in C++", Wiley India, 2008, 1st Edition

Guidelines for ICA:

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Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.

Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.

ANALOG ELECTRONICS AND SIGNAL SYSTEMS (MD M)					
COURSE OUTLINE					
Course Title:	**ANALOG ELECTRONICS AND SIGNAL SYSTEMS (MD M)**	**Short Title:**	**AESS**	**Course Code:**	**AIDS - 406**

Course description:
This course provides a comprehensive understanding of analog electronics and signal systems, covering fundamental concepts, circuit analysis, and signal processing techniques. Students will explore semiconductor devices, analog circuits, and signal behavior in both time and frequency domains.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	02	15	30	2

Prerequisite course(s):
Basic Electrical and Electronics Engineering

Course objectives:
The objective of this course is to:
1. Understand the characteristics, configurations, and applications of operational amplifiers (Op-Amps).
2. Analyze and design various Op-Amp-based circuits, including amplifiers, filters, and converters.
3. Apply Op-Amps in signal processing applications such as multivibrators, Schmitt triggers, and instrumentation amplifiers.
4. Learn fundamental concepts of signals, systems, Fourier series, and their applications in circuit analysis.
5. Utilize Laplace transforms for analyzing electrical circuits and understanding system behavior.

Course outcomes:
After successful completion of this course the student will be able to:
1. Demonstrate a thorough understanding of operational amplifier characteristics and configurations.
2. Design and analyze Op-Amp-based circuits for various signal processing applications.
3. Implement active filters, DACs, and ADCs for real-world electronic systems.
4. Apply signal and system concepts, including Fourier series, to analyze continuous and discrete-time signals.
5. Utilize Laplace transforms to solve circuit problems and evaluate system stability.

COURSE CONTENT

ANALOG ELECTRONICS AND SIGNAL SYSTEMS		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 06 Hours**	**Marks: 12**

Introduction to Analog Electronics

Overview of Analog and Digital Electronics, Role of Analog Electronics in Computer Engineering, Zener Diode, Voltage Regulation, BJT Small Signal Amplifiers: Gain, Bandwidth, and Frequency Response, introduction to multistage amplifiers, Ideal vs. Practical Op-Amp Characteristics, Applications: Summing Amplifiers, Integrators, Differentiators.		
Unit–II:	**No. of Lectures: 06 Hours**	**Marks: 12**
Filters and Oscillators		
Frequency Response Analysis, Concept of Bandwidth, Resonance in Circuits, Active and Passive Filters: Low Pass, High Pass, Band Pass, and Band Stop, Design and Analysis of Butterworth and Chebyshev Filters, Bode Plot Analysis, Oscillator Principle and Feedback, RC, LC, and Crystal Oscillators.		
Unit–III:	**No. of Lectures: 06 Hours**	**Marks: 12**
Signal Systems Fundamentals		
Classification of Signals: Continuous-Time, Discrete-Time, Periodic, Aperiodic, Signal Representation and Transformation, Properties: Linearity, Time-Invariance, Causality, and Stability, Convolution and its Applications, Fourier Series for Periodic Signals, Fourier Transform: Properties and Applications, Sampling Theorem, Aliasing and Reconstruction, Basics of Modulation and Demodulation, Introduction to Noise in Systems		
Unit–IV:	**No. of Lectures: 06 Hours**	**Marks: 12**
Signal System Analysis Techniques		
Laplace Transform in Signal Systems, Definition and Properties, Application to LTI Systems Z-Transform, Z-Transform for Discrete-Time Signals, Inverse Z-Transform, System Stability and Feedback, Criteria for Stability, Feedback in Analog Systems, Analog-to-Digital (ADC) and Digital-to-Analog (DAC) Conversion		
Unit–V:	**No. of Lectures: 06 Hours**	**Marks: 12**
Advanced Topics in Analog Electronics and Signal Systems		
Nonlinear Amplifiers and Their Applications, Power Amplifiers: Classes and Characteristics, Class A and Class B Power Amplifier Analysis, Communication Systems, Analog Modulation Techniques: AM, FM, PM, Introduction to Digital Modulation, Role of Mixed-Signal Systems in Computer Engineering, Analog Signal Processing in AI and IoT, Future of Signal Systems in Computing		
Text Books:		
1. "Electronic Circuit Analysis and Design" by Donald A. Neamen 2. "Signals and Systems" by Oppenheim and Willsky		
Reference Books: 1. "Analog Electronics: Circuits, Systems and Signal Processing" by David Crecraft and Stephen Gergely. 2. "Electronic Principles" by Albert Malvino. 3. "Analog Design Essentials" by Willy Sansen. 4. "Design of Analog Integrated Circuits and Systems" by Kenneth R. Laker and Willy M. C. Sansen. 5. "Signals and Systems" by Alan V. Oppenheim, Alan S. Willsky, and S. Hamid Nawab. 6. "Microelectronic Circuits" by Sedra and Smith 7. "Analog and Digital Communication Systems" by Simon Haykin		
ICA Guidelines:		

Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.

NPTEL Links:

1. Analog Electronic Circuits by Prof. Shouribrata Chatterjee, IIT Delhi
   https://archive.nptel.ac.in/courses/108/105/108105158/
2. Analog Electronic Circuits by Prof. Shanthi Pavan, IIT Madras
3. https://archive.nptel.ac.in/courses/108/106/108106188/
4. Electronics for Analog Signal Processing I by Prof. K. Radhakrishna Rao, IIT Madras
   onlinecourses.nptel.ac.in
   https://archive.org/details/NPTEL-ElecEngr-Electronics_for_Analog_Signal_I
5. Analog Circuits and Systems by Prof. K. Radhakrishna Rao, IIT Madras
   https://onlinecourses.nptel.ac.in/noc24_ee81/preview
6. Analog Circuits and Systems 1 by Prof. Jayanta Mukherjee, IIT Bombay
   https://www.nptelvideos.com/course.php?id=524

WEB DESIGNING AND PUBLISHING LAB (VSEC)						
COURSE OUTLINE						
Course Title:	**WEB DESIGNING AND PUBLISHING LAB (VSEC)**		**Short Title:**	WDPL	**Course Code:**	**AIDS -408**
	Hours/week	**No. of weeks**	**Total hours**		**Semester credits**	
Practical	02	15	30		**1**	
COURSE CONTENT						
WEB DESIGN AND PUBLISHING LAB			**Semester:**		**IV**	
Teaching Scheme:			**Examination scheme**			
Practical:	**2 hours/week**		**Internal Continuous Assessment (ICA)CA:**		**25 marks**	

Concern faculty member should suitably frame at least **THREE** laboratory assignments from the Group A and **THREE** experiments from the Group B from the following list.

(Group A)

1. Use HTML to create a basic web page structure with headers, paragraphs, images, and links.
2. Design a responsive navigation bar using HTML and CSS.
   Tasks: Use media queries to make the navigation bar adaptable to different screen sizes. Implement JavaScript to toggle the menu on smaller screens.
3. Develop an image gallery layout using HTML and CSS.
   Tasks: Implement a lightbox effect using JavaScript to view images in a larger size when clicked.
4. Design a modal popup using HTML for the content.
   Tasks: Style the modal with CSS. Use JavaScript to control the opening and closing of the modal when a button is clicked.
5. Design an accordion menu with collapsible sections using HTML.
   Tasks: Style the accordion with CSS. Use JavaScript to toggle the visibility of the content panels when a section header is clicked.
6. Implementation: Create a basic weather app interface using HTML.
   Tasks: Style the app with CSS. Use JavaScript to fetch weather data from an API and display it dynamically on the page.

(Group B)

1. Use jQuery to create a responsive content slider with automatic transitions and navigation controls.
2. Utilize jQuery for real-time form validation and display appropriate error messages for invalid inputs.
3. To develop a dynamic to-do list application using jQuery, allowing users to add, edit, delete, and mark tasks as completed.
4. Use Figma to create a simple and clean website layout with a header, footer, and main content area.
5. Use Figma to design an attractive landing page with a hero image, call-to-action buttons, and a features section.
6. Use Figma to design a product page for an e-commerce website, including product images, descriptions, and pricing.
7. Use Google Sites to create a personal portfolio website showcasing projects, skills, and contact information.

8. Utilize Google Sites to create a team collaboration site for project updates, team member information, and file sharing Note: Use of Open Source Software/Tool/Technology is recommended for laboratory assignments of concern subject.
Text Books:
1. Eloquent JavaScript: “A Modern Introduction to Programming" by Marijn Haverbeke 2.”Twitter Bootstrap 4 Succinctly” by Peter Shaw
Reference Books:
1. Learning jQuery by Stack Overflow Community 2. Figma Handbook" by Design+Code
Guidelines for ICA:
Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

ABILITY ENHANCEMENT COURSE (AEC)					
COURSE OUTLINE					
Course Title:	**ABILITY ENHANCEMENT COURSE (AEC)**	**Short Title:**	**AEC**	**Course Code:**	**AIDS - 409**

Course description:

The Course Provides students English proficiency across four key skills: **Listening, Reading, Writing, and Speaking**. It is used for study, work, and migration purposes in English-speaking countries.

Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	02	**15**	**30**	**01**

Course Objectives:

The objective of this course is:

1. Evaluate English proficiency for academic, professional, and migration purposes.
2. Provide an internationally recognized standard for English language assessment.
3. Develop language skills necessary for effective communication in diverse environments.
4. Prepare candidates for real-life language use in academic and work-related.
5. To equip students with test-taking strategies to maximize their scores.

Course Outcomes:

After successful completion of this course, the student will be able to:

1. Demonstrate a high level of English proficiency for academic, professional, or migration purposes.
2. Develop leadership and teamwork skills in collaborative environments.
3. Apply effective strategies for all Ability Enhancement modules.
4. Develop confidence in using English in real-life and test situations.
5. Achieve the required Ability Enhancement score for university admissions, work, or immigration.

COURSE CONTENT

ABILITY ENHANCEMENT COURSE		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical	**2 hours/week**	**Internal Continuous Assessment (ICA) CA**	**25 Marks**

Concerned faculty member should suitably frame **FOUR** assignments in the form of interactive Practice Sessions based on the following modules.

Listening:

1. **Activity 1:** Podcasts, news, speeches, conversations, storytelling, News websites, BBC CNN, NBC
2. **Practice 1:** Practice with audio materials (podcasts, TED Talks, movies)
3. **Practice 2:** Cornell Method, Mind Mapping, Key Points and Summarization
4. **Practice 3:** Listening tests and quizzes, Practical exercises

Reading:

1. **Activity 3:** Fiction, short stories, novels: News articles, essays, reports, Research papers, textbooks, Blogs, social media posts, online articles
2. **Practice 1:** Self-assessment and comprehension quizzes
3. **Practice 2:** Note-taking strategies for effective retention
4. **Practice 3:** Understanding idioms and figurative language

5. **Practice 4:** Context clues and word recognition
Writing: 1. **Activity 4:** Write a daily journal, Letters to an English speaker, Make lists of the things you see every day, Write descriptions of your family and friends. 2. **Practice 1:** Common writing mistakes and how to fix them. 3. **Practice 2:** Unity in writing (sticking to one main idea) 4. **Practice 3:** Poetry, short stories, scripts 5. **Practice 4:** Storytelling techniques, point of view, dialogue
Text Books:
1. Barron's, IELTS Practice Exam, New Age International Private Limited, 2nd Edition.
Reference Books:
1. IELTS 19 Academic, Authentic Practice Tests, Cambridge University Press,2024 2. Pauline Cullen, IELTS Academic and General Training, Cambridge University Press,2014
NPTEL Links:
1. Skills by Prof. Binod Mishra, IIT Roorkee, https://nptel.ac.in/courses/109107121 2. Skills Development by Prof. P. Patnaik, Prof. V.N. Giri, Prof. D. Suar, IIT Kharagpur, https://nptel.ac.in/courses/109105110
Links: (for online practice)
1. A noticeboard message | Learn English (britishcouncil.org) 2. Free IELTS on Computer familiarisation test (ieltsidpindia.com)
Guide lines for ICA:
Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on the completion date declared for each assignment.

INNOVATION AND ENTREPRENEURSHIP (HSSM)					
COURSE OUTLINE					
Course Title:	**INNOVATION AND ENTREPRENEURSHIP (HSSM)**	**Short Title:**	**I&E**	**Course Code:**	**AIDS -410**

Course description:
This course will equip students with the knowledge, skills, and mindset to become innovative entrepreneurs. The course will cover a wide range of topics, including idea generation, prototyping, technological and non- technological innovation, entrepreneurship, social innovation, intellectual property rights, commercialization, startup development, the innovation ecosystem, pre-incubation and incubation stages, entrepreneurial opportunities

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	02	15	30	2

Prerequisite course(s): No

Course objectives:

The objective of this course is to:
1. Identify and evaluate innovative ideas.
2. Develop prototypes and test their feasibility.
3. Understand the different types of innovation and their potential impact.
4. Develop entrepreneurial skills and mindset

Course outcomes:

After successful completion of this course the student will be able to:
1. Think creatively and come up with innovative ideas
2. Develop prototypes and test their feasibility
3. Understand the different types of innovation and their potential impact
4. Apply entrepreneurial principles to solve real-world problems
5. Protect their intellectual property.

COURSE CONTENT

INNOVATION AND ENTREPRENEURSHIP	**Semester:**	**IV**
Teaching Scheme:		
Lectures:	**2 hours/week**	

Unit–I:	**No. of Lectures: 06 Hours**	**Marks: 12**

Introduction to Innovation and Entrepreneurship

Defining innovation, Types of innovation: incremental, radical, disruptive, The innovation process, Factors that drive innovation, Defining entrepreneurship, The entrepreneurial process, Fundamentals of Entrepreneurship: Characteristics and Skills, Difference Between Invention and Innovation, Role of Technology in Driving Innovation.

Unit–II:	**No. of Lectures: 06 Hours**	**Marks: 12**

Idea Generation and Prototyping

Techniques for brainstorming and generating ideas, Creativity Models: SCAMPER, Brainstorming, Design Thinking, Problem Identification: Customer-Centric Approach, Ideation Process: Tools and Techniques, Developing and Testing Prototypes, Different prototyping methods and tools, Creating low-fidelity and high-fidelity prototypes, User testing and feedback collection.

Unit–III:	**No. of Lectures: 06 Hours**	**Marks: 12**

Entrepreneurial Process and Business Model Development

Identifying Opportunities in Technology-Based Markets, Technical, Financial, and Market Feasibility, Legal and Ethical Issues in Entrepreneurship, Intellectual Property Rights (IPR), Patents, Copyrights, and Trademarks.
Business Model Canvas: Value Proposition, Customer Segments, and Revenue Streams, Prototyping and Minimum Viable Product (MVP) Development. Pitching an Idea: Structuring and Delivering a Persuasive Presentation, Funding Options: Bootstrapping, Venture Capital, and Crowd funding

Unit–IV:	**No. of Lectures: 06 Hours**	**Marks: 12**

Technology and Innovation Ecosystem

Business Plan Development: Components and Stages in Business Plan Development, Validation of Business Opportunity: Application of Market Research Tools at the Early Stage of Startup.
Role of Technology in Startup Growth, Overview of Startup Incubators and Accelerators Government Policies and Schemes Supporting Entrepreneurship in India (e.g., Startup India, Make in India), Global Perspectives on Technology-Driven Startups.

Unit–V:	**No. of Lectures: 06 Hours**	**Marks: 12**

Start-up and its working

Start-ups, Definition, requirements, company act, opportunities and schemes, benefits of start up formation, start-up registration process., funding opportunities, incubators and accelerators roles, responsibilities and partnership, infrastructure. Funding, government schemes, Case Studies of Innovative Companies, Analysis of Successful Technology Startups (Google, Infosys, Flipkart, etc.)

Text Books:

1. Bruce R. Barringer and R. Duane Ireland, "Entrepreneurship: Successfully Launching New Ventures" 7th Edition, Publisher: Pearson, April 16, 2024, ISBN-13: 978-0138287696.
2. 8 Steps To Innovation: Going From Jugaad To Excellence, Collins India, 2013. ISBN: 9789350293584.

Reference Books:

1. Innovation and Entrepreneurship, Peter F. Drucker, Harper Business; Reprint, 2006, ISBN: 9780060851132.
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Currency; Illustrated, 2011. ISBN: 9780307887894.
3. Innovator's DNA, Updated, with a New Preface: Mastering the Five Skills of Disruptive Innovators, Harvard Business Review Press; Revised, 2019. ISBN: 1633697207.
4. Problem-Solving", Penguin Random House India Pvt. Ltd. 2020, ISBN: 9780670094097
5. HBS series on Innovation and Entrepreneurship

NPTEL Links:

1. Innovation and Start-up Policy By Prof. Rahul K. Mishra | IILM Institute for Higher Education, https://onlinecourses.swayam2.ac.in/imb20_mg22/preview
2. Innovation, Business Models and Entrepreneurship, By Prof . Rajat Agrawal and Prof. Vinay Sharma | IIT Roorkee , https://onlinecourses.nptel.ac.in/noc19_mg55/preview
3. Design Thinking - A Primer, By Prof. Ashwin Mahalingam & Prof. Bala Ramadurai | IIT Madras, https://onlinecourses.nptel.ac.in/noc19_mg60/preview
4. Introduction to Intellectual Property By KAPILA IPR committee | IIT Kharagpur, https://onlinecourses.swayam2.ac.in/aic21_ge20/preview

Students must submit ICA in the form of journal. Concerned faculty member should suitably frame **FIVE** assignments based on the above syllabus. Faculty in charge will assess the assignments continuously, and grade or mark each assignment on completion date declared for each assignment.

ENVIRONMENTAL SCIENCES					
COURSE OUTLINE					
Course Title:	**ENVIRONMENTAL SCIENCES**	**Short Title:**	**EVS**	**Course Code:**	**AIDS-411**

Course description:
The course aims to percolate the importance of environmental science and environmental studies.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	02	15	30	02

Prerequisite course(s):

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. Integrate the knowledge on human interactions with the environment and problems associated with it
2. Analyze the importance of renewable and non-renewable natural resources
3. Learn the fundamentals of ecosystem
4. Learn and conserve the biodiversity and its conservation
5. Analyze the relation between social issues and the environment

Course outcomes:

After successful completion of this course the student will be able to:

1. Evaluate the effectiveness of various environmental policies and practice them as life-long learning
2. Develop the strategies for effective waste management and resource conservation
3. Articulate the interconnected, and interdisciplinary nature of environmental studies
4. Evaluate the local and global scale of environmental problems
5. Communicate complex environmental information to both technical and non-technical audiences.

COURSE CONTENT

ENVIRONMENTAL SCIENCES		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**End Semester Examination (ESE) UA:**	**25 marks**

Unit I	**No. of Lectures: 08 Hours**	**5 Marks**

Multidisciplinary Nature of Environmental Studies and Social Issues

Definition, scope and importance multidisciplinary nature of environmental studies and need for public awareness, From Un sustainable to Sustainable development, Water conservation, rain water harvesting, water shed management, Resettlement and rehabilitation of people; its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions.
Climate change, global warming, acid rain, ozone layer depletion, nuclear
Accidents and holocaust. Case Studies. Waste land reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act Wild life Protection Act Forest Conservation Act Issues involved in enforcement of environmental legislation. Public awareness.

Unit II	**No. of Lectures: 05 Hours**	**5 Marks**

Natural Resources

Renewable and non-renewable resources

Natural resources and associated problems.
Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people

Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
Role of an individual in conservation of natural resources.
Equitable use of resources for sustainable lifestyles

Unit III	**No. of Lectures: 08 Hours**	**5 Marks**

Ecosystems, Biodiversity and their Conservations

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the ecosystem like Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries), Introduction–Definition: genetic, species and ecosystem diversity, Bio geographic classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-sports of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

Unit IV	**No. of Lectures: 05 Hours**	**5 Marks**

Environmental Pollution

Definition, Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

Unit V	**No. of Lectures: 04 Hours**	**5 Marks**

Human, Population and the Environment

Population growth, variation among nations. Population explosion–Family Welfare Program, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Reference Books:

1. Agarwal, K. C.2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd. Ahmedabad – 380 013, India, Email: mapin@icenet.net (R)
3. BrunnerR.C.,1989, Hazardous Waste Incineration, McGrawHillInc.480p
4. Clark R. S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
6. De A. K. Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment (R)
8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev. Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
9. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
10. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge

Univ. Press 1140p.
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
12. Mckinney, M. L. & School, R. M.1996.EnvironmentalSciencesystems&Solutions, Web Enhanced edition.639p.
13. Mhaskar A. K. Matter Hazardous, Techno-Science Publication (TB)
14. Miller T. G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
15. Odum, E. P.1971. Fundamentals of Ecology.W.B.SaundersCo.USA,574p
16. Rao M N. &Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
17. SharmaB.K.,2 001.Environmental Chemistry. Geol Publ. House, Meerut
18. Survey of the Environment, The Hindu (M)
19. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Second Year Bachelor of Engineering

in

(Common for all)

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

कवयित्री बहिणाबाई चौधरी उत्तर महाराष्ट्र विद्यापीठ
अंतरी पेटवू ज्ञानज्योत
1990
'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE FOR OPEN ELECTIVE - II

For Affiliated Colleges

Semester – IV

W.E.F. 2025 – 26

Open Elective - II

A Student can opt for any one subject out of available institute wide subjects defined in the following list as Open Elective provided, he/she has not taken that particular subject in his/her Programme core, Programme elective, Multidisciplinary Minor, other Open elective and Vocational and Skill Enhancement courses etc. throughout his / her four years of UG Engineering Programme. The student must opt a subject that is compulsorily from faculty other than that of the Major discipline.

Course Code	Name of the Subject / Course	Faculty Offered by	Department Offered by
Open Elective - II (w.e.f. 2025 - 26 at Semester - IV, Second Year Engineering)			
OE – 407 A	Human Resource Management	Comm. & Mgmt.	Management
OE – 407 B	Logical Reasoning and Problem Solving	Sci. & Tech.	Mathematics
OE – 407 C	Retail Management	Comm. & Mgmt.	Commerce
OE – 407 D	Public Health and Hygiene	Sci. & Tech.	Zoology
OE – 407 E	Agricultural Pest Management	Sci. & Tech.	Zoology
OE – 407 F	Basics of Stock Markets	Comm. & Mgmt.	Commerce
OE – 407 G	Problems of Philosophy	Humanities	Philosophy
OE – 407 H	Social and Preventive Pharmacy	Sci. & Tech.	Pharmacy

HUMAN RESOURCE MANAGEMENT (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**HUMAN RESOURCE MANAGEMENT**	**Short Title:**	HRM	**Course Code:**	**OE – 407 A**

Course description:

This course provides a comprehensive understanding of Human Resource Management (HRM), including key functions such as talent acquisition, performance management, training and development, and compensation management. It also covers emerging trends like AI in HR, digital HR, people analytics and sustainable HRM practices.

Lecture	Hours/week	No. of weeks	Total hours	Semester credits
	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to impart knowledge so that the student will:

1. To understand the fundamental principles and functions of HRM.
2. To analyse workforce planning, recruitment, selection, and retention strategies.
3. To evaluate performance management systems, appraisal techniques, and key HR metrics.
4. To assess training and development programs to enhance employee skills and productivity.
5. To explore digital HR, work-life balance, compensation strategies, and sustainable HRM practices.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain HRM concepts and their significance in business operations.
2. Apply talent acquisition and retention strategies in an organizational context.
3. Implement performance appraisal and feedback systems effectively.
4. Develop employee training and development programs for career growth.
5. Utilize modern HR tools and technologies to enhance organizational efficiency.

COURSE CONTENT

HUMAN RESOURCE MANAGEMENT		Semester:	IV
Teaching Scheme:		**Examination scheme**	
Lectures:	**4 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Basics of Human Resource Management

Introduction to HRM: Meaning, Definitions, Nature and Objectives,
Functions of HRM: Managerial and Operative Functions
Differences between HRM, Personnel Management, and HRD
Role of HR Managers: Skills, Qualities, and Future Challenges
Emerging Trends: AI in HR, Digital HR, and People Analytics

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Talent Acquisition and Management

Human Resource Planning (HRP): Concept, Need, Characteristics, Benefits, Process.
Recruitment: Concept, Purpose, Sources, and Process
Selection: Concept, Process, Selection Tests, and Barriers
Placement: Concept and Problems
Induction/Orientation: Concept, Objectives, Steps, Problems
Promotion, Demotion, Transfer, Layoff, Downsizing, Rightsizing, and

Voluntary Retirement Scheme (VRS)		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Performance Management and Appraisal		
Performance Management: Concept, Objectives, and Modern Approaches Performance Appraisal: Concept, Need, and Importance Performance Appraisal: Traditional Methods and Modern Methods Key Performance Indicators (KPIs) and Balanced Scorecard Approach Bias in Performance Appraisal: Types and Ways to Mitigate Legal and Ethical Issues in Performance Appraisal		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Training and Development		
Definitions, Need, and Objectives of Training & Development Concept and Importance of Executive Development Training Methods: On-the-Job and Off-the-Job Methods, Virtual Learning and E-Learning Platforms Evaluating Training Effectiveness: Tools and Models Difference between Training, Development, and Education Career Development and Succession Planning		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Advanced HRM Practices		
HRM in the Digital Age: HRIS (Human Resource Information System) and Digital Transformation Work-Life Balance: Flexible Work Models, Hybrid Work, and Employee Wellbeing Compensation Management: Wage and Salary Administration, Incentives, and Benefits Sustainable HRM: Green HRM, Corporate Social Responsibility (CSR) in HR, and Ethical HRM		
Text Books:		
1. "Human Resource Management: Text and Cases" by Dr. V.S.P. Rao (Excel Books)		
Reference Books:		
1. Human Resource Management By Dr. Shikha Kapoor - Taxmann 2. Human Resource Management By Dr K. Ashwathappa – Tata McGraw Hill 3. Essentials of Human Resource Management By P. SubbaRao – Himalaya Publishing House 4. HR From the Outside In: Six Competencies for the Future of Human Resources – 5. Boudreau & Cascio - McGraw-Hill Education- ISBN: 978-0071790351		
NPTEL Links: 1. Principles of HRM by Prof. Aradhna Malik https://archive.nptel.ac.in/courses/110/105/110105069/ 2. Talent Acquisition and Management by Prof. Santosh Rangnekar http://kcl.digimat.in/nptel/courses/video/110107152/L19.html 3. Performance & Reward Management by Prof Susmita Mukhopadhyay https://archive.nptel.ac.in/courses/110/105/110105137/ 4. Training and Development by Prof. Susmita Mukhopadhyay and Prof. S. Srinivasan https://onlinecourses.nptel.ac.in/noc22_hs63/preview		

LOGICAL REASONING AND PROBLEM SOLVING (Open Elective – II)					
COURSE OUTLINE					
Course	**LOGICAL REASONING AND PROBLEM**	**Short**	LRPS	**Course**	**OE – 407 B**

Title:	**SOLVING**	**Title:**		**Code:**	

Course description:

The Logical Reasoning course is designed to enhance a student's ability to think critically and make reasoned judgments through structured and logical thought processes. This course focuses on developing key skills required to analyze patterns, relationships, and arguments, which are essential for solving complex problems. Throughout the course, students will be exposed to various types of logical reasoning problems, including deductive and inductive reasoning, analogies, sequences, and puzzles.

Lecture	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**
	03	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

1. Course will provide an introduction to logical and philosophical reasoning.
2. To enhance the analytical skill and problem solving skill of the students.
3. To improve verbal and non-verbal reasoning ability skill of the students

Course outcomes:

After successful completion of this course the student will be able to:

1. Choose analogy and classification, and perform coding and decoding on data
2. Evaluate arguments, identify assumptions, and recognize logical fallacies, strengthening their ability to think critically and make informed decisions.
3. Recognize logical reasoning applicable to real-life situations and solve real-life problems
4. Apply critical thinking in analyzing number patterns, ranks, and time sequences, fostering decision-making skills that are crucial for problem-solving.
5. Develop the ability to identify and interpret visual patterns and sequences.

COURSE CONTENT

LOGICAL REASONING AND PROBLEM SOLVING		**Semester:**	**IV**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Analogy : Completing the analogous pair, Direct/ Simple Analogy, Choosing the analogous pair, Double Analogy Choosing a similar word, Detecting Analogies, Multiple word analogy, Number analogy, Alphabet Analogy

Classification : Choosing the odd word, Choosing the odd pair of word, Choosing the odd numeral, Choosing the odd numeral pair/ group

Coding and Decoding : Letter coding, Direst letter coding, Number/ Symbol Coding, Matrix Coding , Substitution, Deciphering message word codes, Deciphering number and symbol codes for messages.

Blood relations: Deciphering jumbled up descriptions, Relation puzzle, Coded relations

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Direction sense Test : Directions and Cardinal Directions , Direction puzzle

Logical Sequence of words : Sequence in process , Sequence in object formation

Data Sufficiency : Yes/No Questions, Value Questions

Verification of Truth of the Statement: Relationship with the thing mentioned.

Sequential Output Tracing

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Logic : Logical Reasoning, Logical Deduction , Two- Premise Arguments, Three-Premise Arguments **Statement – Arguments :** Strong arguments and weak Arguments **Statement –assumption :** Type 1- implicit statement, Type2-Implicit in Context **Statement –Conclusions :** Direct / indirect implications of conclusions **Cause and Effect Reasoning**		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Logical Venn Diagrams: Type 1, Type 2 **Number, Ranking and Time Sequence Test:** Type 1: Number Test, Type 2: Ranking Test, Type 3: Time Sequence Test **Mathematical Operations** Type 1: Problem-Solving by Substitution, Type 2: Interchange of Signs and Numbers, Type 3: Deriving the Appropriate Conclusions **Arithmetical Reasoning:** Type 1: Calculation-Based Problems, Type 2: Data-Based Questions, Type 3: Problems on Ages, Type 4: Venn-Diagram Based Questions		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
NON-VERBAL REASONING: **Classification:** Choosing the Odd Figure, Choosing a Similar Figure, Finding Figures with the Same Characteristics, **Analytical Reasoning** **Mirror-Images** : Mirror-Images of Capital letters, Small letters, Numbers and figures **Water-Images :** Water-Images of Capital letters, Small letters, Numbers and figures **Cubes and Dice :** 2D and 3D cubes, Number opened dice and Letter opened dice		
Text Books:		
1. Dr. R.S. Aggarwal "A Modern Approach to Verbal & Non-Verbal Reasoning" by S. Chand Publication.		

RETAIL MANAGEMENT (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**RETAIL MANAGEMENT**	**Short Title:**	R M	**Course Code:**	**OE – 407 C**
Course description:					
This course provides an in-depth understanding of retail management, covering key concepts such as retail formats, consumer behavior, supply chain management, and e-retailing. It explores the role of technology in retail, sustainable business practices, and emerging retail trends. The course equips students with the knowledge and skills required to manage retail operations efficiently and explore entrepreneurial opportunities in the retail sector.					

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

The objective of this course is to:

6. Understand the fundamentals of retailing, consumer behavior, and key retail formats.
7. Analyze retail operations, supply chain management, and technology integration in retail.
8. Apply e-retailing strategies and digital innovations to enhance customer experience.
9. Evaluate sustainable and ethical retail practices and their impact on business.
10. Develop entrepreneurial skills by exploring emerging trends and business opportunities in retail.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the core concepts, significance, and evolution of retailing.
2. Analyze retail supply chain, store operations, and digital retail transformations.
3. Apply technology-driven solutions like AI, IOT, and block chain in retail management.
4. Evaluate sustainable retail models and ethical business practices.
5. Develop innovative retail business strategies and entrepreneurial ventures.

COURSE CONTENT

RETAIL MANAGEMENT		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Retailing

Retailing: Definition, significance, and evolution
Retail formats, business models, and ownership structures
Consumer behavior and purchase decision-making
Key drivers of retail growth in India and globally

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Retail Organization and Supply Chain Management

Store location, layout, and visual merchandising
Inventory control, logistics, and warehouse management
POS systems, cash handling,
Role of automation in retail operations

Unit-III	**No. of Lectures: 09 Hours**	**Marks: 12**

E-Retailing and Digital Transformation

Growth of e-commerce and omnichannel retailing
AI, IoT, and blockchain applications in retail
Customer data management and personalized marketing strategies
Role of AR/VR in enhancing customer experience
Cybersecurity and data privacy in online retailing

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Sustainable and Ethical Retailing		
Sustainability and green retailing practices Ethical sourcing and fair trade in retail Waste management and circular economy in retail Impact of government policies and regulations on retailing		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Future Trends and Entrepreneurship in Retail		
Retail analytics and business intelligence for decision-making Startups and innovation in retail entrepreneurship Franchising and global retail expansion Emerging trends: Quick commerce, Direct-to-Consumer (DTC) models Case studies on innovative retail success stories		
Text Books:		
1. "Retailing Management – Text and Case" (7th Edition) by Swapna Pradhan, Tata McGraw Hill		
Reference Books:		
1. Suja Nair, Retail Management, 2011 Edition, Generic, 2015. 2. R. S. Tiwari, Retail Management, Himalaya Publishing House. 3. Francois Chaubard, AI for Retail: A Practical Guide to Modernize Your Retail Business with AI and Automation, Wiley, 2023 4. Michael Levy, Barton A. Weitz and, Dhruv Grewal Professor Retailing Management, McGraw Hill; 10th edition (4 January 2018) 5. Gibson G. Vedamani, "Retail Management- Functional Principles and Practices", Jaico Publishing House, Mumbai.		
NPTEL Links: 1. Retail Management by By Prof. Swagato Chatterjee, IIT Kharagpur. https://onlinecourses.nptel.ac.in/noc25_mg56/preview		

PUBLIC HEALTH AND HYGIENE (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**PUBLIC HEALTH AND HYGIENE**	**Short Title:**	**PHH**	**Course Code:**	**OE – 407 D**
Course description:					
This course provides a comprehensive understanding of public health and hygiene practices, exploring their significance in preventing disease, promoting well-being, and improving the quality of life for individuals and communities. Students will learn about the principles and strategies involved in maintaining public health, the role of hygiene in disease prevention, and the impact of environmental and behavioral factors on health.					
	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**	

	03	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

1. Gain knowledge of common food-borne and water-borne diseases (causes, symptoms, transmission), and apply strategies for prevention and control.
2. To impart basic and technical knowledge on nursery management for strengthening of horticulture sector.
3. To study the disease and pest controlling nursery with practical experience.

Course outcomes:

1. Demonstrate the ability to design balanced meal plans considering calorie needs and dietary requirements for different individuals and life stages.
2. Effectively communicate the causes, symptoms, and prevention strategies for common food-borne and water-borne diseases.
3. Competently demonstrate essential personal hygiene practices and advocate for social hygiene initiatives in the community.
4. Articulate the negative health consequences of unhealthy habits and positively promote physical activities like cycling and walking, stress management techniques (yoga), and responsible family planning methods.
5. Develop an understanding of nutrition principles, balanced diets, and dietary needs for different life stages (infants, children, adults, pregnancy, lactation), promoting healthy eating practices for disease prevention.

COURSE CONTENT

PUBLIC HEALTH AND HYGIENE		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Nutrition and health:

Introduction: Scope and importance of Public health and hygiene. Balanced diet, diet control for diabetics and cholesterol, etc. Concept of energy, calories, daily food intake as per occupation, pregnancy and lactation. Dietary requirements of infants, pre-school children, schoolchildren, adults.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Health Hazards:

Health dynamicity – definition, factors influencing health, health as a medium of socio-economic development. Diseases – Common food borne and water borne diseases (jaundice, cholera, diarrhea and typhoid) – causative agents, symptoms, mode of transmission, prevention and control.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Health hygiene:

Personal hygiene, body odour, oral hygiene and sexual hygiene, grooming, feminine hygiene, sleep hygiene, hand washing, toiletry. Social hygiene – clean living movements, occupational hygiene, food and cooking hygiene, medical hygiene, excessive hygiene.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12
Health Education:		
Definition, objectives, principles ,effects of smoking, alcoholism and drug abuse (hashish, opium, brown sugar).Population control and family welfare- use of contraceptives Importance of Body fitness Importance of cycling and walking exercise. Stress reduction management – Importance of yoga Sickle Cell Disorder.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Healthy Lifestyle:		
Lifestyle habits ,Balanced Diet , Stress Management**,** Benefits of a Healthy Lifestyle, Excessive usage of T.V., computer, mobile phones, two wheelers, and their impacts on health.		
Text Books:		
1. "Essentials of Public Health and Sanitation – Part I- IV" by Jatin V. Modi and Renjith S. Chawan.		
Reference Books:		
1. Murray, C. J. L. and A.D. Lopez. (1996), The Global Burden Of Disease. World Health Organization. 2. Park, J.E. and Park, K. Textbook of Community Health for Nurses. 3. Swaminathan S. Principles of Nutrition and Dietetics.		
NPTEL Links: 1. **One Health-**By One Health InstructorsICMR - Regional Medical Research Centre, Bhubanesw (One Health - Course (nptel.ac.in) 2. **Basics of Health Promotion and Education Intervention** By Dr. Arista Lahiri, Dr. Sweety Suman Jha, Dr. Madhumita Dobe, Dr. Chandrashekhar Taklikar | IIT Kharagpur, IIT Kharagpur, AIIH&PH, Kolkata, AIIH&PH, Kolkata (Basics of Health Promotion and Education Intervention - Course (nptel.ac.in))		

AGRICULTURAL PEST MANAGEMENT (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**AGRICULTURAL PEST MANAGEMENT**	**Short Title:**	APM	**Course Code:**	**OE – 407 E**
Course description:					
This course provides a comprehensive understanding of the tactics and practices of managing pests in agricultural systems. It covers the identification, biology, and ecology of common agricultural pests. Students will learn integrated pest management (IPM) strategies that combine biological, cultural, physical, and chemical control methods to minimize pest damage while promoting environmental sustainability and economic viability**.**					
	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**	

Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Biology, Environmental Science

Course objectives:

The objective of this course is to:

1. To understand agricultural pest management.
2. To learn economic impacts of integrated pest management and decision making.
3. To improve the biological precepts and sampling for detection convey.
4. To learn management of insect pests of cotton and rice.
5. To understand management of insect pests of vegetable crops and oilseeds.

Course outcomes:

After successful completion of this course the student will be able to:

1. Apply the concept of agricultural pest management.
2. Co-relate the economic impacts of integrated pest management and decision making.
3. Acquire skill of the biological precepts and sampling for detection.
4. Illustrate the management of insect pests of Cotton and rice.
5. Demonstrate and analyse the management of insect pests of vegetable crops and oilseeds.

COURSE CONTENT

AGRICULTURAL PEST MANAGEMENT		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

The IPM paradigm: concepts, strategies and tactics and Economic impacts of IPM

Historical perspectives, Early conceptual efforts in Integrated Pest Management (IPM} development, Kinds of pests, Pest management strategies and tactics, Funding IPM research and implementation, Measuring IPM implementation. Economic impacts of IPM: Measuring IPM adoption, Individual economic impacts to the IPM user, Analyzing typical adoption cases using budgets, Analyzing optimal IPM decisions, Aggregate or market-level economic impacts of IPM, 1 Capturing price effects when IPM impacts are large, Aggregating economic impacts over time, Valuing health and environmental impacts.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Economic decision rules for IPM and Decision making and economic risk in IPM

Economic decision rules for IPM: Economic decision levels, The EIL, The ET, Development of EILs and ETs, Current approaches, Limitations to EILs and ETs. Decision making and economic risk in IPM: Defining IPM within a management context, Economic injury level (EIL) and economic threshold (ET), Risk and IPM, Representing risky situations, Decision making criteria and tools, Risk preferences defined.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

IPM as applied ecology-the biological precepts and Sampling for detection, estimation and IPM decision making

IPM as applied ecology-the biological precepts: Life systems, Pest population dynamics, Stochastic models and meta populations, Population structure and life tables, Population stability and species diversity, Open and closed ecosystems, Scale and ecologically based pest management Sampling for detection, estimation and IPM decision making: Basics of sampling, Necessary sample size, Detection sampling, Estimation sampling, Decision sampling.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Management of Insect Pest of Cotton and Rice

Management of Insect Pests of Cotton: Introduction Changing Insect Pest Scenario, Cultural, Mechanical, and Physical Control, Microbial Control, Biological Control, Botanical Control, Chemical Control, Integrated Pest Management. Management of Insect Pests of Rice: Introduction, Component of Integrated

Pest Management, Cultural Methods, Biological Control, Behavior modifying chemicals, Botanical Bio pesticides.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Management of Insect Pests of Vegetable Crops and Oilseeds		
Management of Insect Pests of Vegetable Crops in Net House: Introduction, Physical Control, Cultural Control, Mechanical Control, Biological Control, Botanical Control. Management of Insect Pests of Oilseeds Crops: Rapeseed-Mustard, Sunflower, Groundnut, Sesamum, Linseed.		
Textbooks:		
1. "Integrated Pest Management, Concepts, Tactics, Strategies and Case Studies" by Edward B. Radcliffe, William D. Hutchison, Rafael E. Cancelado, Cambridge Publishing. 2. "Theory and Practice of Integrated Pest Management" by Ramesh Arora, Balwinder Singh, A.K. Dhawan, Scientific Publisher.		
Reference Books: 1. "Integrated Pest Management for Crops and Pastures" by Paul Horne, Jessica Page, Land Links Publishing 2. "Encyclopedia of Pest Management" Volume II, by Devid Pimentel, CRC Press Taylor and Francis Group Publishing.		
NPTEL Links: 1. Integrated Pest Management (IPM) by IIT Kanpur. https://archive.nptel.ac.in/courses/126/104/126104003/		

BASICS OF STOCK MARKETS (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**BASICS OF STOCK MARKETS**	**Short Title:**	BSM	**Course Code:**	**OE – 407 F**
Course description:					
This course introduces students to the fundamental concepts of stock markets, investment avenues, and trading mechanisms. It covers the structure and functioning of Indian financial markets, types of securities, stock trading strategies, mutual funds, and regulatory frameworks. The course also emphasizes investor protection measures, risk management, and financial literacy to enable informed decision-making in stock market investments.					
	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**	
Theory	**03**	**15**	**45**	**03**	
Prerequisite course(s):					
Course objectives:					
The objective of this course is to: 1. Remember and define the fundamental concepts of stock markets and various investment instruments. 2. Understand the structure, organization, and functioning of financial markets in India.					

3. Apply knowledge of primary and secondary market operations, trading mechanisms, and investment avenues.
4. Analyze stock trading strategies, risk-return factors, and investor protection measures.
5. Evaluate the role of regulatory bodies and ethical investment practices in the stock market.

Course outcomes:

1. After successful completion of this course the student will be able to:
2. Describe the functioning and significance of stock markets in the Indian financial system.
3. Classify different types of investment instruments and explain their characteristics.
4. Examine stock trading mechanisms, market indices, and risk-return factors.
5. Develop basic investment strategies and assess stock market operations.

COURSE CONTENT

BASICS OF STOCK MARKETS		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction

Saving vs Investment – Understanding the Need for Investment
Types of Investment Instruments – Equity Shares, Preference Shares, Bonds, Debentures, Government Securities, Sovereign Gold Bonds
Overview of Stock Exchanges – BSE, NSE & Their Indices
Difference Between Trading & Investment in Stock Market

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Types of Market and Derivatives

Types of Markets – Primary & Secondary Markets
Primary Market – IPO, Credit Rating Agencies, Underwriting, Grey Market
Secondary Market – Stock Brokers, Sub Brokers, Listing of Shares, Depositories
Basics of Derivatives – Futures, Options, Call & Put, Commodity & Financial Derivatives

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Mutual Funds and Investment Avenues

Concept and Advantages of Mutual Funds
Types of Mutual Funds – Equity, Debt, Liquid, Hybrid, Growth, Income, Tax-Saving, Pension Funds
Role of Asset Management Companies (AMCs) and Fund Managers
Factors to Consider Before Investing in Mutual Funds

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Stock Trading and Investment Strategies

Basics of Stock Trading – How to Open a Demat & Trading Account
Stock Order Types – Market Order, Limit Order, Stop Loss, Intraday Trading
Understanding Stock Market Indices and Their Importance
Risk & Return Analysis – Concept of Diversification, Systematic vs. Unsystematic Risk

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Regulatory Framework & Investor Protection

Role of SEBI (Securities and Exchange Board of India) in Stock Market Regulation

Investor Protection Mechanisms – Grievance Redressal, Investor Rights & Duties Common Stock Market Frauds & Scams – Insider Trading, Pump & Dump Schemes Overview of Taxation on Stock Market Investments – Capital Gains Tax, Securities Transaction Tax

Text Books:

1. Prasanna Chandra, "Investment Analysis and Portfolio management", Tata McGraw Hill,3rd Edn., 2008
2. Julian Walmsley, "New Financial Instruments", John Wiley & Sons, 2nd edition, Inc 1998
3. PunithavathyPandian, Security Analysis and Portfolio Management, 2nd edition, Vikas Publishing House Pvt. Ltd., 2013
4. Dhanesh Khatri, Security Analysis and Portfolio Management, 1st edition, MacMillan Publishers, 2010

Reference Books:

1. Bharati V. Pathak, " The Indian Financial System: Markets, Institutions and Services", Pearson education, 3rd edn.
2. Bhole I. M.: "Financial Markets and Institutionals": Tata McGraw Hill, New Delhi.
3. Chandler M. V. and Goldfeld S. M: Economics of Money and Banking: Harper and Row, New York.
4. Edwin J. Elton, Martin J. Gruber, Modern Portfolio Theory and Investment Analysis, 8 th edition, John Wiley & Sons, 2010
5. SEBI Manual, 33rd edition, Taxmann Publications, 2019
6. Shashi K Gupta, Security Analysis Portfolio Management, 1st edition, Kalyani Publishers, 2010

NPTEL Links:

1. **Financial Institution and Market**
   https://archive.nptel.ac.in/courses/110/105/110105121/

PROBLEMS OF PHILOSOPHY (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**PROBLEMS OF PHILOSOPHY**	**Short Title:**	POP	**Course Code:**	**OE – 407 G**

Course description:

This course explores some of the central questions and issues in philosophy, designed to introduce students to fundamental philosophical problems and to develop their critical thinking skills. The course covers a broad range of topics, including metaphysics, epistemology, ethics, philosophy of mind, philosophy of language, and political philosophy. Students will examine classic and contemporary texts by influential philosophers, critically analyze their arguments, and engage with different philosophical traditions.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Lecture	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

1. To provide knowledge of philosophical Theories
2. To create awareness about Indian and western Philosophy .
3. To understand Theory's Problem of Change, Problem of Self,Problem of Values

4. To understanding various Self of Philosophy
5. Help students understand key ethical dilemmas and encourage thinking about how philosophy informs moral decisions, ethical theory, and the application of ethical principles in real-world situations.

Course outcomes:

1. Students will understand knowledge of philosophical Theories
2. Students will understand about Problem of Change, Problem of Self.
3. Students will to understand Values
4. Students will to understand theory of causation
5. Developing the ability to critically analyze and evaluate philosophical arguments, identifying strengths and weaknesses in reasoning.

COURSE CONTENT

PROBLEMS OF PHILOSOPHY		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Nature of Philosophy:

Concept and definition of Philosophy according to Empiricism, Rationalism, Advait Vedanta, Buddhism. Scope of Philosophy in relation to Natural Sciences, Social Sciences, Political Science, Economics and Sociology, Religion.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Problem of Knowledge:

Western approach of Empiricism and Rationalism (Locke and Leinbnitz) , Indian approach of Empiricism and Rationalism (Charvaka and Nyaya) ,Sources of knowledge, Perception , Inference , Intuition , Testimony.

Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**

Problem of Change:

Concept of change and permanence , Theories of change and causation Satkaryavad (Samkhya) Arambhavada (Nyaya), Aristotle's four fold theory of causation, Hume's theory of causation, and Mill’s concept of causation.

Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**

Problem of Self

Nature of Self, Concept of self-according to Plato ,Descartes ,Samkhya ,Buddhism

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Problem of Values

Nature of values and their role in human life, Kinds of values ,Moral ,Aesthetic Problem of Truth, Correspondence Theory of Truth ,Coherence Theory of Truth ,Pragmatic Theory of Truth.

Text Books:

1. “The problems of philosophy” by Russell, B. (1959) New York, Oxford University Press.

Reference Books:

1. Moore G. E.-Some Main Problemsof Philosophy
2. Durant Will-The Pleasures of Philosophy
3. Hawking W. E- Types of Philosophy
4. Ewing A. C.-The Fundamental Questions of Philosophy
5. Ayer A. J.-The Central Questions of Philosophy

NPTEL Links:

1. **Philosophy and Critical Thinking-**By Prof. Gyan Prakash | Indian Institute of Technology (Indian School of Mines), Dhanbad, India
   Philosophy and Critical Thinking - Course (nptel.ac.in)
2. **Indian Philosophy-Prof. Satya Sundar Sethy** is a Professor in the Department of Humanities and Social Sciences, IIT Madras.
   Indian Philosophy - Course (nptel.ac.in)

SOCIAL & PREVENTIVE PHARMACY (Open Elective – II)					
COURSE OUTLINE					
Course Title:	**SOCIAL & PREVENTIVE PHARMACY**	**Short Title:**	SPP	**Course Code:**	**OE – 407 H**

Course description:

This course is designed to impart basic knowledge on public health, epidemiology, preventive care and other social health related concepts. Also, to emphasize the roles of students in the public health programs.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	**03**	**15**	**45**	**03**

Prerequisite course(s):

Course objectives:

1. The objective of this course is to:
2. Preventive healthcare.
3. Public health and national health programs.
4. Food and nutrition related health issues.
5. Health education & social promotion of maintenance of health.

Course outcomes:

1. After successful completion of this course the student will be able to:
2. Describe various sources of health hazards and disease preventive measures.
3. Discuss the health care issues associated with food and nutritional substances.
4. Describe the general roles and responsibilities of students in public health.
5. Create awareness so that health status of society can be raised.

COURSE CONTENT

SOCIAL & PREVENTIVE PHARMACY		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to social Pharmacy

Definition & Scope: Social Pharmacy as a discipline & its scope in improving public health.
Concept of health: WHO definition, various dimensions, determinants and health indicators.
Public and private health system in India, national health mission.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Environment and Health

Water pollution, importance of safe drinking water, waterborne diseases, air pollution, noise pollution, sewage and solid waste disposal, occupational illness. Psychosocial Pharmacy: Drugs of misuse and abuse- psychotropic, narcotics, alcohol, tobacco products. Social impact of these habits on social health and productivity and suicidal behaviors.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

First Aid

Need for emergency treatment, emergency treatment in shock, snake bite, burns, poisoning, fractures, resuscitation methods.

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Nutrition and Health

Basics of nutrition: Macronutrients and Micronutrients, Importance of water & fiber in diet, Balanced diet, Malnutrition, nutrition deficiency diseases, ill effects of junk foods, caloric & nutrients values of various foods, fortification of food, Introduction to food safety, adulteration of foods, effects of artificial ripening, use of pesticides, genetically modified foods, Dietary supplements, nutraceuticals, food supplements, indications, benefits, Drug –Food interactions.

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Epidemiology

Introduction to epidemiology, and its applications. Understanding the terms epidemic, pandemic, endemic, mode of transmission, outbreak, quarantine, isolation, incubation period, contact tracing, morbidity, mortality, Causative agents, mode of transmission and prevention of following communicable diseases, Respiratory infections- Mumps, Influenza(including Avian-Flu, H1N1, SARA,COVID-19), whooping cough, tuberculosis., Intestinal infections- Viral hepatitis, acute diarrheal disease, typhoid, food poisoning, Arthropod-borne disease- dengue, malaria, chikungunya, STDs, HIV/AIDS.

Text Books:

1. New approach to Social Pharmacy, S.P.S. Khurana Pee Vee publications.
2. A text book of Health Education & Community Pharmacy, Dr. Anees Siddique, Birla publications

Reference Books:

1. Social Pharmacy: Tayler, Geoffrey. Pharmaceutical Press. London.
2. Social Pharmacy: Innovation and Development. Geoff Harding, Sarah Nettleton and Kevin

Taylor. The Pharmaceutical Press.
3. Community Pharmacy Handbook- Jonathan Waterfield.
4. Essentials of Community Medicine- Apracical approach, Hiremath Lalita D, Hiremath Dhananjaya A 2nd Edition, 2012,ISBN: 9789350250440, JAYPEE Publications.

EXIT COURSE

Internship / Apprenticeship:

Internship / Apprenticeship / OJT shall be corresponding to the programme (Major) subject. Internship / Apprenticeship / OJT shall be monitored jointly by faculty and Industry / organization mentor.

The role of a Mentor, nominated by institute, shall be to provide professional/research guidance to the student during the internship. They shall also facilitate networking with other subject matter experts/professionals, which will enhance the internship experience and learning of the students.

Internship / Apprenticeship / OJT corresponding to the programme (Major) subject in Exit course with an external organization / entity is desirable. External organization may be industries, research institutions, University research centers or CSIR laboratories. Internship / Apprenticeship / OJT shall be preferably in offline mode, however online mode may also be permitted.

Preferably the Mini Project in Exit course shall be based on Internship / Apprenticeship / OJT.

Activities under Internship / Apprenticeship / OJT include Project work, Seminar, Industrial Training (excluding credits for Advanced Courses). This can be Industrial / Govt. / NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship / academic / industry research project.

After completion of Internship, students shall prepare a comprehensive report highlighting their learnings and takeaways during the internship period. The students are mandated to give a seminar based on the internship undertaken before an expert committee constituted by the concerned department and the assessment of internship shall be based on the following criteria:

1) Quality and effectiveness of presentation
2) Depth of knowledge and demonstrated skills
3) Variety and relevance of learning experience
4) Practical applications and relationships with concepts taught in the course
5) Internship Report
6) Attendance record, student diary (log), supervisor evaluation

Attendance record shall include daily attendance with IN and OUT time. It shall be signed by Industry supervisor.

Student Diary (log) shall include daily activities carried out by the student during Internship with Task assigned, Activities performed, key learnings etc. It shall be signed by Industry supervisor.

Supervisor evaluation form shall include the following with ratings in FIVE-point scale.

1) Behaviours
2) Performs in a dependable manner
3) Cooperates with co-workers and supervisors
4) Shows interest in work
5) Learns quickly
6) Shows initiative
7) Produces high quality work
8) Accepts responsibility
9) Accepts criticism
10) Demonstrates organizational skills
11) Uses technical knowledge and expertise
12) Shows good judgment
13) Demonstrates creativity/originality
14) Analyzes problems effectively
15) Is self-reliant
16) Communicates well
17) Writes effectively
18) Has a professional attitude
19) Gives a professional appearance
20) Is punctual
21) Uses time effectively

Supervisor evaluation form shall be signed by Industry supervisor.

Mini project:

The student shall carry out a Mini project based on the knowledge acquired during the degree course and/or Internship. The project may be either fully theoretical/practical or involving both theoretical and practical work to be assigned by the guide / mentor / department. The work may also be Study/Survey/Design or R&D work. The work may also be on specified task or project assigned to the students during Internship. The project may also be a sponsored project. The project shall be corresponding to the programme (Major) subject.

Upon completion of the Mini project, the student shall submit project report in the form of hard bound. Assessment for the Mini project shall also include presentation by the student. Assessment of Mini project shall be based on the following criteria:

1) Problem Identification / Project Objectives
2) Methodology / Design
3) Implementation
4) Results and Discussion
5) Conclusion
6) Report
7) Depth of Understanding
8) Presentation

9) Demonstration of the project

****

Honors offered by Artificial Intelligence and Data Science for students of the same Branch of Engineering

In addition to 168 credits of UG Engineering Programmes (Bachelor of Engineering) i.e. Major in which the student has taken admission, a student may opt for Honors in the same Engg. / Tech. discipline / branch / Emerging Areas.

A student is required to study additional 20 credits in the same Engg. / Tech. discipline/ branch / Emerging Areas for Honors distributed over semesters III to VIII.

The total number of credits required for completion of the Honors in the same Engg./ Tech. discipline/ Emerging Areas is 20 credits, in addition to 168 credits in Major.

Students will have to compulsorily choose Honors from the same Engg. / Tech. discipline / branch.

Honors Degree in the Bachelor of Engineering programme shall be awarded to students earning additional total credits of all six semesters from second year to final year, i.e., 20 Credits, in addition to 168 credits or 126 credits respectively. The student admitted in first year must earn 168 credits and 126 credits admitted in lateral entry (admitted after Diploma or B.Sc.) at second year.

Honors offered by Artificial Intelligence and Data Science are as follows.

A. Data Science in Healthcare

B. Visual Computing

C. Business Intelligence

The detail syllabus structure for the same is as follows.

Kavayitri Bahinabai Chaudhari
NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Honors in
Data Science in Health Care
for
Second Year Bachelor of Engineering in
Artificial Intelligence and Data Science
(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE
For Affiliated Colleges
Semester – IV
W.E.F. 2025 – 26

Specialization Honors in "Data Science in Health Care"

Syllabus Structure for Specialization Honors in "Data Science in Health Care": Additional Credit (Semester – III) (w.e.f. 2025 – 26)
(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -311 A	Fundamental of Data Science	PCC	3			3	40	60			100	3
AIDS -312 A	Fundamental of Data Science Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Data Science in Health Care": Additional Credit (Semester – IV) (w.e.f. 2025 – 26)
(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -414 A	Data Analytics in Health Care	PCC	3			3	40	60			100	3
AIDS -415 A	Data Analytics in Health Care Lab	PCC			2	2			25	25 (PR)	50	1

FUNDAMENTALS OF DATA SCIENCE (Honors PCC)					
COURSE OUTLINE					
Course Title:	**FUNDAMENTALS OF DATA SCIENCE (PCC)**	**Short Title:**	FODS	**Course Code:**	**DS–311A**

Course description:
This course provides an introduction to data science with a focus on its applications in health care. It covers fundamental concepts such as data collection, cleaning, and preprocessing, along with exploratory data analysis and visualization techniques. Students will learn the basics of machine learning for health care, including supervised and unsupervised learning methods for disease prediction and patient monitoring.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To provide an understanding of data science concepts and their significance in health care applications.
2. To introduce various data sources in health care, including Electronic Health Records (EHRs) and wearable sensors.
3. To equip students with skills in data collection, cleaning, preprocessing, and feature engineering techniques.
4. To develop proficiency in exploratory data analysis and visualization using tools like Matplotlib, Seaborn, and Tableau.
5. To introduce machine learning techniques for health care, including classification, regression, and clustering models.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the role and importance of data science in health care applications.
2. Identify and process different types of health care data, including structured and unstructured data.
3. Perform data wrangling, missing value imputation, and feature engineering for health data analysis.
4. Conduct exploratory data analysis and visualize health care data insights effectively.
5. Apply machine learning techniques for disease prediction and patient monitoring.

COURSE CONTENT

FUNDAMENTALS OF DATA SCIENCE		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Data Science & Health Care Applications

Overview of Data Science, its importance, and applications.
Introduction to health informatics and digital health care systems.
Data sources in health care: Electronic Health Records (EHRs), clinical trials, wearable sensors.

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Data Collection, Cleaning & Preprocessing

Types of health care data: Structured, unstructured, semi-structured. Data wrangling, missing

value imputation, data normalization. Feature engineering and dimensionality reduction techniques.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Exploratory Data Analysis & Visualization		
Descriptive statistics, probability distributions. Data visualization tools: Matplotlib, Seaborn, Tableau. Case study: EHR visualization and insights.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Machine Learning Basics for Health Care		
Introduction to supervised and unsupervised learning. Regression, classification, and clustering techniques. Application of ML in disease prediction and patient monitoring.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Ethical & Legal Aspects in Health Data Science		
HIPAA, GDPR, and data privacy regulations. Bias in health care data and fairness in AI. Case studies on ethical AI in medicine.		

Text Books:

1. **"**Data Science for Healthcare: Methodologies and Applications" by Chandan K. Reddy, Charu C. Aggarwal, publisher Springer.
2. "Machine Learning for Healthcare" by John R. Mashey, Peter Szolovits, publisher MIT Press.
3. "Python Data Science Handbook" by Jake VanderPlas, publisher O'Reilly.

Reference Books:

1. Joel Grus – Data Science from Scratch: First Principles with Python, O'Reilly Media, 2019.
2. Hadley Wickham & Garrett Grolemund – R for Data Science, O'Reilly Media, 2017.
3. Dhananjay Katre – Data Science for Beginners: A Step-By-Step Guide to Data Science & Machine Learning, BPB Publications, 2021.
4. Thomas Davenport & DJ Patil – Big Data at Work: Dispelling the Myths, Uncovering the Opportunities, Harvard Business Review Press, 2014.
5. Cathy O'Neil & Rachel Schutt – Doing Data Science: Straight Talk from the Frontline, O'Reilly Media, 2013.

NPTEL Links:

1. Economics of Health and Health Care, IIT Kanpur, Prof. Anurag Sengupta https://nptel.ac.in/courses/110104095
2. Data Science and Engineers, IIT Madras, Prof. Ragunathan Rengasamy, Prof. Shankar Narasimhan https://onlinecourses.nptel.ac.in/noc21_cs69/preview

FUNDAMENTALS OF DATA SCIENCE LAB (Honors PCC)					
COURSE OUTLINE					
Course Title:	**FUNDAMENTALS OF DATA SCIENCE LAB (PCC)**	**Short Title:**	**FDSL**	**Course Code:**	**AIDS -312A**

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Practical	02	15	30	1

COURSE CONTENT			
FUNDAMENTALS OF DATA SCIENCE		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**		
		End Semester Examination (ESE)UA (PR):	**25 marks**
		Internal Sessional Exam (ISE) ICA	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame at least **SIX** laboratory assignments

1. Introduction to Data Science and Healthcare Applications: Compare Data Science vs. AI vs. Machine Learning with real-world examples.
2. Identify different healthcare data sources (EHRs, clinical trials, wearable sensors).
3. Work with structured and unstructured healthcare data.
4. Perform data cleaning: Handle missing values, outliers, and inconsistencies.
5. Apply feature engineering and dimensionality reduction techniques.
6. Compute descriptive statistics and visualize data distributions.
7. Use Matplotlib and Seaborn for healthcare data visualization.
8. Implement regression and classification techniques for disease prediction.
9. Apply clustering algorithms for patient segmentation.
10. Train and evaluate models using healthcare datasets.
11. Study data privacy regulations: HIPAA, GDPR, and their impact on AI in healthcare.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.

DATA ANALYTICS IN HEALTH CARE (Honors PCC)					
COURSE OUTLINE					
Course Title:	**DATA ANALYTICS IN HEALTH CARE (PCC)**	**Short Title:**	DAHC	**Course Code:**	**DS–414A**

Course description:
This course provides an overview of health care analytics, covering fundamental concepts, statistical analysis, and advanced machine learning techniques. Students will explore real-world applications, including predictive analytics, medical imaging, and health care robotics. The course also introduces big data frameworks, cloud-based analytics, and IoT-driven health monitoring.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	03

Prerequisite course(s):

Course Objectives:

1. The objective of this course is to:
2. To introduce the fundamental concepts of health care analytics and its role in decision-making.
3. To familiarize students with the health informatics data pipeline, databases, and real-world applications.
4. To provide an understanding of statistical analysis, hypothesis testing, and time series analysis in health care.
5. To equip students with knowledge of predictive and prescriptive analytics, including machine learning and deep learning techniques for medical applications.

Course Outcomes:

After successful completion of this course the student will be able to:

1. Understand the basics of health care analytics, decision-making processes, and real-world applications.
2. Apply statistical analysis techniques, including hypothesis testing and time series analysis, in health care scenarios.
3. Implement machine learning and deep learning models for disease prediction and medical image analysis.
4. Analyze the role of big data frameworks, cloud computing, and IoT in health care data processing.
5. Develop a health care analytics project using modern tools and technologies.

COURSE CONTENT

DATA ANALYTICS IN HEALTH CARE		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Health Care Analytics

Basics of health care analytics and decision-making.

Health informatics data pipeline and databases. Real-world use cases: Predictive analytics, hospital management systems.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Statistical Analysis & Hypothesis Testing		
Hypothesis formulation and A/B testing in health care. Time series analysis for patient monitoring. Statistical tools: R, Python, SPSS.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Predictive & Prescriptive Analytics		
Supervised ML for disease prediction. Deep learning for medical imaging (CNNs, RNNs). Reinforcement learning applications in health care robotics.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Big Data in Health Care		
Introduction to big data frameworks (Hadoop, Spark). Cloud-based health care analytics (AWS, Google Cloud AI). IoT and real-time data analysis from wearables.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Capstone Project & Industry Trends		
Implementing a health care analytics project. Review of latest trends: AI-driven diagnostics, telemedicine, personalized medicine. Future scope and career opportunities in health data science.		
Text Books:		
1. "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement" by Hui Yang, Eva K. Lee, publisher Wiley		
Reference Books: 1. "Big Data and Analytics in Healthcare" by Poonam Tanwar, Vishal Jain, Chuan-Ming Liu, publisher Elsevier. 2. "Python Data Science Handbook" by Jake VanderPlas, publisher O'Reilly.		
NPTEL Links: 1. Exploring Survey Data on Health Care By Prof. Pratap C. Mohanty | IIT Roorkee https://onlinecourses.nptel.ac.in/noc22_hs40/preview 2. Data Analytics with Python By Prof. A Ramesh | IIT Roorkee https://onlinecourses.nptel.ac.in/noc21_cs45/preview		

DATA ANALYTICS IN HEALTH CARE LAB (Honors PCC)					
COURSE OUTLINE					
Course Title:	**Data Analytics in Health Care Lab (PCC)**	**Short Title:**	**DAHCL**	**Course Code:**	**AIDS - 415A**

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Practical	02	15	30	1

COURSE CONTENT			
DATA ANALYTICS IN HEALTH CARE LAB		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical:	**2**		
		End Semester Examination (ESE) UA:PR	**25 marks**
		Internal Continuous assessment (ICA) CA	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame at least **SIX** laboratory assignments

1. Introduction to Data Science in Health Care: Compare Data Science, Health Informatics, and Digital Health with real-world applications.
2. Identify key challenges in health care data analytics.
3. Extract and analyze Electronic Health Records (EHRs) and wearable sensor data.
4. Perform data wrangling, handling missing values, and data normalization.
5. Apply feature selection techniques for health data.
6. Implement Principal Component Analysis (PCA) for dimensionality reduction.
7. Perform statistical analysis on a real-world health care dataset.
8. Create visualizations using Matplotlib, Seaborn, and Tableau.
9. Implement regression and classification techniques for disease prediction.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Honors

in

Visual Computing

for

Second Year Bachelor of Engineering in Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE

For Affiliated Colleges

Semester – IV

W.E.F. 2025 – 26

Specialization Honors in "Visual Computing"

Syllabus Structure for Specialization Honors in "Visual Computing": Additional Credit (Semester – III) (w.e.f. 2025 – 26)
(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical			
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)	Total	
AIDS -311B	Introduction to Computer Vision	PCC	3			3	40	60			100	3
AIDS -312B	Introduction to Computer Vision Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Visual Computing": Additional Credit (Semester – IV) (w.e.f. 2025 – 26)
(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical			
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)	Total	
AIDS -414B	Mathematical Foundation for Computer Vision	PCC	3			3	40	60			100	3
AIDS -415B	Mathematical Foundation for Computer Vision Lab	PCC			2	2			25	25 (PR)	50	1

INTRODUCTION TO COMPUTER VISION (Honors PCC)					
COURSE OUTLINE					
Course Title:	**INTRODUCTION TO COMPUTER VISION (PCC)**	**Short Title:**	**ICV**	**Course Code:**	**AIDS - 311B**

Course description:

This course provides a foundational understanding of computer vision, covering image processing techniques, feature detection, object recognition, and motion analysis. Students will explore key algorithms such as edge detection, morphological operations, and feature matching, along with machine learning and deep learning-based approaches like CNNs, YOLO, and Faster R-CNN. Real-world applications in augmented reality, autonomous vehicles, and medical imaging will be discussed.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	03

Prerequisite course(s):

Linear Algebra ,Basic Probability ,Statistics, Foundations of Machine Learning

Course objectives:

The objective of this course is to:

1. To introduce the fundamental concepts of Computer Vision and its real-world applications.
2. To provide a comprehensive understanding of image representation, processing techniques, and feature extraction methods.
3. To explore various image processing techniques, including spatial and frequency domain operations, edge detection, and morphological transformations.
4. To impart knowledge of feature detection, description, and matching techniques used in image analysis and pattern recognition.
5. To understand object detection and recognition techniques using classical machine learning and deep learning approaches.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the basic concepts of Computer Vision, and its applications in various fields.
2. Apply image processing techniques such as noise removal, histogram equalization, edge detection, and morphological operations.
3. Analyze images by extracting features using different detection and description techniques like SIFT, SURF, ORB, and BRIEF.
4. Implement object detection and recognition techniques using Machine Learning and Deep Learning models such as CNN, YOLO, and Faster R-CNN.
5. Perform image segmentation and motion analysis using thresholding, clustering, and optical flow methods.

COURSE CONTENT

INTRODUCTION TO COMPUTER VISION		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**
Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**	

Introduction to Computer Vision: Basics of Computer Vision & its Applications, Difference between Computer Vision, Image Processing, and Machine Learning, The Human Visual System vs. Computer Vision , Image Representation: Pixels, Color Models (RGB, HSV, Grayscale, CMYK)

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Image Processing Fundamentals: Image Acquisition and Formation, Image Preprocessing: Noise Removal, Histogram Equalization, Spatial and Frequency Domain Processing, Edge Detection: Sobel, Canny, Laplacian, Prewitt Morphological Operations: Dilation, Erosion, Opening, Closing

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Feature Detection and Description: Interest Point Detection: Harris Corner Detector, FAST, SIFT, SURF, Feature Matching: ORB, BRIEF, Brute Force, FLANN, Keypoint Extraction and Descriptors, Applications of Feature Matching in Image Stitching and Augmented Reality

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**

Object Detection and Recognition : Template Matching & Contour Detection, Machine Learning for Vision: SVM, k-NN for Image Classification, Deep Learning in Computer Vision: CNN Architecture, Transfer Learning, Object Detection: YOLO, SSD, Faster R-CNN

Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**

Image Segmentation and Motion Analysis: Thresholding and Clustering: Otsu's Method, k-Means, Mean Shift, Segmentation Algorithms: Watershed, Graph Cuts, Motion Estimation: Optical Flow, Background Subtraction, Applications: Autonomous Vehicles, Medical Imaging, Biometrics

Text Books:

1. Szeliski, R. – *Computer Vision: Algorithms and Applications* (Springer, 2022)
2. Gonzalez, R. C., & Woods, R. E. – *Digital Image Processing* (Pearson, 2017)
3. Prince, S. J. D. – *Computer Vision: Models, Learning, and Inference* (Cambridge, 2012)

Reference Books:

1. Forsyth, D., & Ponce, J. – *Computer Vision: A Modern Approach* (Pearson, 2015)

NPTEL Links:

1. Computer Vision By PROF.JAYANTA MUKHOPADHYAY IIT Kharagpur
   https://archive.nptel.ac.in/courses/106/105/106105216/
2. Modern Computer Vision By Prof. A.N. Rajagopalan | IIT Madras
   https://onlinecourses.nptel.ac.in/noc24_ee21/preview

INTRODUCTION TO COMPUTER VISION LAB (Honors PCC)						
COURSE OUTLINE						
Course Title:	**INTRODUCTION TO COMPUTER VISION LAB(PCC)**		**Short Title:**	**ICVL**	**Course Code:**	**AIDS - 312B**
	Hours/week	**No. of weeks**	**Total hours**		**Semester credits**	
Practical	02	15	30		1	

COURSE CONTENT			
INTRODUCTION TO COMPUTER VISION LAB		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**		
		End Semester Examination (ESE) UA:PR:	**25 marks**
		Internal Continuous Assessment (ICA) CA	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame at least **SIX** laboratory assignments

1. Implement basic image processing techniques such as noise removal and histogram equalization.
2. Perform edge detection using Sobel and Canny filters.
3. Apply feature detection methods like Harris Corner Detector and SIFT.
4. Implement object detection using YOLO or Faster R-CNN.
5. Implement object detection using Faster R-CNN.
6. Perform image segmentation using Otsu's Method
7. Perform image segmentation using k-Means clustering.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.

MATHEMATICAL FOUNDATION FOR COMPUTER VISION (Honors PCC)					
COURSE OUTLINE					
Course Title:	**MATHEMATICAL FOUNDATION FOR COMPUTER VISION (PCC)**	**Short Title:**	**MFCV**	**Course Code:**	**AIDS - 414B**

Course description:

This course provides a mathematical foundation for computer vision, emphasizing linear algebra, probability, optimization, image transformations, and deep learning techniques. Students will explore essential mathematical concepts such as vectors, matrices, eigenvalues, and probability distributions, along with their applications in computer vision tasks like image processing, object tracking, and deep learning-based vision models.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	03

Prerequisite course(s):

Linear Algebra ,Basic Probability ,Statistics, Foundations of Machine Learning

Course objectives:

The objective of this course is to:

1. To introduce fundamental mathematical concepts, including linear algebra, probability, and optimization, for computer vision applications.
2. To equip students with knowledge of PCA and SVD for image compression and face recognition.
3. To develop an understanding of probability models such as Bayes Theorem, Gaussian distributions, and Markov-based models for vision tasks.
4. To explore optimization techniques used in deep learning and image registration, including gradient descent and RANSAC.
5. To introduce mathematical foundations in deep learning, including CNNs, backpropagation, and loss functions for vision tasks.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand the role of linear algebra in computer vision, including matrix operations, eigenvalues, and transformations.
2. Apply probability and statistical models for object tracking and image segmentation.
3. Implement optimization techniques such as gradient descent, least squares, and RANSAC for image processing.
4. Analyze image transformations, including camera projection, stereo vision, and depth estimation.
5. Develop deep learning models using CNNs, backpropagation, and loss functions for various computer vision applications.

COURSE CONTENT

MATHEMATICAL FOUNDATION FOR COMPUTER VISION		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**		
		End Semester Examination (ESE) UA(PR):	**60 marks**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12
Linear Algebra for Computer Vision: Vectors, Matrices, and Transformations, Eigenvalues & Eigenvectors: Principal Component Analysis (PCA), Singular Value Decomposition (SVD) for Image Compression, Applications: Face Recognition using PCA		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Probability and Statistics for Vision: Probability Theory Basics: Bayes Theorem, Gaussian Distributions,Random Variables & Expectation, Hidden Markov Models (HMM) in Object Tracking, Markov Random Fields (MRF) for Image Segmentation		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Optimization Techniques: Convex and Non-Convex Optimization, Gradient Descent: SGD, Adam Optimization,Least Squares and RANSAC for Image Registration, Applications: Deep Learning Optimization in Vision		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Image Transformations and Geometry: Homogeneous Coordinates & Camera Projection, 2D & 3D Image Transformations: Rotation, Scaling, Translation, Affine & Perspective, Epipolar Geometry: Stereo Vision and Depth Estimation, Camera Calibration and Pose Estimation		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Mathematical Foundations in Deep Learning: Basics of Neural Networks: Activation Functions, Backpropagation , Convolutional Neural Networks (CNNs) and Filters,Loss Functions in Vision Models, Applications in Image Generation (GANs) and Super-Resolution		
Text Books:		
1. David Forsyth & Jean Ponce – Computer Vision: A Modern Approach (Pearson, 2015) 2. Simon J. D. Prince – Mathematical Methods for Computer Vision (Cambridge University Press, 2012)		
Reference Books: 1. Ian Goodfellow, Yoshua Bengio, Aaron Courville – Deep Learning (MIT Press, 2016) 2. Richard Hartley & Andrew Zisserman – Multiple View Geometry in Computer Vision (Cambridge University Press, 2003)		
NPTEL Links: 1. Mathematics for Machine Learning, IIT Kharagpur By Prof. Debjani Chakraborty, Prof. Debashree Guha Adhya https://nptel.ac.in/courses/111105489 2. Essential Mathematics for Machine Learning By Prof. Sanjeev Kumar, Prof. S. K. Gupta, IIT Roorkee https://onlinecourses.nptel.ac.in/noc21_ma38/preview 3. Computer Vision And Image Processing - Fundamentals And Applications By Prof. M. K. Bhuyan IIT Guwahati https://onlinecourses.nptel.ac.in/noc25_ee13/preview		

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<tr><td>Course Title:</td><td colspan="3">MATHEMATICAL FOUNDATION FOR COMPUTER VISION LAB (PCC)</td><td>Short Title:</td><td>MFCVL</td><td>Course Code:</td><td>AIDS - 415B</td></tr>
<tr><td colspan="2"></td><td>Hours/week</td><td>No. of weeks</td><td colspan="2">Total hours</td><td colspan="2">Semester credits</td></tr>
<tr><td colspan="2">Practical</td><td>02</td><td>15</td><td colspan="2">30</td><td colspan="2">1</td></tr>
<tr><th colspan="8">COURSE CONTENT</th></tr>
<tr><td colspan="3">MATHEMATICAL FOUNDATION FOR COMPUTER VISION LAB</td><td colspan="3">Semester:</td><td colspan="2">IV</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="5">Examination scheme</td></tr>
<tr><td colspan="2">Practical:</td><td>2 hours/week</td><td colspan="4"></td></tr>
<tr><td colspan="3" rowspan="2"></td><td colspan="4">End Semester Examination (ESE) UA:PR:</td><td>25 marks</td></tr>
<tr><td colspan="4">Internal Continuous Assessment(ICA)CA</td><td>25 marks</td></tr>
<tr><td colspan="3">End Semester Exam (ESE) Pattern:</td><td colspan="5">Practical (PR)</td></tr>
<tr><td colspan="8">Concerned faculty member should suitably frame at least SIX laboratory assignments
1. Implement Principal Component Analysis (PCA) for image dimensionality reduction.
2. Utilize probability theory for image segmentation techniques.
3. Apply statistical methods to enhance image segmentation accuracy.
4. Optimize an image processing pipeline using gradient descent.
5. Implement epipolar geometry principles for stereo vision applications.
6. Train a simple Convolutional Neural Network (CNN) for image classification.
7. Analyze different loss functions used in CNN training.</td></tr>
<tr><td colspan="8">Guide lines for ICA:</td></tr>
<tr><td colspan="8">Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.</td></tr>
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</table>

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Honors

in

Business Intelligence

for

Second Year Bachelor of Engineering in Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE

For Affiliated Colleges

Semester – IV

W.E.F. 2025 – 26

Specialization Honors in "Business Intelligent"

Syllabus Structure for Specialization Honors in "Business Intelligent": Additional Credit (Semester – III) (w.e.f. 2025 – 26)
(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical			
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)	Total	
AIDS -311C	Introduction to Business Intelligence	PCC	3			3	40	60			100	3
AIDS -312C	Introduction to Business Intelligence Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Business Intelligent": Additional Credit (Semester – IV) (w.e.f. 2025 – 26)
(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical			
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)	Total	
AIDS -414C	Database Management and SQL	PCC	3			3	40	60			100	3
AIDS -415C	Database Management and SQL Lab	PCC			2	2			25	25 (PR)	50	1

INTRODUCTION TO BUSINESS INTELLIGENCE (Honors PCC)					
COURSE OUTLINE					
Course Title:	**INTRODUCTION TO BUSINESS INTELLIGENCE (PCC)**	**Short Title:**	**IBI**	**Course Code:**	**DS–311C**

Course description:
This course provides a comprehensive introduction to Business Intelligence (BI), covering its fundamentals, architecture, tools, and applications. Students will explore data warehousing concepts, ETL processes, OLAP operations, and data visualization techniques using tools like Power BI, Tableau, and Google Data Studio.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To introduce the fundamental concepts of Business Intelligence (BI) and its role in decision-making.
2. To explore the architecture and components of BI, including data sources, ETL, data warehousing, and reporting.
3. To develop an understanding of OLAP operations, BI reporting tools, and data visualization techniques.
4. To analyze the role of predictive analytics and KPIs in business decision-making.
5. To provide hands-on experience with BI tools like Power BI, Tableau, Google Data Studio, and SQL for BI.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand and explain Business Intelligence concepts and its scope in various industries.
2. Design data warehouse architectures using Star and Snowflake schemas and implement ETL processes.
3. Perform OLAP operations (Roll-up, Drill-down, Slice, Dice, Pivot) for multi-dimensional data analysis.
4. Utilize BI reporting tools (Power BI, Tableau, Google Data Studio) to create insightful dashboards and reports.
5. Use SQL queries to extract, aggregate, and analyze business data efficiently.

COURSE CONTENT

INTRODUCTION TO BUSINESS INTELLIGENCE		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Business Intelligence

Definition and Scope of Business Intelligence
Components of BI: Data Sources, ETL, Data Warehousing, Reporting
BI vs. Data Science vs. Analytics

Applications of BI in Finance, Healthcare, Retail, and E-commerce		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Introduction to Mechanics &Acoustics		
Data Warehousing Concepts Architecture: Star Schema, Snowflake Schema Extract, Transform, Load (ETL) Process Data Marts and Operational Data Stores		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Online Analytical Processing (OLAP) & Reporting		
OLAP Operations: Roll-up, Drill-down, Slice, Dice, Pivot OLAP Types: MOLAP, ROLAP, HOLAP Data Visualization Techniques: Dashboards, Scorecards, Reports BI Reporting Tools: Power BI, Tableau, Google Data Studio		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Business Analytics and Decision-Making		
Key Performance Indicators (KPIs) and Metrics Predictive Analytics in Business Intelligence Case Study: Customer Segmentation using BI Introduction to AI-driven BI Solutions		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Business Intelligence Tools and Applications		
SQL for BI: Aggregation, Joins, Grouping, Window Functions Implementing BI in Cloud: AWS QuickSight, Google Looker Future Trends in Business Intelligence		
Text Books:		
1. Turban, Sharda, Delen, & King – Business Intelligence: A Managerial Perspective on Analytics (Pearson, 2019)		
Reference Books: 1. Ralph Kimball – The Data Warehouse Toolkit (Wiley, 2013) 2. Stephen Few – Information Dashboard Design (O'Reilly, 2013)		
NPTEL Links: 1. Business Intelligence and Analytics, IIT Madras, Prof. Saji K Mathew https://onlinecourses.nptel.ac.in/noc24_cs65/preview		

INTRODUCTION TO BUSINESS INTELLIGENCE LAB (Honors PCC)					
COURSE OUTLINE					
Course Title:	**INTRODUCTION TO BUSINESS INTELLIGENCE LAB (PCC)**	**Short Title:**	**IBIL**	**Course Code:**	**AIDS - 312C**
	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**	
Practical	02	15	30	1	

COURSE CONTENT			
INTRODUCTION TO BUSINESS INTELLIGENCE LAB		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**		
		End Semester Examination (ESE) UA:PR	**25 marks**
		Internal Continuous Assessment (ICA) CA	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame at least **SIX** laboratory assignments

1. Introduction to BI: Compare BI vs. Data Science vs. Analytics with real-world examples.
2. Design a Star Schema and Snowflake Schema for a retail business.
3. Implement an ETL process using Talend or Apache Nifi.
4. Perform OLAP operations (Roll-up, Drill-down, Slice, Dice, Pivot) on a sample dataset using SQL Server Analysis Services (SSAS).
5. Dashboard Creation: Develop a Power BI/Tableau dashboard for sales analytics.
6. Apply predictive analytics for customer segmentation using Python or R.
7. KPI Analysis: Define KPIs for an e-commerce business and visualize them using Google Data Studio.
8. SQL for BI: Write SQL queries using Window functions, Aggregations, Joins, and Grouping.
9. Cloud BI Implementation: Deploy a BI dashboard in AWS QuickSight or Google Looker.

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.

DATABASE MANAGEMENT AND SQL (Honors PCC)					
COURSE OUTLINE					
Course Title:	**DATABASE MANAGEMENT AND SQL (PCC)**	**Short Title:**	**DMAS**	**Course Code:**	**DS – 414C**

Course description:
This course provides a comprehensive understanding of databases and their role in Business Intelligence (BI). It covers relational and NoSQL databases, SQL querying, advanced SQL techniques, and Big Data technologies like Hadoop and Spark SQL. Students will explore database performance optimization, data warehousing, and dashboard building using SQL queries. students will gain practical experience in managing and analyzing business data.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	03

Prerequisite course(s):
Mathematics course with vector calculus

Course objectives:
The objective of this course is to:
1. Understand the fundamentals of relational and NoSQL databases.
2. Apply SQL queries for data manipulation, retrieval, and performance optimization.
3. Explore advanced SQL functions, including window functions, stored procedures, and triggers.
4. Gain hands-on experience with NoSQL databases such as MongoDB and Cassandra.
5. Learn about Big Data technologies and their integration with Business Intelligence applications.

Course outcomes:
After successful completion of this course the student will be able to:
1. Write and optimize SQL queries for business analytics and decision-making.
2. Implement data warehousing concepts and ETL processes.
3. Use MongoDB and Cassandra for NoSQL-based applications.
4. Analyse and visualize business data using SQL-based BI tools.
5. Apply database management skills in real-world business intelligence scenarios.

COURSE CONTENT

DATABASE MANAGEMENT AND SQL		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Databases
Overview of Databases and their Role in BI, Relational vs. Non-Relational Databases
Database Management System (DBMS) vs. Data Warehouse, Introduction to MySQL, PostgreSQL, MongoDB

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

SQL Basics and Data Manipulation
Data Definition Language (DDL): CREATE, ALTER, DROP, Data Manipulation Language (DML): INSERT, UPDATE, DELETE, Data Query Language (DQL): SELECT, WHERE, ORDER BY, GROUP BY Joins & Subqueries.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Advanced SQL for Business Intelligence		
Window Functions and Aggregate Functions, Stored Procedures, Triggers, and Views Performance Optimization in SQL, SQL for Data Analytics: Ranking, Partitioning, Pivoting		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
NoSQL Databases and Big Data		
Introduction to NoSQL: Document, Key-Value, Columnar, Graph Databases MongoDB: CRUD Operations, Aggregation Pipeline, Cassandra: Column-Family Data Model Big Data and Distributed Databases (Hadoop, Spark SQL)		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Database Applications in Business Intelligence		
Building Business Dashboards using SQL Queries, Data Warehousing with SQL Real-world Case Studies in Banking, E-commerce, and Healthcare, Future Trends: Data Lakes, Cloud Databases, AI in Databases		

Text Books:

1. Héctor García-Molina, Jeffrey D. Ullman, Jennifer Widom – Database Systems: The Complete Book (Pearson, 2013)

Reference Books:

1. Ramez Elmasri & Shamkant B. Navathe – Fundamentals of Database Systems (Pearson, 2016)
2. Kristina Chodorow – MongoDB: The Definitive Guide (O'Reilly, 2013)
3. Abraham Silberschatz, Henry F. Korth, S. Sudarshan – Database System Concepts (McGraw Hill, 2019)
4. Ben Forta – SQL in 10 Minutes, Sams Teach Yourself (Sams Publishing, 2019)
5. Dan Sullivan – NoSQL for Mere Mortals (Addison-Wesley, 2015)
6. Tom White – Hadoop: The Definitive Guide (O'Reilly, 2015)

NPTEL Links:

1. Database Management system, IIT Kharagpur, Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay ,https://onlinecourses.nptel.ac.in/noc22_cs91/preview
2. Introduction to Database System, IIT Madras, Prof. Sreenivasa Kumar https://onlinecourses.nptel.ac.in/noc25_cs40/preview

DATABASE MANAGEMENT AND SQL LAB (Honors PCC)						
COURSE OUTLINE						
Course Title:	**DATABASE MANAGEMENT AND SQL LAB (PCC)**		**Short Title:**	**DMSL**	**Course Code:**	**AIDS - 415C**
	Hours/week	**No. of**	**Total hours**		**Semester credits**	
Practical	02	15	30		1	
COURSE CONTENT						
DATABASE MANAGEMENT AND SQL LAB		**Semester:**			**IV**	
Teaching Scheme:		**Examination scheme**				
Practical:	**2 hours/week**					
		End Semester Examination (ESE) UA(PR):			**25 marks**	
		Internal Continuous Assessment (ICA) CA			**25 marks**	
End Semester Exam (ESE) Pattern:		**Practical (PR)**				

Concern faculty member should conduct any SIX Laboratory Assignment

1. Introduction to SQL:
   - Create a database and tables using SQL.
   - Insert, update, delete, and retrieve records.
2. Data Definition Language (DDL) Operations:
   - Implement CREATE, ALTER, DROP commands.
   - Define constraints such as Primary Key, Foreign Key, UNIQUE, CHECK, and NOT NULL.
3. Data Manipulation Language (DML) Operations:
   - Perform SELECT, INSERT, UPDATE, DELETE operations.
   - Use WHERE, ORDER BY, GROUP BY, HAVING clauses.
4. Joins and Subqueries:
   - Implement INNER JOIN, LEFT JOIN, RIGHT JOIN, FULL JOIN.
   - Write subqueries using nested SELECT statements.
5. Normalization and Indexing:
   - Demonstrate normalization up to 3rd Normal Form.
   - Implement indexing to optimize query performance.
6. Views and Stored Procedures:
   - Create and use views in SQL.
   - Develop stored procedures and functions with parameters.
7. Triggers and Transactions:
   - Implement triggers for INSERT, UPDATE, DELETE events.
   - Apply ACID properties in SQL transactions.
8. Advanced SQL Functions:
   - Use Window Functions (ROW_NUMBER, RANK, DENSE_RANK).
   - Apply Aggregate Functions (SUM, COUNT, AVG, MAX, MIN).

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.

Specialization Minor offered by Artificial Intelligence and Data Science for students of other Branch of Engineering

In addition to 168 credits of UG Engineering Programmes (Bachelor of Engineering) i.e. Major in which the student has taken admission, a student may opt for Specialization Minor in another Engg. / Tech. discipline / branch / Emerging Areas, not in Major Engg. / Tech. discipline / branch.

A student is required to study additional 20 credits in another Engg. / Tech. discipline/ branch / Emerging Areas for Specialization Minor distributed over semesters III to VIII.

The total number of credits required for completion of the Specialization Minor in another Engg./ Tech. discipline/ Emerging Areas is 20 credits, in addition to 168 credits in Major.

Students will have to compulsorily choose Specialization Minor from other Engg. / Tech. discipline / branch, not from Major Engg. / Tech. discipline / branch.

Specialized Minor Degree in the Bachelor of Engineering programme shall be awarded to students earning additional total credits of all six semesters from second year to final year, i.e., 20 Credits, in addition to 168 credits or 126 credits respectively. The student admitted in first year must earn 168 credits and 126 credits admitted in lateral entry (admitted after Diploma or B.Sc.) at second year.

Specialization Minors offered by Artificial Intelligence and Data Science are as follows.

A. Health Informatics
B. Business Data Analytics
C. Cyber Security

The detail syllabus structure for the same is as follows.

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Minors

in

Health Informatics

for

Second Year Bachelor of Engineering

offered by

Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

COURSE OUTLINE

For Affiliated Colleges

Semester – IV

W.E.F. 2025 – 26

Specialization Minor in "Health Informatics"

Syllabus Structure for Specialization Minor in "Health Informatics": Additional Credit (Semester – III) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -313A	Introduction to Health Informatics	PCC	3			3	40	60			100	3
AIDS -314A	Introduction to Health Informatics Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Minor in "Health Informatics": Additional Credit (Semester – IV) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -416A	Electronic Health Records (EHR) and Standards	PCC	3			3	40	60			100	3
AIDS -417A	Electronic Health Records (EHR) and Standards Lab	PCC			2	2			25	25 (PR)	50	1

INTRODUCTION TO HEALTH INFORMATICS (Minor PCC)					
COURSE OUTLINE					
Course Title:	**INTRODUCTION TO HEALTH INFORMATICS (PCC)**	**Short Title:**	**IHI**	**Course Code:**	**AIDS - 313A**

Course description:

This course provides a comprehensive introduction to Health Informatics, exploring the role of information technology in modern healthcare systems. Students will learn about electronic health records (EHR), interoperability standards, health data analytics, and emerging technologies like AI and IoT in healthcare. The course covers regulatory frameworks (HIPAA, HL7, FHIR), data management solutions, and visualization tools such as Power BI and Tableau.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To introduce students to the fundamentals of health informatics and its applications.
2. To provide knowledge of electronic health records (EHR), interoperability, and healthcare data management.
3. To explore emerging technologies like AI, machine learning, and IoT in healthcare.
4. To understand security, privacy, and ethical aspects of health informatics.
5. To develop practical skills in health data analytics and visualization tools.

Course outcomes:

After successful completion of this course the student will be able to:

1. Explain the core concepts of health informatics and its impact on healthcare systems.
2. Understand the structure, implementation, and challenges of electronic health records (EHR).
3. Apply data analytics techniques to process and interpret healthcare data.
4. Analyze the role of AI and emerging technologies in healthcare applications.
5. Demonstrate knowledge of health informatics security and ethical principles.

COURSE CONTENT

INTRODUCTION TO HEALTH INFORMATICS		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 Marks**
		Duration of ESE	**03 Hours**
		Internal Sessional Exam (ISE) CA:	**40 Marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Health Informatics

Definition, scope, and significance of health informatics, Evolution of digital healthcare and healthcare informatics standards, Role of IT in healthcare: hospital management systems, digital records, Regulatory frameworks (HIPAA, HL7, FHIR)

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Electronic Health Records (EHR) and Interoperability Structure and components of HER, Benefits and challenges of EHR implementation, Health Information Exchange (HIE) and interoperability standards, Cloud computing and blockchain in health data management		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Health Data Analytics and Visualization Basics of healthcare data: structured vs. unstructured data, Data preprocessing, integration, and storage solutions,		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Introduction to data analytics (descriptive, predictive, prescriptive), Tools for health data visualization (Power BI, Tableau, Python)		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
AI and Emerging Technologies in Healthcare Artificial intelligence and machine learning in diagnostics, Deep learning applications in medical imaging, Internet of Medical Things (IoMT) and wearable devices,		
Text Books:		
1. "Health Informatics: An Interprofessional Approach" – Ramona Nelson & Nancy Staggers		
Reference Books: 1. "Biomedical Informatics: Computer Applications in Health Care and Biomedicine" – Edward H. Shortliffe & James J. Cimino 2. "Introduction to Healthcare Informatics" – Sue Biedermann & Donna R. Ramey		
NPTEL Links: 1. Data Integration & Interoperability in Healthcare, Ms Ishwarya Muthukrishnan https://elearn.nptel.ac.in/shop/nptel/data-integration-interoperability-in-healthcare/?v=c86ee0d9d7ed		

<table>
<tr><th colspan="6">INTRODUCTION TO HEALTH INFORMATICS LAB (Minor PCC)</th></tr>
<tr><th colspan="6">COURSE OUTLINE</th></tr>
<tr><td>Course Title:</td><td colspan="2">INTRODUCTION TO HEALTH INFORMATICS LAB (PCC)</td><td>Short Title:</td><td>IHIL</td><td>Course Code: AIDS - 314A</td></tr>
<tr><td></td><td>Hours/week</td><td>No. of weeks</td><td colspan="2">Total hours</td><td>Semester credits</td></tr>
<tr><td>Practical</td><td>02</td><td>15</td><td colspan="2">30</td><td>01</td></tr>
<tr><th colspan="6">COURSE CONTENT</th></tr>
<tr><td colspan="2">INTRODUCTION TO HEALTH INFORMATICS LAB</td><td colspan="2">Semester:</td><td colspan="2">III</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="4">Examination scheme</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td colspan="3"></td><td></td></tr>
<tr><td colspan="2" rowspan="2"></td><td colspan="3">End Semester Examination (ESE) UA: PR</td><td>25 marks</td></tr>
<tr><td colspan="3">Internal Continuous Assessment (ICA): CA</td><td>25 marks</td></tr>
<tr><td colspan="2">End Semester Exam (ESE) Pattern:</td><td colspan="4">Practical (PR)</td></tr>
<tr><td colspan="6">Concerned faculty member should suitably frame SIX laboratory assignments from the following list.

1. Write a Python program to input patient details (name, age, gender, disease) and display them.
2. Implement basic operations (addition, subtraction, multiplication, division) on patient health records.
3. Read and display patient data from a CSV file using Pandas.
4. Perform basic data cleaning (handling missing values, removing duplicates).
5. Generate bar charts and pie charts for disease distribution in a dataset using Matplotlib & Seaborn.
6. Create a line chart to analyze patient recovery trends.
7. Compute mean, median, mode, and standard deviation for patient blood pressure records.
8. Perform correlation analysis between age and disease prevalence.
9. Develop a simple Python program to store, retrieve, and update patient health records using dictionaries.
10. Implement a file-based storage system for patient records (CSV/JSON).
11. Simulate IoT-based health monitoring (e.g., heart rate, temperature) using random data generation.
12. Analyze trends and detect anomalies in sensor data.</td></tr>
<tr><td colspan="6">Guidelines for ICA:</td></tr>
<tr><td colspan="6">Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.</td></tr>
<tr><td colspan="6">Guidelines for ESE:</td></tr>
<tr><td colspan="6">ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In the ESE (PR), the students may be asked to perform the practical assignment with minor modification.
Evaluation will be based on the paper work of algorithm, understanding of the logic and the syntax, quality of the program, execution of the program, type of input and output for the program.</td></tr>
</table>

ELECTRONIC HEALTH RECORDS (EHR) AND STANDARDS (Minor PCC)					
COURSE OUTLINE					
Course Title:	**ELECTRONIC HEALTH RECORDS (EHR) AND STANDARDS (PCC)**	**Short Title:**	**EHRS**	**Course Code:**	**AIDS - 416A**

Course description:
This course provides a comprehensive understanding of Electronic Health Records (EHR), covering architecture, standards, regulatory frameworks, and interoperability. Students will explore data privacy, security (HIPAA, GDPR, ABDM), AI-driven analytics, and clinical decision support systems (CDSS).

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To understand the fundamentals of Electronic Health Records (EHR) and their significance in healthcare.
2. To explore various standards and regulations associated with EHR.
3. To analyze data privacy, security, and interoperability challenges in EHR systems.
4. To study data analytics applications in healthcare using EHR.
5. To implement basic EHR functionalities and gain hands-on experience.

Course outcomes:

After successful completion of this course, students will be able to:

1. Explain the fundamentals and significance of Electronic Health Records.
2. Analyze various EHR standards and regulatory requirements.
3. Evaluate interoperability challenges and solutions for EHR data exchange.
4. Apply data science techniques for analyzing EHR data.
5. Implement basic functionalities of an EHR system.
6. Explore emerging technologies and future trends in EHR systems.

COURSE CONTENT

ELECTRONIC HEALTH RECORDS (EHR) AND STANDARDS		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 Marks**
		Duration of ESE:	**03 Hours**
		Internal Sessional Exam (ISE) CA:	**40 Marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Electronic Health Records (EHR)
Overview of Healthcare Information Systems**,** Introduction to Electronic Health Records (EHR)**,** Components and Architecture of HER**,** Benefits and Challenges of EHR Implementation**,** Role of Data Science in EHR

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

EHR Standards and Regulations

International and National EHR Standards, Health Level 7 (HL7), Digital Imaging and Communications in Medicine (DICOM), Systematized Nomenclature of Medicine - Clinical Terms (SNOMED CT), Fast Healthcare Interoperability Resources (FHIR), Regulatory Frameworks: HIPAA, GDPR, Ayushman Bharat Digital Mission (ABDM), Data Privacy, Security, and Compliance in EHR

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Interoperability and EHR Data Exchange

Need for Interoperability in Healthcare**,** EHR Data Sharing Mechanisms**,** Interoperability Challenges and Solutions**,** Cloud-Based EHR Systems**,** Case Studies on EHR Interoperability

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Data Science Applications in EHR

Introduction to Healthcare Data Analytics, Predictive Analytics in HER, Machine Learning and AI Applications in HER, Clinical Decision Support Systems (CDSS), Case Studies on EHR Analytics

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Implementation of EHR Systems

EHR System Development and Deployment**,** Role of Blockchain in EHR Security**,** Open-Source EHR Systems (e.g., OpenMRS)**,** Emerging Technologies in EHR (IoT, AI, Blockchain)**,** Mobile Health (mHealth) and Telemedicine Integration

Text Books:

1. Electronic Health Records: Understanding and Using Computerized Medical Records – Richard Gartee
2. Health Informatics: Practical Guide for Healthcare and Information Technology Professionals – Robert Hoyt

Reference Books:

1. Principles of Health Interoperability HL7 and SNOMED – Tim Benson
2. Biomedical Informatics: Computer Applications in Healthcare and Biomedicine – Edward H. Shortliffe, James J. Cimino
3. Healthcare Data Analytics – Chandan K. Reddy, Charu C. Aggarwal

NPTEL Links:

1. Healthcare Applications: Role & Relevance of EHRs in Healthcare Ms Dipti Dilip Gujela https://elearn.nptel.ac.in/shop/iit-workshops/completed/healthcare-applications-role-relevance-of-ehrs-in-healthcare/

ELECTRONIC HEALTH RECORDS (EHR) AND STANDARDS LAB (Minor PCC)					
COURSE OUTLINE					
Course Title:	**ELECTRONIC HEALTH RECORDS (EHR) AND STANDARDS LAB (PCC)**	**Short Title:**	**EHRSL**	**Course Code:**	**AIDS - 417A**

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Practical	02	15	30	01

COURSE CONTENT			
INTRODUCTION TO HEALTH INFORMATICS LAB		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**		
		End Semester Examination (ESE) UA: PR	**25 Marks**
		Internal Continuous Assessments (ICA) CA:	**25 Marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame at least **SIX** Laboratory assignments

1. Introduction to EHR: Define Electronic Health Records (EHR) and explain its significance in modern healthcare, List the key features of an EHR system, Compare EHR with traditional paper-based health records.
2. Benefits and Challenges of HER: Identify at least five benefits of using HER,
3. Discuss the challenges faced during EHR implementation, Describe the role of interoperability in EHR systems.
4. Overview of EHR Standards: Define the importance of standards in EHR systems,
5. List and briefly describe EHR standards: HL7 (Health Level Seven), DICOM (Digital Imaging and Communications in Medicine), FHIR (Fast Healthcare Interoperability Resources),ICD (International Classification of Diseases),LOINC (Logical Observation Identifiers Names and Codes)
6. Access an open-source EHR system such as OpenMRS or GNU Health.
7. Create a sample patient record and enter basic health data.
8. Export the patient data in HL7 or FHIR format and analyze the structure.

Guidelines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Second Year Engineering Minors

in

Business Data Analytics

for

Second Year Bachelor of Engineering

offered by

Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology

'A' Grade
NAAC Re-Accredited
(4th Cycle)

COURSE OUTLINE

For Affiliated Colleges

Semester – IV

W.E.F. 2025 – 26

Specialization Minor in "Business Data Analytics"

Syllabus Structure for Minor in "Business Data Analytics": Additional Credit (Semester – III) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -313B	Introduction to business analytics	PCC	3			3	40	60			100	3
AIDS -314B	Introduction to business analytics Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Minor in "Business Data Analytics": Additional Credit (Semester – IV) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
AIDS -416B	Database systems & sql for analytics	PCC	3			3	40	60			100	3
AIDS -417B	Database systems & sql for analytics Lab	PCC			2	2			25	25 (PR)	50	1

INTRODUCTION TO BUSINESS ANALYTICS (Minor PCC)					
COURSE OUTLINE					
Course Title:	**Introduction to Business Analytics (PCC)**	**Short Title:**	**IBA**	**Course Code:**	**AIDS - 313B**

Course description:
This course provides a comprehensive introduction to Business Analytics, equipping students with the knowledge and skills to analyze business data and derive actionable insights. It covers essential topics such as data-driven decision-making, data management, exploratory data analysis (EDA), predictive analytics, and business intelligence tools. Students will gain hands-on experience with SQL, data visualization techniques, machine learning models, and BI tools like Power BI or Tableau.

	Hours/week	**No. of**	**Total hours**	**Semester credits**
Theory	03	15	45	03

Prerequisite course(s):

Course objectives:

The objective of this course is to:
1. To introduce the fundamentals of Business Analytics and its applications.
2. To familiarize students with data-driven decision-making processes.
3. To apply various analytical techniques for business problem-solving.
4. To explore the role of data visualization and business intelligence tools.
5. To develop hands-on experience in Business Analytics using Python/R.

Course outcomes:

After successful completion of this course the student will be able to:
1. Understand the role and importance of Business Analytics in decision-making.
2. Apply data preprocessing techniques to handle real-world business data.
3. Perform Exploratory Data Analysis (EDA) to extract insights from data.
4. Implement predictive modeling techniques for business problem-solving.
5. Use Business Intelligence tools for data visualization and reporting.

COURSE CONTENT

INTRODUCTION TO BUSINESS		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 Marks**
		Duration of ESE	**03 Hours**
		Internal Sessional Exam (ISE) CA:	**40 Marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Introduction to Business Analytics:- Definition and Scope of Business Analytics, Types of Business Analytics: Descriptive, Predictive, and Prescriptive ,Importance of Data-Driven Decision-Making, Applications of Business Analytics in Different Sectors

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Data Management and Preprocessing:- Data Sources in Business Analytics, Data Collection, Cleaning, and Preparation, Handling Missing Data and Outliers, Introduction to SQL for Business Analytics

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Exploratory Data Analysis (EDA):- Descriptive Statistics and Summary Measures, Data Visualization Techniques (Bar Charts, Histograms, Box Plots),Correlation and Causation Analysis, Case Study on Real-World Business Data		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Predictive Analytics and Machine Learning:- Introduction to Regression Analysis (Linear & Logistic) Supervised vs. Unsupervised Learning in Business Analytics, Decision Trees and Random Forests for Business Insights, Case Study: Predicting Customer Behavior		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Business Intelligence and Dashboarding:- Introduction to Business Intelligence (BI) Tools Dashboard Designing using Power BI/Tableau, Real-Time Data Analytics for Business Applications, Role of AI & Big Data in Business Analytics		

Text Books:

1. **Business Analytics: The Science of Data-Driven Decision Making** – U. Dinesh Kumar

Reference Books:

1. **Data Science for Business** – Foster Provost & Tom Fawcett
2. **Business Intelligence and Analytics: Systems for Decision Support** – Ramesh Sharda, Dursun Delen, Efraim Turban
3. **Introduction to Business Analytics Using Python** – Bhimasankaram Pochiraju, Sridhar Seshadri
4. **Data Science for Business Analytics** – Jeffrey D. Camm, James J. Cochran, Michael J. Fry
5. Online resources from NPTEL, Coursera, and edX on Business Analytics

NPTEL Links:

Reinforcement Learning, IIT Madras, Prof. Balaraman Ravindram
https://archive.nptel.ac.in/courses/106/106/106106143/

<table>
<tr><th colspan="6">INTRODUCTION TO BUSINESS ANALYTICS LAB (Minor PCC)</th></tr>
<tr><th colspan="6">COURSE OUTLINE</th></tr>
<tr><td>Course Title:</td><td colspan="2">INTRODUCTION TO BUSINESS ANALYTICS LAB (PCC)</td><td>Short Title:</td><td>IBAL</td><td>Course Code: AIDS -314B</td></tr>
<tr><td></td><td>Hours/week</td><td>No. of weeks</td><td colspan="2">Total hours</td><td>Semester credits</td></tr>
<tr><td>Practical</td><td>02</td><td>15</td><td colspan="2">30</td><td>01</td></tr>
<tr><th colspan="6">COURSE CONTENT</th></tr>
<tr><td colspan="2">INTRODUCTION TO BUSINESS ANALYTICS LAB</td><td colspan="2">Semester:</td><td colspan="2">III</td></tr>
<tr><td colspan="2">Teaching Scheme:</td><td colspan="4">Examination scheme</td></tr>
<tr><td>Practical:</td><td>2 hours/week</td><td colspan="3"></td><td></td></tr>
<tr><td colspan="2" rowspan="2"></td><td colspan="3">End Semester Examination (ESE) UA: PR</td><td>25 marks</td></tr>
<tr><td colspan="3">Internal Continuous Assessment (ICA) CA</td><td>25 marks</td></tr>
<tr><td colspan="2">End Semester Exam (ESE) Pattern:</td><td colspan="4">Practical (PR)</td></tr>
<tr><td colspan="6">Concerned faculty member should suitably frame SIX laboratory assignments from the following list.
1. Data Collection and Cleaning using Python/R
2. SQL Queries for Business Data Management
3. Exploratory Data Analysis (EDA) using Pandas & Matplotlib
4. Implementation of Linear Regression for Sales Prediction
5. Classification Techniques for Customer Segmentation
6. Data Visualization and Dashboard Creation using Tableau/Power BI
7. Time Series Forecasting for Business Trends</td></tr>
<tr><td colspan="6">Guide lines for ICA:</td></tr>
<tr><td colspan="6">Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.</td></tr>
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<tr><td colspan="6">ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.</td></tr>
<tr><td colspan="6">NPTEL Links:
Data Analytics with Python By Prof. A Ramesh | IIT Roorkee
Data Analytics with Python - Course (nptel.ac.in)</td></tr>
</table>

DATABASE SYSTEMS & SQL FOR ANALYTICS (Minor PCC)					
COURSE OUTLINE					
Course Title:	**DATABASE SYSTEMS & SQL FOR ANALYTICS (PCC)**	**Short Title:**	**DSQLA**	**Course Code:**	**AIDS -416B**

Course description:

This course provides an understanding of database systems and their role in business analytics. It covers the fundamentals of relational and NoSQL databases, SQL programming for data retrieval and manipulation, and advanced querying techniques used in data analytics. Students will also explore data warehousing concepts, ETL processes, and business intelligence applications. The course includes hands-on experience with SQL and NoSQL databases like MongoDB, enabling students to manage and analyze business data efficiently.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	03

Prerequisite course(s):

Fundamental Database system concepts, DDL,DML,DCL statements ,SQL queries, PL/SQL

Course objectives:

The objective of this course is to:

1. To understand the fundamentals of Database Systems and their role in Business Analytics.
2. To learn SQL programming for data extraction, transformation, and analysis.
3. To explore Relational Database Management Systems (RDBMS) and NoSQL databases.
4. To apply SQL-based data processing for business insights.
5. To develop hands-on experience in data querying and visualization uses SQL-based tools.

Course outcomes:

After successful completion of this course the student will be able to:

1. Understand database fundamentals and their role in Business Analytics.
2. Write and optimize SQL queries for data retrieval and manipulation.
3. Apply advanced SQL techniques for data aggregation and transformation.
4. Explore Data Warehousing and ETL processes in business intelligence.
5. Implement NoSQL databases for handling unstructured data.

COURSE CONTENT

DATABASE SYSTEMS & SQL FOR ANALYTICS		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3hours/week**	**End Semester Examination (ESE) UA:**	**60 Marks**
		Duration of SES:	**03 Hours**
		Internal Sessional Exam (ISE) CA:	**40 Marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**

Fundamentals of Database Systems:- Introduction to Databases and DBMS, Types of Databases: Relational vs. NoSQL, Database Design Concepts (ER Diagrams, Normalization),Role of Databases in Business Analytics

Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**

Structured Query Language (SQL) – Basics:- Introduction to SQL and its Importance in Analytics, SQL Data Types and Operators, Creating and Managing Tables (DDL),Data Manipulation (DML): Insert, Update, Delete, Data Retrieval Using **SELECT** Queries.

Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**

Advanced SQL for Data Analytics:- Filtering and Sorting Data, Aggregate Functions (SUM, AVG, COUNT, GROUP BY, HAVING),Joins and Subqueries for Data Extraction, Common Table Expressions (CTEs) and Views, Case Study: Querying Business Data.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Data Warehousing & ETL Processes: - Concept of Data Warehousing and Data Lakes, Extract, Transform, Load (ETL) Process, Star Schema and Snowflake Schema in Data Warehousing, Real-World Case Study on Business Intelligence.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
NoSQL Databases for Business Analytics: - Introduction to NoSQL: Document-based, Column-based, Key-Value Stores, Comparison of SQL vs. NoSQL for Business Applications Hands-on: Working with MongoDB for Business Data Storage, Case Study on NoSQL Usage in Business Analytics		

Text Books:

1. **Database System Concepts** – Abraham Silberschatz, Henry F. Korth, S. Sudarshan

Reference Books:

1. SQL for Data Analytics – Upom Malik, Matt Goldwasser, Benjamin Johnston
2. The Data Warehouse Toolkit – Ralph Kimball
3. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence – Pramod J. Sadalage, Martin Fowler
4. Business Intelligence Guidebook: From Data Integration to Analytics – Rick Sherman
5. Online resources from NPTEL, Coursera, and edX on Database Systems & SQL for Analytics

NPTEL Links:

Data Base Management System By Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay | IIT Kharagpur

Data Base Management System - Course (nptel.ac.in)

DATABASE SYSTEMS & SQL FOR ANALYTICS LAB (Minor PCC)						
COURSE OUTLINE						
Course Title:	**DATABASE SYSTEMS & SQL FOR ANALYTICS LAB (PCC)**		**Short Title:**	**DSQLAL**	**Course Code:**	**AIDS -417B**
	Hours/week	**No. of weeks**	**Total hours**		**Semester credits**	
Practical	02	15	30		01	
Prerequisite course(s):						
Fundamental Database system concepts, DDL,DML,DCL statements ,SQL queries, PL/SQL						
COURSE CONTENT						
DATABASE SYSTEMS & SQL FOR ANALYTICS LAB		**Semester:**	**IV**			
Teaching Scheme:		**Examination scheme**				
Practical:	**2 hours/week**					
		End Semester Examination (ESE) UA:PR			**25 marks**	
		Internal Continuous Assessments (ICA) CA:			**25 marks**	
End Semester Exam (ESE) Pattern:		**Practical (PR)**				

Concerned faculty member should suitably frame at least **SIX** Laboratory assignments

1. Designing and Managing Relational Databases
2. Writing SQL Queries for Business Data Retrieval
3. Using SQL Joins for Complex Data Analysis
4. Implementing Views, Common Table Expressions (CTEs), and Subqueries
5. Optimizing SQL Queries for Performance and Efficiency
6. Applying SQL for Data Cleaning and Preprocessing
7. Introduction to NoSQL Databases for Unstructured Data
8. Hands-on Practice with MongoDB for NoSQL Data Management

Guide lines for ICA:

Students must submit ICA in the form of journal. Each assignment should be well documented. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.

NPTEL Links:

Data Base Management System By Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay | IIT Kharagpur

Data Base Management System - Course (nptel.ac.in)

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering Minors

in

Cyber Security

for

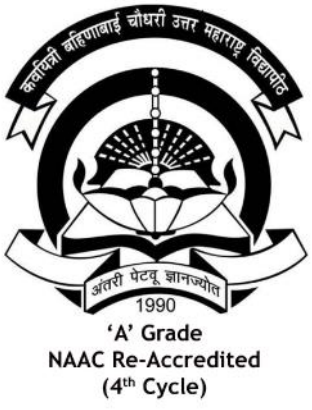
Second Year Bachelor of Engineering

offered by

Artificial Intelligence and Data Science

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



COURSE OUTLINE

For Affiliated Colleges

Semester – IV

W.E.F. 2025 – 26

Specialization Minor in "Cyber Security"

Syllabus Structure for Specialization Minor in "Cyber Security": Additional Credit (Semester – III) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical			
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)	Total	
AIDS -313C	Information Theory for Cybersecurity	PCC	3			3	40	60			100	3
AIDS -314C	Information Theory for Cybersecurity Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Minor in "Cyber Security": Additional Credit (Semester – IV) (w.e.f. 2025 – 26)

(As per NEP 2020 Guidelines)

Course Code	Name of the Course	Category	Teaching Scheme				Evaluation Scheme					Credits
							Theory		Practical			
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)	Total	
AIDS -416C	Data Encryption	PCC	3			3	40	60			100	3
AIDS -417C	Data Encryption Lab	PCC			2	2			25	25 (PR)	50	1

INFORMATION THEORY FOR CYBER SECURITY (Minor PCC)					
COURSE OUTLINE					
Course Title:	**INFORMATION THEORY FOR CYBER SECURITY (PCC)**	**Short Title:**	**ITCS**	**Course Code:**	**AIDS - 313C**

Course description:
The course covers fundamentals of Information Theory and Cryptography. It also explores key cryptographic techniques such as Diffie-Hellman, AES and elliptic curve cryptography. Additionally, the course addresses digital forensics, public key infrastructure (PKI) and lightweight cryptography applications.

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Theory	03	15	45	03

Prerequisite course(s):
Probability Theory, Computer Networks

Course objectives:
The objective of this course is to
1. Provide an insight to information coding techniques.
2. Error correction mechanism for cyber security.

Course Outcomes:
After successful completion of this course, the student will be able to:
1. Apply Shannon's Information Theory.
2. Understand cryptographic principles.
3. Analyze information-theoretic security in cryptography.
4. Assess secrecy metrics.
5. Explore digital forensics and cryptographic systems.

COURSE CONTENT

INFORMATION THEORY FOR CYBER SECURITY		**Semester:**	**III**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	**No. of Lectures: 09 Hours**	**Marks: 12**
Foundations of Information Theory: Shannon's foundation of Information theory, Random variables, Probability distribution factors, Uncertainty/entropy information measures, Leakage, Quantifying Leakage and Partitions.		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Cryptography and Secure Communication: Secrecy, Authentication, Secret sharing, Quantum Cryptography, Randomized Ciphers, Types of codes: block codes, Hamming and Lee metrics.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Information-Theoretic Security and Cryptography: Information-theoretic security and cryptograph, basic introduction to Diffie-Hellman, AES, and side-channel attacks.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Secrecy Metrics and Secure Source Coding: Secrecy metrics: strong, weak, semantic security, partial secrecy, Secure source coding: rate-distortion theory for secrecy systems, Differential privacy.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Digital Forensics and Cryptography: Digital and network forensics, Public Key Infrastructure, Light weight cryptography, Elliptic Curve Cryptography and applications.		

Text Books:

1. Information Theory & Coding, Muralidhar Kulkarni, KS Shivaprakasha, John Wiley & Sons.
2. Communication Systems: Analog and digital, Singh and Sapre, Tata McGraw Hill.

Reference Books:

1. Fundamentals in information theory and coding, Monica Borda, Springer.
2. Information Theory, Coding and Cryptography R Bose.
3. Multi-media System Design, Prabhat K Andleigh and Kiran Thakrar.

INFORMATION THEORY FOR CYBER SECURITY LAB (Minor PCC)					
COURSE OUTLINE					
Course Title:	**INFORMATION THEORY FOR CYBER SECURITY LAB (PCC)**	**Short Title:**	**ITCSL**	**Course Code:**	**AIDS - 314C**

	Hours/week	**No. of weeks**	**Total hours**	**Semester credits**
Practical	02	15	30	01

COURSE CONTENT			
INFORMATION THEORY FOR CYBER SECURITY LAB		**Semester:**	**III**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA(PR):**	**25 marks**
		Internal Continuous Assessment (ICA) CA:	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame SIX laboratory assignments from the following list.

1. Entropy Calculation for a Random Experiment
   Choose a random experiment (e.g., flipping a coin, rolling a die).
   Calculate the entropy of the random variable using Shannon's entropy formula.
2. XOR Encryption and Decryption
   Write a Python program to encrypt and decrypt a string using the XOR operation.
   Demonstrate symmetric key encryption.
3. Implement the Caesar Cipher
   Develop a Python program that implements the Caesar Cipher.
   Encrypt and decrypt text using a fixed shift value.
4. Ciphertext Analysis
   Use a simple encryption method (e.g., Caesar Cipher or XOR).
   Show that the ciphertext alone does not reveal useful information without the key.
5. Simple Digital Signature System
   Implement a digital signature system using public and private keys.
   Demonstrate message signing and verification.
6. Hashing and Message Integrity
   Implement hashing using SHA-256 in Python.
   Verify message integrity by comparing hash values before and after modification.
7. Symmetric Key Encryption (AES)
   Use Python’s cryptography library to encrypt and decrypt data using AES.
   Demonstrate secure key management.

Guide lines for ICA:

Students must submit ICA in the form of journal. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.

DATA ENCRYPTION (Minor PCC)					
COURSE OUTLINE					
Course Title:	**DATA ENCRYPTION (PCC)**	**Short Title:**	**DE**	**Course Code:**	**AIDS - 416C**

Course description:
The course covers key concepts in data encryption and cryptography. Topics include symmetric and asymmetric cryptography, digital signatures and message authentication. Real-world case studies and attacks, will also be explored to understand practical cryptographic applications.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	03	15	45	03

Prerequisite course(s):
Linear Algebra, Cryptography

Course objectives:
The objective of this course is to introduce
1. Concept of security.
2. Types of attack experienced.
3. Encryption and authentication to deal with attacks

Course Outcomes:
After successful completion of this course, the student will be able to:
1. Understand key principles of data security and encryption.
2. Learn symmetric and asymmetric cryptographic algorithms (e.g. DES, RSA).
3. Apply digital signatures and message authentication techniques.
4. Analyze real-world cryptographic case studies and attacks.
5. Master key management and public-key cryptography.

COURSE CONTENT

DATA ENCRYPTION		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End Semester Exam (ESE) UA:**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

Unit–I:	No. of Lectures: 09 Hours	Marks: 12

Introduction to Security: Need for security, Security approaches, Principles of security, Types of attacks.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12

Encryption Techniques: Plaintext, Cipher text, Substitution & Transposition techniques, Encryption & Decryption, Types of attacks, Key range & Size.

Unit–III:	No. of Lectures: 09 Hours	Marks: 12

Symmetric & Asymmetric Key Cryptography: Algorithm types & Modes, DES, IDEA, RSA, Symmetric & Asymmetric key together, Digital signature.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

Case Studies of Cryptography: Denial of service attacks, IP spoofing attacks, Conventional Encryption and Message Confidentiality, Conventional Encryption Algorithms, Key Distribution.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Public Key Cryptography and Message Authentication: Approaches to Message Authentication, SHA-1, MD5, Public-Key Cryptography Principles, Key Management.

Text Books:
1. Cryptography and Network Security, Mohammad Amjad, John Wiley & Sons.
2. Cryptography & Network Security by Atul Kahate, TMH.

Reference Books:

1. Information Theory & Coding, Muralidhar Kulkarni, KS Shivaprakasha, John Wiley & Sons.
2. Cryptography and Network Security by B. Forouzan, McGraw-Hill.
3. The Data Compression Book by Nelson, BPB.

DATA ENCRYPTION LAB (Minor PCC)					
COURSE OUTLINE					
Course Title:	**DATA ENCRYPTION LAB (PCC)**		**Short Title:**	**DEL**	**Course Code:**	**AIDS - 417C**
	Hours/week	**No. of weeks**	**Total hours**		**Semester credits**	
Practical	02	15	30		01	

LAB COURSE CONTENT			
DATA ENCRYPTION LAB		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**End Semester Exam (ESE) UA(PR):**	**25 marks**
		Internal Continuous Assessment (ICA) CA:	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

Concerned faculty member should suitably frame SIX laboratory assignments from the following list.

1. Write a brief explanation of why security is important in computing and also
2. explain any 3 types of attacks.
3. Write a simple Caesar Cipher program in any language that shifts letters by 3 positions.
4. Write a Python program for implementing an XOR Cipher to encrypt and decrypt message using a single key.
5. Encrypt a message using the public key and decrypt it using the private key with Online RSA tool (to generate an RSA key pair).
6. Write a Python program to hash a string using SHA-1.
7. Write a Python program to hash a string using MD5.

Guide lines for ICA:

Students must submit ICA in the form of journal. Faculty in charge will assess the assignments continuously and grade or mark each assignment on completion date declared for each assignment.

Guidelines for ESE:

ESE will be based on practical assignment submitted by the student in the form of journal. Evaluation will be based on oral, paper work and performance in the ESE.