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

Second Year Bachelor of Engineering

in

Computer

(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) (Computer) (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)		
CS -301	Discrete Mathematics	PCC	3			3	40	60			100	3
CS -302	Discrete Mathematics Lab	PCC			2	2			25	25 (PR)	50	1
CS -303	Computer Organization and Architecture	PCC	3			3	40	60			100	3
CS -304	Computer Organization and Architecture Lab	PCC			2	2			25	25 (PR)	50	1
CS -305	Linux Programming Lab	PCC	1		2	3			25	25 (PR)	50	2
CS -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
CS -308	Principles of Economics	HSSM	2			2						2
CS -309	Universal Human Values	HSSM	1		2	3			25		25	2
CS -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) (Computer) (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)		
CS -401	Data Structure and Algorithms	PCC	3			3	40	60			100	3
CS -402	Data Structure and Algorithms-Lab	PCC			2	2			25	25 (PR)	50	1
CS -403	Database Management Systems	PCC	3			3	40	60			100	3
CS -404	Database Management Systems-Lab	PCC			2	2			25	25 (PR)	50	1
CS -405	Object Oriented Programming Lab	PCC	1		2	3			25	25 (PR)	50	2
CS -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
CS -408	Web Designing and Publishing	VSEC			2	2			25		25	1
CS -409	Ability Enhancement Course	AEC			2	2			25		25	1
CS -410	Innovation and Entrepreneurship	HSSM	2			2						2
CS -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 Computer (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)		
CS -412	Internship / Apprenticeship	OJT							125			4
CS -413	Mini Project	Project							25			4
									150			8

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

Second Year Bachelor of Engineering in Computer

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



COURSE OUTLINE

For Affiliated Colleges

Semester – III

W.E.F. 2025 – 26

DISCRETE MATHEMATICS (PCC)					
COURSE OUTLINE					
Course Title:	**DISCRETE MATHEMATICS**	**Short Title:**	DM	**Course Code:**	**CS-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, , IIT Kanpur.
   https://nptel.ac.in/courses/111104026
2. Discrete Mathematics by Dr. Sugata Gangopadhyay, Dr. Aditi Gangopadhyay, IIT Roorkee.
   https://nptel.ac.in/courses/111107058

DISCRETE MATHEMATICS LAB (PCC)						
COURSE OUTLINE						
Course Title:	**Discrete Mathematics Lab**		**Short Title:**	DML	**Course Code:**	**CS-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**	
Practical	**2 hours/week**	**End Semester Exam (ESE) UA:PR**	**25 marks**
		Internal Sessional Exam (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 assignments.

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, IIT Kanpur By Prof. A.K. Lal
   https://nptel.ac.in/courses/111104026

2. Discrete Mathematics, IIT Roorkee By Dr. Sugata Gangopadhyay, Dr. Aditi Gangopadhyay https://nptel.ac.in/courses/111107058

COMPUTER ORGANIZATION AND ARCHITECTURE (PCC)

COURSE OUTLINE

Course Title:	COMPUTER ORGANIZATION AND ARCHITECTURE	Short Title:	COA	Course Code:	CS-303

Course description:

The aim of this course is to introduce the students to the fundamentals of microprocessor with its internal architecture and programming model, basic operational concept within a computer, main memory & cache memory concept and various arithmetic operations on data.

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

Prerequisite course(s):

Fundamental Knowledge of Logic Gates and Number System.

Course objectives:

1. To introduce - the functional blocks of a computer system and 8086/8088 microprocessor.
2. To study 8086 instruction-set along with assembler directives and concept of macro & procedure.
3. To explain the basic operational concepts of processor and memory interaction, instruction formats, and the fundamentals of hardwired and microprogrammed control units.
4. To study various types of memory.
5. To learn number representation methods and algorithms for arithmetic operations like addition, subtraction, multiplication, division, and floating-point representation.

Course outcomes:

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

1. Describe the functional components of a computer system along with the understanding of 8086/8088 architecture, programming model, and addressing modes.
2. Write programs using the 8086-instruction set, macros & procedures, interrupts and assembler directives.
3. Illustrate the connection between processor and memory, identify instruction formats, and distinguish between hardwired and micro-programmed control unit designs.
4. Explain memory systems using hierarchical organization, memory interleaving, cache mapping techniques, and identify various types of memories.
5. Perform various arithmetic operations such as addition, subtraction, multiplication, division, and represent floating-point numbers in IEEE single and double precision formats.

COURSE CONTENT

COMPUTER ORGANIZATION AND ARCHITECTURE		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

Functional blocks of a computer: CPU, Memory, Input-Output, Control Unit.
8086/8088 Microprocessor: Internal Architecture, Programming Model, Register Organization, Memory Segmentation, Addressing Modes, Difference between 8086 and 8088.

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

8086 Instruction Set (Basic Instructions) Macro and Procedure ,8086 Assembler Directives (Basic Directives) DOS/BIOS Interrupts ,8086 Memory Banking

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

Basic Operational Concepts: Connection between Processor and Main Memory.
Instruction Formats: Zero, One, Two, Three and One & Half Address Instruction Formats
Basic Processing Unit: Some fundamental Concepts, Instruction Execution.
Introduction to I/O Interface, USB
Introduction to Hardwired and Micro-programmed Control Unit.

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

Important Characteristics of Memory System.
Memory Organization: Memory Interleaving, Hierarchical Memory Organization
Cache memory, Cache size vs. block size, Mapping Function and its Types.
Introduction to SRAM, DRAM, ROM, PROM, EPROM.

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

Number representation: Signed & magnitude, 1s & 2s Compliment, Integer Addition & Subtraction, Overflow.
Multiplication of Numbers: Booth's algorithm, Bit Pairing Method.
Division: Restoring and Non-Restoring Division Algorithms
Floating Point system: Normalization, Representation in IEEE Single & Double precision formats.

Text Books:

1. Douglas V Hall, Microprocessor and Interfacing, Programming and Hardware, Tata McGraw Hill, Revised 2nd Edition.
2. Yu-Cheng Liu and Glenn A. Gibson, Microcomputer Systems: The 8086/8088 Family. Architecture, Programming and Design, Prentice Hall of India, 2nd Edition.

Reference Books:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, McGraw Hill, 5th Edition.
2. John P. Hayes, Computer Architecture and Organization, WCB/McGraw-Hill, 3rd Edition.
3. William Stallings, Computer Organization and Architecture: Designing for Performance, by Pearson Prentice Hall, 7th Edition.
4. Vincent P. Heuring and Harry F. Jordan, Computer System Design and Architecture, Pearson Education, 2nd Edition.
5. V. Carl Hamacher, Zvonko G. Vranesic, Safwat G. Zaky, Computer Organization, The McGraw Hill Companies,Inc. 4th Edition.
6. Peter Abel, IBM PC Assembly Language and Programming, Pearson, 5th Edition.
7. John Uffenbeck, The 80x86 Family: Design, Programming and Interfacing, Pearson Education, 3rd Edition.

NPTEL Links:

1. Computer Organization and Architecture, IIT Guwahati, by Dr. Santosh Biswas, Prof. Jatindra Kumar Deka and Prof. Arnab Sarkar
   https://nptel.ac.in/courses/106103180
2. Computer Organization and Architecture, IIT Madras, by Prof. V. Kamakoti
   https://nptel.ac.in/courses/106106166
3. Microprocessor and Microcontrollers, IISc Bangalore, by Prof. Krishna Kumar

https://nptel.ac.in/courses/106108100
4. Microprocessors and Interfacing, IIT Guwahati, by Shaik Rafi Ahamed
https://nptel.ac.in/courses/108103157

Web Resources:

https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/

COMPUTER ORGANIZATION AND ARCHITECTURE LAB (PCC)					
COURSE OUTLINE					
Course Title:	**COMPUTER ORGANIZATION AND ARCHITECTURE LAB**	**Short Title:**	**COAL**	**Course Code:**	**CS-304**
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			
COMPUTER ORGANIZATION AND ARCHITECTURE 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 at least **SIX** laboratory assignments using 8086 Assembly Language Programming from the following list.

1. Program using MACRO: Display personal information using MACRO.
2. Program for Addition/Subtraction of two 8 bits numbers
3. Program for Addition/Subtraction of two 8 bits numbers using NEAR procedure.
4. Program for Addition/Subtraction of two 8 bits numbers using FAR procedure.
5. Program for Multiplication/Division of two 8 bits numbers using NEAR procedure.
6. Program for Multiplication/Division of two 8 bits numbers using FAR procedure.
7. Program to find out Factorial of any given number using recursive procedure.
8. Program to generate Fibonacci Series.
9. Program for Password Verification.
10. Program for BCD to HEX conversion.

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

Text Books:

1. Douglas V Hall, Microprocessor and Interfacing, Programming and Hardware, Tata McGraw Hill, Revised 2nd edition.
2. Peter Abel, IBM PC Assembly Language and Programming, 5th edition, Pearson.

Reference Books:

1. John E. Uffenbeck, The 8086/ 8088 Family: Design, Programming and Interfacing", By Pearson.
2. A. Ray and K. Bhurchandi , Advanced Microprocessors and Peripherals: Architecture, Programming & Interfacing, Tata McGraw Hill, 3rd Edition by
3. Barry B Bray, "The Intel Microprocessors-Architecture, Programming and Interfacing", Pearson LPE/PHI, 7th Edition.
4. B. Ram, Computer Fundamentals Architecture and Organization, New Age International Rajaraman, Computer Organization & Architecture, PHI Learning

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:

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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. Microprocessor and Microcontrollers, IISc Bangalore, by Prof. Krishna Kumar
   https://nptel.ac.in/courses/106108100
2. Microprocessors and Interfacing, IIT Guwahati, by Shaik Rafi Ahamed
   https://nptel.ac.in/courses/108103157

Web Resources:

https://github.com/jake1412/8086-Programs

LINUX PROGRAMMING LAB (PCC)

LAB COURSE OUTLINE

Course Title:	**LINUX PROGRAMMING LAB**	**Short Title:**	**LPL**	**Course Code:**	**CS-305**

Course description:

This course introduces students to the fundamental concepts of Linux operating systems, command-line usage, shell scripting, and basic system programming in "C" language.

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

Prerequisite course(s):

Some basics of C language programming

Course Objectives:

1. To introduce students to the fundamentals of UNIX/Linux operating systems.
2. To familiarize students with essential UNIX/Linux commands and utilities
3. To explain the basics of shell scripts along with its execution.
4. To provide hands-on experience in basic shell scripting and C programming.

Course Outcomes:

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

1. Explain UNIX/Linux operating system architecture.
2. Execute basic UNIX/Linux commands and utilities.
3. Design and develop basic shell scripts.
4. Implement file handling operations using system calls in C programs.
5. Able to understand and implement process Management.

LAB COURSE CONTENT

LINUX PROGRAMMING 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)**	

LAB COURSE CONTENT

1: Introduction to Linux and UNIX

- The operating system
- History and Evolution of UNIX/Linux
- Architecture of UNIX/Linux
- UNIX/Linux File System

2: UNIX/Linux Commands and Utilities

- Basic Commands: e.g. cal, date, ls, pwd, cd, cp, mv, rm, mkdir, rmdir
- File Permissions and Ownership: e.g. chmod, chown, chgrp
- Text Processing Commands: e.g. cat, more, grep
- Process Management Commands: e.g. ps, kill

3: Shell Scripting

- Shell Scripting Basics
- Variables, Operators, and Conditional Statements
- Looping Constructs: for, while, until
- Taking Decisions: if-then-fi, if-then-else-fi

4: File Handling and System Calls

- File Descriptors and File Handling System Calls (open, read, write, close)
- File Manipulation (lseek, stat, chmod)
- Directory Handling (mkdir, rmdir, opendir, readdir)

5: Process Management

- Introduction to Process and Process States
- Creating and Terminating Processes (fork, exec, wait, exit)

Practical: -

Concerned faculty member should suitably frame at least **SIX** laboratory assignments from the following list:

Group: A

Any THREE from the following list: -

1. Write a shell script for finding out file type and displaying the list of files in a directory.
2. Write a shell script for displaying user process and system related information.
3. Write a shell script to create basic calculator.
4. Write a shell script to count the number of files in directory.
5. Write a shell script to display current time of system and display the message according to the time.

Group: B

Any THREE from the following list: -

1. Study and execution of various Linux commands.
2. Write a C program to print User ID and Group ID.
3. Write a C program to demonstrate the use of read and write functions.
4. Write a C program to demonstrate the use of command line arguments.

   Write a C program to demonstrate the use of fork () function for creating child process.

Text Books:

1. Sumitabha Das, "UNIX Concepts and Applications", Tata McGraw-Hill Publications.
2. Yashwant P. kanetkar, "Unix Shell Programming", BPB Publicatins.

Reference Books:

1. Neil Mathew, Richard Stones, "Beginning Linux Programming", Wiley Publications.
2. W. Richard Stevens and Stephen A. Rago, "Advanced Programming in the UNIX Environment", PEARSON
3. Robert Love, "Linux System Programming", 2nd Edition, O'REILLY.
4. Richard Blum and Christine Bresnaham, "Linux Command Line and Shell Scripting BIBLE", 3rd Edition, WILEY.
5. Randal K. Michael, "Mastering UNIX Shell Scripting", 2nd Edition, WILEY.

NPTEL Links:

Linux Programming and Scripting, IIT Madras. Anand Iyer, IIT Madras
https://nptel.ac.in/courses/117106113

Web Resources:

https://www.geeksforgeeks.org/linux-tutorial/
https://www.geeksforgeeks.org/introduction-linux-shell-shell-scripting/

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.

BIOLOGY FOR ENGINEERS (MD M)					
COURSE OUTLINE					
Course Title:	**BIOLOGY FOR ENGINEERS**	**Short Title:**	BE	**Course Code:**	**CS - 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

Prerequisite course(s):

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:**	CS-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:

1. Principles Of Economics represented by Prof. Sabuj Kumar Manda, IIT Madras.
   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**	**Short Title:**	**UHV**	**Course Code:**	**CS - 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, JeevanVidyaPrakashan, 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**	**Short Title:**	**CEP**	**Course Code:**	**CS-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 weeks**	**Total hours**	**Semester credits**
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



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 (Computer)

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



COURSE OUTLINE

For Affiliated Colleges

Semester – IV

W.E.F. 2025 – 26

DATA STRUCTURE & ALGORITHM (PCC)					
COURSE OUTLINE					
Course Title:	**DATA STRUCTURE & ALGORITHMS**	**Short Title:**	DSA	**Course Code:**	**CS-401**

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:**	**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 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 Publications.
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**		**Short Title:**	DSAL	**Course Code:**	**CS-402**
	Hours/week	**No. of weeks**	**Total hours**		**Semester credits**	
Practical	02	15	30		**1**	
COURSE CONTENT						
DATA STRUCTURE AND ALGORITHMS LAB			**Semester:**		**IV**	
Teaching Scheme:			**Examination scheme**			
Practicals:	**2 hours/week**		**End Semester Exam (ESE) UA:PR**		**25 marks**	
			Internal Sessional Exam (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 laboratory assignments 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. 4. 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. 5. 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. 6.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 assignments.
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 .

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

<table>
<tr><th colspan="6">DATABASE MANAGEMENT SYSTEM LAB (PCC)</th></tr>
<tr><th colspan="6">COURSE OUTLINE</th></tr>
<tr><td>Course Title:</td><td colspan="2">DATABASE MANAGEMENT SYSTEM LAB</td><td>Short Title:</td><td>DBMSL</td><td>Course Code: CS-404</td></tr>
<tr><td></td><td colspan="2">Hours/week</td><td>No. of weeks</td><td>Total hours</td><td colspan="2">Semester credits</td></tr>
<tr><td>Practical</td><td colspan="2">02</td><td>15</td><td>30</td><td colspan="2">1</td></tr>
<tr><th colspan="6">COURSE CONTENT</th></tr>
<tr><td colspan="3">DATABASE MANAGEMENT SYSTEM LAB</td><td colspan="2">Semester:</td><td>IV</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="3">Examination scheme</td></tr>
<tr><td>Practical:</td><td colspan="2">2 hours/week</td><td colspan="2">End Semester Exam (ESE) UA:PR</td><td>25 marks</td></tr>
<tr><td colspan="3"></td><td colspan="2">Internal Sessional Exam (ICA):CA</td><td>25 marks</td></tr>
<tr><td colspan="3">End Semester Exam (ESE) Pattern:</td><td colspan="3">Practical (PR)</td></tr>
<tr><td colspan="6">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.</td></tr>
</table>

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.

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.

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

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

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

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

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:-

Lab manual should contain at least SIX experiments from the following list.

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. Robert Lafore, "Object Oriented Programming in C++", Pearson Education, 2002, Fourth Edition

Reference Books:

1. Ashok N. Kamthane, "Object-Oriented Programming with ANSI and Turbo C++",Pearson Education, 2006, 1st Edition
2. Rajesh K. Shukla, "Object-Oriented Programming in C++", Wiley India, 2008, 1st Edition
3. Yashavant P. Kanetkar, "Let Us C++", BPB Publications, 3rd Edition
4. Venugopal K.R., "Mastering C++", TMH, 2nd Edition.
5. Mahesh Bhave, Sunil Patekar, "Object Oriented Programming with C++", Second Edition, 2012.
6. Herbert Schildt, "The Complete Reference C++", TMH , Fourth Edition, , 2003.
7. R.S. Salaria, Mastering Object-Oriented Programming with C++, Khanna Book Publishing, N.Delhi

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 assignments.

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

Course description:

This course covers operational amplifiers (Op-Amps), their characteristics, and applications in analog circuits. Students will study amplifiers, comparators, filters, and signal conversion techniques (DAC/ADC). Fundamentals of signals and systems, including Fourier series and Laplace transforms, are introduced. Practical design guidelines and real-world applications are emphasized. The course enhances problem-solving skills in analog and signal processing domains.

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

Prerequisite course(s): Basic understanding of electronics, circuit analysis, and semiconductor devices. Familiarity with calculus and differential equations is recommended.

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 SYSTEM		**Semester:**	**IV**
Teaching Scheme :		**Examination scheme:**	
Lectures:	**2 hours/week**	**End Semester Examination (ESE) UA:**	**60**
		Internal Sessional Examination (ISE) CA :	**40**
		Internal Continuous Assessment (ICA)CA:	**25**
Unit–I:	**No. of Lectures: 06 Hours**	**Marks: 12**	

Operational amplifier

Operational amplifier IC-741 and its pin configuration Op-Amp: open loop and closed loop amplifier Op-Amp characteristics: Input and output offset voltage, Input offset current, Input bias current, CMRR, slew rate, frequency response. Inverting and non-inverting amplifier with derivation of voltage gain Summing and differential amplifier, integrator, differentiator, comparator, V-I and I-V converter.

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

Applications of Op-Amp

Instrumentation amplifier, log amplifier, antilog amplifier, Schmitt trigger. Astable, Monostable and Bistable multivibrator.

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

Filters and Convertors

OPAMP active filters – Low pass, high pass, band pass ,band stop , Design guidelines, DAC-Weighted registor,R2R ladder, ADC-Single slope , Dual slope and Successive approximation, Switched capacitors circuit, basic concept and practical configuration.

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

Introduction to Signals: Elementary Signals- Continuous Time (CT) signals, Discrete Time (DT) signals, Classification of Signals, Basic Operations on signals. Classifications of Systems-Static and dynamic systems, linear and non-linear systems, time variant and time invariant systems, stable and unstable systems.

Fourier Series: Trigonometric Fourier series, complex or exponential form of Fourier series, Parseval's identity for Fourier series.

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

Laplace Transforms: Definition, Region of Convergence (ROC), LT of some important function and numerical. Initial value theorem, Final value theorem. Convolution integral, numericals. Application of LT only in series R-L circuit and series R-C circuit.

Text Books:

1. Ramakanth A. Gayakwad, "Op-Amps and Linear Integrated Circuits," Pearson Education.
2. D. Roy Choudhury and Shail Jain, "Linear Integrated Circuits," New Age International Publishers.

Reference Books:

1. S Salivahanan. A Vallavaraj C. Gnanapriya, Digital Signal Processing, TMH, Second Edition 2001.
2. K. R. Botkar, "Linear Integrated Circuits," Khanna Publishers.
   A. Anand Kumar, "Signals and Systems," PHI Learning Pvt. Ltd.
3. Oppenheim A. V. and Willsky A. S., "Signals and Systems," Pearson Education.
4. Simon Haykin and Barry Van Veen, "Signals and Systems," Wiley India.
5. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications," Pearson Education.

Guidelines for ICA

Concern Faculty Member should frame at least **SIX** assignment base on given syllabus. 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.

NPTEL Links:

1. Integrated Circuits and applications by By Prof. Shaik Rafi Ahamed,IIT Guwahati https://onlinecourses.nptel.ac.in/noc24_ee73/preview
2. Principles of signals and Systems by By Prof. Aditya K. Jagannatham ,IIT Kanpur https://onlinecourses.nptel.ac.in/noc20_ee15/preview

WEB DESIGNING AND PUBLISHING LAB (VSEC)					
COURSE OUTLINE					
Course Title:	**WEB DESIGNING AND PUBLISHING LAB**	**Short Title:**	WDPL	**Course Code:**	**CS-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
Reference Books:
1. Twitter Bootstrap 4 Succinctly” by Peter Shaw 2. Learning jQuery by Stack Overflow Community 3. 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**	**Short Title:**	**AEC**	**Course Code:**	**CS - 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**	**Short Title:**	**I&E**	**Course Code:**	**CS-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.

Reference Books:

1. 8 Steps To Innovation: Going From Jugaad To Excellence, Collins India, 2013. ISBN: 9789350293584.
2. Pavan Soni, “Design Your Thinking - The Mindsets, Toolsets and Skill Sets For Creative Problem Solving”, Penguin Random House India Pvt. Ltd. 2020, ISBN: 9780670094097.
3. Intellectual Property, A primer for academia, Prof. Rupinder Tiwari, Mamta Bharadwaj, Publication Bureau Panjab University Chandigarh.
4. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Currency; Illustrated, 2011. ISBN: 9780307887894.

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:**	**CS - 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.)

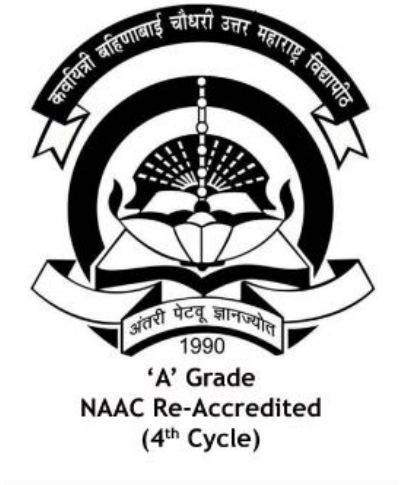
Second Year Bachelor of Engineering

in

Computer

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



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 Title:	**LOGICAL REASONING AND PROBLEM SOLVING**	**Short Title:**	LRPS	**Course Code:**	**OE – 407 B**

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:**	RM	**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
Lecture	**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

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Honors offered by Computer 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 Computer are as follows.

A. Data Science
B. Blockchain
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 – Honors
in
Data Science
for Second Year Bachelor of Engineering
in
Computer
(As per NEP 2020 Guidelines)

Faculty of Science and Technology

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

SYLLABUS STRUCTURE & COURSE OUTLINE
For Affiliated Colleges
Semester – III & IV
W.E.F. 2025 – 26

Specialization Honors in "Data Science"

Syllabus Structure for Specialization Honors in "Data Science": 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)		
CS-311 A	Data Science and Visualization	PCC	3			3	40	60			100	3
CS-312 A	Data Science and Visualization Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Data Science": 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)		
CS-414 A	Statistics and Machine Learning	PCC	3			3	40	60			100	3
CS-415 A	Statistics and Machine Learning Lab	PCC			2	2			25	25 (PR)	50	1

DATA SCIENCE AND VISUALIZATION (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**DATA SCIENCE AND VISUALIZATION**	**Short Title:**	DSV	**Course Code:**	CS-311A

Course description:
This course introduces key concepts in data science and big data analytics, covering the data science process, statistical foundations, machine learning techniques, and data visualization. Topics include clustering, regression, classification, decision trees, neural networks, and dashboard design. Students will gain hands-on experience in data analysis and visualization, developing essential skills for data-driven decision-making.

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

Prerequisite course(s): Computer graphics, Database management system

Date Science and Visualization

Course objectives:

The objective of this course is to:

1. To learn data collection and preprocessing techniques for data science
2. To Understand and practice analytical methods for solving real life problems.
3. To study data exploration techniques
4. To learn different types of data and its visualization
5. To study different data visualization techniques and tools

Course outcomes:

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

1. Apply data preprocessing methods on open access data and generate quality data for analysis
2. Apply and analyze classification and regression data analytical methods for real life Problems.
3. Implement analytical methods using Python/R CO4: Apply different data visualization techniques to understand the data.
4. Analyze the data using suitable method; visualize using the open-source tool.
5. Model Multi-dimensional data and visualize it using appropriate tool tool.

COURSE CONTENT

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

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

Defining data science and big data, Recognizing the different types of data, Gaining insight into the data science process, Data Science Process: Overview, Different steps, Machine Learning Definition and Relation with Data Science

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

Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Some Other Correlational Caveats, Correlation and Causation Probability : Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem

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

Data Analysis Theory and Methods: Clustering –Overview, K-means- overview of method, determining number of clusters, Association Rules- Overview of method, Apriori algorithm, evaluation of association rules, Regression-Overview of linear regression method, model description.

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

Decision Trees: What Is a Decision Tree? Entropy, The Entropy of a Partition, Creating a Decision Tree, Random Forests Neural Networks : Perceptron's, Feed-Forward Neural Networks, Backpropagation, Example: Defeating a CAPTCHA

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

Introduction to data visualization, challenges of data visualization, Definition of Dashboard, Their type, Evolution of dashboard, dashboard design and principles, display media for dashboard. Types of Data visualization: Basic charts scatter plots, Histogram, advanced visualization Techniques like streamline and statistical measures, Plots, Graphs, Networks, Hierarchies, Reports.

Text Books:

1. Data Mining: Concepts and Techniques, 3rd Edition. Jiawei Han, Micheline Kamber, Jian Pei.
2. Data Science from Scratch : Joel Grus, O'Reilly Media Inc., ISBN: 9781491901427
3. Information visualization perception for design, colin ware, MK publication

Reference Books:

1. Big data black book, Dream tech publication
2. Getting Started with Business Analytics: Insightful Decision-Making , David Roi Hardoon, GalitShmueli, CRC Press
3. Business Analytics, James R Evans, Pearson
4. Python Data science Handbook, Jake VanderPlas, Orielly publication
5. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Vovost Foster, Fawcett Tom

NPTEL Links:

1. Essential Mathematics For Machine Learning, IIT Roorkee, by Prof. Sanjeev Kumar and Prof. S.K. Gupta.
   https://archive.nptel.ac.in/courses/111/107/111107137/
2. Data Science For Engineers, IIT Madras, by Prof. Ragunathan Rengasamy and Prof. Shankar Narasimhan.
   https://archive.nptel.ac.in/courses/106/106/106106179/
3. Biological data analysis and visualization with R, IIT Kharagpur, By Prof. Riddhiman Dhar
   https://onlinecourses.nptel.ac.in/noc25_bt43/preview

DATA SCIENCE AND VISUALIZATION LAB (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**DATA SCIENCE AND VISUALIZATION LAB**	**Short Title:**	**DSVL**	**Course Code:**	**CS-312A**

	Hours/week	**No. of weeks**	**Total hours**	**Semester**
Practical	**02**	**15**	**30**	**3**

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

Concern faculty member should conduct any SIX Laboratory Assignment

1. Introduction to Data Science and Big Data: Define Data Science and Big Data with real-world applications.
2. Introduction to Data Science and Big Data: Explore different sources of Big Data (structured, semi-structured, unstructured).
3. Recognizing Different Types of Data: Load and analyze structured (CSV, Excel), semi-structured (JSON, XML), and unstructured (text, image) data.
4. Data Science Process and Its Steps: Perform Exploratory Data Analysis (EDA) on a given dataset.
5. Descriptive Statistics and Probability: Compute mean, median, mode, variance, and standard deviation of a dataset.
6. Implement Linear Regression to predict continuous values.
7. Construct a Decision Tree classifier and visualize it.

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. Essential Mathematics For Machine Learning, IIT Roorkee, by Prof. Sanjeev Kumar and Prof. S.K. Gupta.
   https://archive.nptel.ac.in/courses/111/107/111107137/
2. Data Science For Engineers, IIT Madras, by Prof. Ragunathan Rengasamy and Prof. Shankar Narasimhan.
   https://archive.nptel.ac.in/courses/106/106/106106179/

STATISTICS AND MACHINE LEARNING (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**STATISTICS AND MACHINE LEARNING**	**Short Title:**	SML	**Course Code:**	CS-414A

Course description: This course covers essential statistical concepts and their role in Machine Learning. Topics include descriptive and inferential statistics, hypothesis testing, correlation, regression analysis, and Bayesian learning. Students will explore supervised, unsupervised, and reinforcement learning, along with regression models, decision trees, and Naïve Bayes classifiers.

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

Prerequisite course(s):

Date Science and Visualization

Course objectives:

The objective of this course is to:

1. To understand basis of statistics and mathematics for Machine Learning
2. To understand basis of descriptive statistics measures and hypothesis
3. To learn various statistical inference methods
4. To introduce basic concepts and techniques of Machine Learning
5. To learn different linear regression methods used in machine learning

Course outcomes:

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

1. Apply appropriate statistical measure for machine learning applications
2. Usage of appropriate descriptive statistics measures for statistical analysis
3. Usage of appropriate statistics inference for data analysis
4. Identify types of suitable machine learning techniques
5. Apply regression techniques to machine learning problems

COURSE CONTENT

STATISTICS AND MACHINE LEARNING		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**		
		End Semester Examination (ESE) UA:	**60 marks**
		Internal Sessional Exam (ISE) CA:	**40 marks**

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

Types of Statistical Inference, Descriptive Statistics, Inferential Statistics, Importance of Statistical Inference in Machine Learning. Descriptive Statistics, Measures of Central Tendency: Mean, Median, Mode, Mid-range, Measures of Dispersion: Range, Variance, Mean Deviation, Standard Deviation. One sample hypothesis testing, Hypothesis, Testing of Hypothesis, Chi-Square Tests, t-test, ANOVA and ANOCOVA. Pearson Correlation, Bi-variate regression, Multi-variate regression, Chi-square statistics

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

Measure of Relationship: Covariance, Karl Pearson's Coefficient of Correlation, Measures of Position: Percentile, Z-score, Quartiles, Bayes' Theorem, Bayes Classifier, Bayesian network, Discriminative learning with maximum likelihood, Probabilistic models with hidden variables, Linear models, regression analysis, least squares.

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

What is Machine Learning? Well posed learning problems, Designing a Learning system,Machine Learning types-Supervised learning, Unsupervised learning, and Reinforcement Learning, Applications

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

Introduction, types of regression. Simple regression- Types, Making predictions, Cost function, Gradient descent, Training, Model evaluation.
Multivariable regression : Growing complexity, Normalization, Making predictions, Initialize weights,
Cost function, Gradient descent, Simplifying with matrices, Bias term, Model evaluation

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

Decision tree representation, Constructing Decision Trees, Classification and Regression Trees, hypothesis space search in decision tree learning Bayes' Theorem, Working of Naïve Bayes' Classifier, Types of Naïve Bayes Model, Advantages, Disadvantages and Application of Naïve Bayes Model

Text Books:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education

Reference Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand and Sons, New Delhi, 2009,
2. Kothari C.R., "Research Methodology. New Age International, 2004, 2nd Ed; ISBN:13: 978- 81-224-1522-3Peter Harrington, Machine Learning In Action, DreamTech Press 2.ISBN: 9781617290183
3. Alpaydin, Ethem. Machine learning: the new AI. MIT press, 2016, ISBN: 9780262529518
4. Stephen Marsland, Machine Learning An Algorithmic Perspective, CRC Press, ISBN: : 978-1-4665-8333-7

NPTEL Links:

1. "Essential Mathematics for Machine Learning" by Prof. S.K. Gupta and Prof. Sanjeev Kumar Department of Mathematics Indian Institute of Technology Roorkee. https://archive.nptel.ac.in/courses/111/107/111107137/

STATISTICS AND MACHINE LEARNING LAB (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**STATISTICS AND MACHINE LEARNING LAB**		**Short Title:**	SMLL	**Course Code:** CS-415A
	Hours/week	**No. of weeks**	**Total hours**		**Semester credits**
Practical	02	15	30		1

COURSE CONTENT			
STATISTICS AND MACHINE LEARNING 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)**	

Concerned faculty member should suitably frame SIX laboratory assignments from the following list.

1. Compute mean, median, mode, and mid-range for a given dataset.
2. Implement variance, standard deviation, and range calculations.
3. Implement Chi-Square Test, t-test, ANOVA, and ANCOVA in Python.
4. Compute Pearson's correlation coefficient for a dataset.
5. Implement Bivariate and Multivariate regression models.
6. Calculate Covariance and Karl Pearson's Coefficient of Correlation.
7. Implement Z-score, Percentile, and Quartiles for a dataset.
8. Implement Bayes' Theorem for classification problems.
9. Train and evaluate a Bayes Classifier using a real-world dataset.
10. Implement Linear Regression using Least Squares method.
11. Apply ML techniques in healthcare, finance, and security.
12. Build and evaluate a Simple Linear Regression model.
13. Implement Classification and Regression Trees (CART).
14. Implement Naïve Bayes Classifier on a dataset.

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. "Essential Mathematics for Machine Learning" by Prof. S.K. Gupta and Prof. Sanjeev Kumar Department of Mathematics Indian Institute of Technology Roorkee.
   https://archive.nptel.ac.in/courses/111/107/111107137/

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

Bachelor of Engineering – Honors
in
Blockchain
for Second Year Bachelor of Engineering
in
Computer
(As per NEP 2020 Guidelines)

Faculty of Science and Technology

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

SYLLABUS STRUCTURE & COURSE OUTLINE
For Affiliated Colleges
Semester – III & IV
W.E.F. 2025 – 26

Specialization Honors in "Blockchain"

Syllabus Structure for Specialization Honors in "Blockchain": 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)		
CS-311B	Fundamentals of Blockchain	PCC	3			3	40	60			100	3
CS-312B	Fundamentals of Blockchain Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Blockchain": 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)		
CS-414B	Smart Contracts and Solidity	PCC	3			3	40	60			100	3
CS-415B	Smart Contracts and Solidity Lab	PCC			2	2			25	25 (PR)	50	1

FUNDAMENTALS OF BLOCKCHAIN (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**FUNDAMENTALS OF BLOCKCHAIN**	**Short Title:**	FB	**Course Code:**	**CS-311B**

Course description:
Blockchain is an emerging technology platform for developing decentralized applications and data storage, over and beyond its role as the technology underlying the cryptocurrencies. The basic tenet of this platform is that it allows one to create a distributed and replicated ledger of events, transactions, and data generated through various IT processes with strong cryptographic guarantees of tamper resistance, immutability, and verifiability. It has applications in finance, government, media and almost all other industries.

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

Prerequisite course(s):
Data Structures and Algorithms & Cryptography Techniques

Course objectives:
The objective of this course is to:
1. Understand the concept of blockchain, how it works, and its key components.
2. Learn how cryptographic techniques like hashing, public-key cryptography, and digital signatures are used to secure data and transactions on blockchain networks.
3. Examine the architecture of various blockchain systems.
4. Understand the role and functioning of smart contracts.

Course outcomes:
After successful completion of this course the student will be able to:
1. Understand the structure of a block chain and why/when it is better than a simple distributed database.
2. Discuss security aspects in blockchain through cryptography.
3. Describe how Crypto currency mining works.
4. Write smart contract using Ethereum frameworks.
5. Integrate ideas from various domains and develop block chain based solutions.

COURSE CONTENT

FUNDAMENTALS OF BLOCKCHAIN		**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
Distributed systems: CAP Theorem, Byzantine General Problem, Consensus, History of Blockchain, Introduction to Blockchain, Generic Elements of blockchain, Benefits and limitations of blockchain, Tiers of blockchain, Features of a blockchain, Types of blockchain, Consensus, CAP theorem and blockchain.

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

Cryptography in Blockchain
Cryptographic primitives, Symmetric cryptography: Stream cipher, Block Ciphers, Data Encryption standard, Advanced Encryption Standard, Asymmetric cryptography, Public and private keys: RSA,

Discrete Logarithm problem, Hash functions, Secure Hash Algorithms, Merkle Trees, Patricia Trees, Distributed Hash Table, Digital Signatures.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Understanding Block chain with Crypto currency		
Bitcoin definition, Transactions: life cycle, structure and types of transaction, Blockchain: structure of a block, structure of a block header, The genesis block, Mining: , Task of miners, Mining rewards, Proof of Work, Mining Algorithms, Hashing rate, Mining Systems, Mining Pools, Bitcoin Network, Bitcoin Limitations		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Smart Contracts and Ethereum		
Smart Conracts: History, Definition, Ricardian contracts: Smart contract templates, Smart Oracles, Deploying smart contract on Blockchain. Ethereum: Introduction, Ethereum Network, components of Ethereum: Keys and addresses, Accounts, Transactions and messages, Ether cryptocurrency, The Ethereum Virtual Machine (EVM), Blocks and blockchain: The genesis block, The block validation mechanism, Block finalization, Block difficulty		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Hyperledger and Block chain outside of Currencies		
Hyperledger Fabric : The Reference Architecture , Requirements and design goals of Hyperledger Fabric, Hyperledger Fabric: Membership services, Blockchain services: consensus services, distributed ledger: peer to peer protocol, Ledger Storage, Components of Fabric: Peers, Applications on Blockchain, Blockchain outside of Currencies: Internet of Things, Government, Health, Finance, Media.		
Text Books:		
1. "Mastering Block Chain: Distributed ledger technology, decentralization, and smart contracts explained" by Imran Bashir, Packt Publishing, Second Edition.		
Reference Books: 1. "Block Chain: Blueprint for a New Economy" by Melanie Swan, O'Reilly, 2015 2. "Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming" by Josh Thompsons,Daniel Drescher. 3. "Block Chain Basics", Apress; 1 st edition, 2017. 4. "Block Chain and Crypto Currencies" Anshul Kaushik, Khanna Publishing House, Delhi. 5. "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Block Chain" by Ritesh Modi,, Packt Publishing. 6. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman 7. "Hands-On Block Chain with Hyperledger: Building Decentralized 8. Applications with Hyperledger Fabric and Composer" by Ramakrishna, Import, 2018		
NPTEL Links: 1. "Introduction to Blockchain Technology and Applications" by By Prof. Sandeep Shukla, IIT Kanpur.https://swayam.gov.in/nd1_noc20_cs01/preview		

FUNDAMENTALS OF BLOCK CHAIN LAB (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**FUNDAMENTALS OF BLOCK CHAIN LAB**	**Short Title:**	FBL	**Course Code:**	CS-312B

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

COURSE CONTENT			
FUNDAMENTALS OF BLOCKCHAIN 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 at least **SIX** Laboratory assignments from the syllabus.

1. Program to Create Merkle tree
2. Program for Creation of Block
3. Program for Block chain Implementation.
4. Creating ERC20 token
5. Implement blockchain in Merkle Trees
6. Implement Mining using block chain
7. Implement peer-to-peer using block chain
8. Creating a Crypto-currency Wallet.

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 Link

1. Blockchain Architecture Design and Use Cases, IIT Madras By Prof. Sandip Chakraborty, Praveen Jayachandran
   https://nptel.ac.in/courses/106105184/
2. Introduction to Blockchain Technology and Applications By Prof. Sandeep Shukla | IIT Kanpur
   https://swayam.gov.in/nd1_noc20_cs01/preview

SMART CONTRACTS AND SOLIDITY (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**SMART CONTRACTS AND SOLIDITY**	**Short Title:**	SCS	**Course Code:**	**CS-414B**

Course description:
Block chain is an emerging technology platform for developing decentralized applications and data storage, over and beyond its role as the technology underlying the crypto currencies. The basic tenet of this platform is that it allows one to create a distributed and replicated ledger of events, transactions, and data generated through various IT processes with strong cryptographic guarantees of tamper resistance, immutability, and verifiability. It has applications in finance, government, media and almost all other industries.

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

Prerequisite course(s):
Fundamental of Block chain

Course objectives:
The objective of this course is to:
1. Students should be able to understand the concept of smart contracts related to block chain.
2. Students should be able to understand the smart contract higher-level language Solidity and apply it to create smart contracts.
3. Students should be able to learn Truffle IDE for creating and deploying a DApp.

Course outcomes:
After successful completion of this course the student will be able to:
1. To understand the working and importance of smart contracts.
2. To learn the solidity language required for coding Ethereum smart contracts.
3. To explain the concept of consensus in block chain networks and the role it plays in ensuring the integrity and security of distributed systems
4. Demonstrate the process of compiling Solidity code using solc to generate bytecode and application binary interfaces (ABIs).
5. To create and deploy a DApp on an Ethereum test network.

COURSE CONTENT

SMART CONTRACTS AND SOLIDITY		**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**

Smart Contracts

What Is a Smart Contract?, Life Cycle of a Smart Contract, Introduction to Ethereum High-Level Languages, Building a Smart Contract with Solidity, The Ethereum Contract ABI.

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

Introduction to Solidity		
Programming with Solidity: Data Types, Predefined Global Variables and Functions,Contract Definition, Functions, Contract Constructor and self-destruct, Adding a Constructor and selfdestruct to our Faucet Example, Function Modifiers, Contract Inheritance, Error Handling (assert, require, revert), Events, Calling Other Contracts (send, call, call code, delegate call) , Gas Considerations.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Consensus		
Consensus via Proof of Work, Consensus via Proof of Stake (PoS), Ethash: Ethereum's Proof-of-Work Algorithm, Casper: Ethereum's Proof-of-Stake Algorithm, Principles of Consensus, Controversy and Competition, Ethereum Fork History: Ethereum Classic (ETC), The Decentralized Autonomous Organization (The DAO),The DAO Hard Fork, Timeline of the DAO Hard Fork, Ethereum and Ethereum Classic: The EVM, Core Network Development.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Development Tools and Frameworks		
Languages, Compilers: Solidity compiler (solc), Integrated Development Environments (IDEs): Remix, Tools and libraries: Node version 7, EthereumJS, Ganache, MetaMask, Truffle, Contract development and deployment: Writing, Testing.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Decentralized App		
What Is a DApp? , Backend (Smart Contract) , Frontend (Web User Interface), Data Storage, Decentralized Message Communications Protocols, A Basic DApp Example: Auction DApp: Auction DApp: Backend Smart Contracts, Auction DApp: Frontend User Interface, Further Decentralizing the Auction DApp, Storing the Auction DApp on Swarm: Preparing Swarm, Uploading Files to Swarm.		
Text Books:		
1. "Mastering Ethereum: Building Smart Contracts and Dapps Book" by Shroff Publisher/O′Reilly Publisher, Andreas Antonopoulos and Gavin Wood. 2. "Mastering Block Chain: Distributed ledger technology, decentralization, and smart contracts explained" by Imran Bashir, Packt Publishing, Second Edition.		
Reference Books: 1. "Tiana Laurence, Blockchain for Dummies" by John Wiley & Sons , 2nd Edition 2019. 2. "Building Blockchain Projects Packt Publishing" by Narayan Prusty. 3. "Block Chain: Blueprint for a New Economy" by Melanie Swan, O'Reilly, 2015. 4. "Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming" by Josh Thompsons. 5. "Block Chain and Crypto Currencies" Anshul Kaushik, Khanna Publishing House, Delhi. 6. "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Block Chain" Ritesh Modi, Packt Publishing.		
NPTEL Links: 1. "Introduction to Blockchain Technology and Applications" by Prof. Sandeep Shukla, IIT Kanpur. https://swayam.gov.in/nd1_noc20_cs01/preview		

SMART CONTRACTS AND SOLIDITY LAB (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**SMART CONTRACTS AND SOLIDITY LAB**	**Short Title:**	SCSL	**Course Code:**	CS-415B

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

Prerequisite course(s):

Fundamental of Blockchain Lab

COURSE CONTENT

Smart Contracts and Solidity Lab		**Semester:**	IV	
Teaching Scheme:		**Examination scheme**		
Practical:	**3 hours/week**	**End semester exam (ESE)PR 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 from the syllabus. Faculty may use following list of experiment as a reference.

1. A) Generate Public private key pairs for Bitcoin and Ethereum addresses.
   B) Connect to the Public/Testnet Ethereum Blockchain network using popular wallets (Metamask, Brave browser) and understand various terminologies like gas, gas fee, gas price, priority fee.
   C) Send test ether from one account to another.
   D) Send test ether to smart contract.
2. Installation and Configuration of Node.js and Web3.js
3. Using Web3.js to Transfer Ether from one account to another.
4. Create a Private Ethereum Blockchain network.
5. Using Web3.js to Interact with Smart Contracts.
6. Using Web3.js with Chrome to Interact with Smart Contracts.
7. Create an Ethereum Permissioned block chain network.
8. Write, deploy and execute chain code in Ethereum Blockchain network.

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
Cyber Security
for Second Year Bachelor of Engineering
in
Computer
(As per NEP 2020 Guidelines)

Faculty of Science and Technology

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

SYLLABUS STRUCTURE & COURSE OUTLINE
For Affiliated Colleges
Semester – III & IV
W.E.F. 2025 – 26

Specialization Honors in "Cyber Security"

Syllabus Structure for Specialization Honors 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	
CS-311C	Information Theory for Cyber security	PCC	3			3	40	60			100	3
CS-312C	Information Theory for Cyber security Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors 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	
CS-414C	Data Encryption	PCC	3			3	40	60			100	3
CS-415C	Data Encryption Lab	PCC			2	2			25	25 (PR)	50	1

INFORMATION THEORY FOR CYBER SECURITY (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**INFORMATION THEORY FOR CYBER SECURITY**	**Short Title:**	**ITCS**	**Course Code:**	CS-311C

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, Lower bounds on key size: secrecy, authentication and secret sharing, provable security.

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

Cryptography and Secure Communication: Secrecy, Authentication, Secret sharing, Unconditional security, Quantum Cryptography, Randomized Ciphers, Types of codes: block codes, Hamming and Lee metrics, parity check codes.

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 (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**INFORMATION THEORY FOR CYBER SECURITY LAB**	**Short Title:**	**ITCSL**	**Course Code:**	CS-312C

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

LAB 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 (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**DATA ENCRYPTION**	**Short Title:**	**DE**	**Course Code:**	CS-414C

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, Knapsack algorithm.		
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, Firewall.
Text Books:
1. Cryptography and Network Security, Mohammad Amjad, John Wiley & Sons.
Reference Books:
1. Cryptography & Network Security by Atul Kahate, TMH. 2. Information Theory & Coding, Muralidhar Kulkarni, KS Shivaprakasha, John Wiley & Sons. 3. Cryptography and Network Security by B. Forouzan, McGraw-Hill. 4. The Data Compression Book by Nelson, BPB.

DATA ENCRYPTION LAB (Honors : PCC)					
COURSE OUTLINE					
Course Title:	**DATA ENCRYPTION LAB**	**Short Title:**	**DEL**	**Course Code:**	CS-415C

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

COURSE CONTENT			
DATA ENCRYPTION LAB		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Laboratory:	**2 hours/week**	**End Semester Exam (ESE) UA:PR**	**25 marks**
Practical		**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.

Specialization Minor offered by Computer 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 Computer are as follows.

A. Data Science
B. Virtual Reality and Augmented Reality
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 – Minor
in
Data Science
for Second Year Bachelor of Engineering
offered by
Computer
(As per NEP 2020 Guidelines)

Faculty of Science and Technology

1990
'A' Grade
NAAC Re-Accredited
(4th Cycle)

SYLLABUS STRUCTURE & COURSE OUTLINE
For Affiliated Colleges
Semester – III & IV
W.E.F. 2025 – 26

Specialization Minor in "Data Science"

Syllabus Structure for Specialization Minor in "Data Science": 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)		
CS-313A	Data Science and Visualization	PCC	3			3	40	60			100	3
CS-314A	Data Science and Visualization Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Minor in "Data Science": 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)		
CS-416A	Statistics and Machine Learning	PCC	3			3	40	60			100	3
CS-417A	Statistics and Machine Learning Lab	PCC			2	2			25	25 (PR)	50	1

DATA SCIENCE AND VISUALIZATION(Minor : PCC)					
COURSE OUTLINE					
Course Title:	**DATA SCIENCE AND VISUALIZATION**	**Short Title:**	DSV	**Course Code:**	CS-313A

Course description:
This course covers key concepts in data science, big data, statistics, machine learning, and data visualization. Topics include data analysis techniques, clustering, regression, classification, decision trees, neural networks, and dashboard design. Students will develop practical skills for data-driven decision-making and analytics.

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

Prerequisite course(s): Computer graphics, Database Management System

Date Science and Visualization

Course objectives:

The objective of this course is to:

1. Provide an understanding of the fundamental concepts and techniques in data science and visualization.
2. Introduce students to data processing, statistical analysis, and machine learning methods used in data science.
3. Develop skills in analyzing, interpreting, and visualizing complex datasets.
4. Familiarize students with modern data visualization tools and techniques for effective data representation.
5. Enable students to apply data science techniques for business analytics and decision-making.

Course outcomes:

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

1. Understand and define core concepts in data science and big data analytics.
2. Apply statistical techniques and probability concepts to analyze datasets.
3. Implement clustering, association rules, regression, and classification techniques for data analysis.
4. Design and develop effective data visualizations using dashboards and advanced visualization techniques.
5. Utilize different data visualization tools to represent complex data structures and insights.

COURSE CONTENT

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

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

Defining data science and big data, Recognizing the different types of data, Gaining insight into the data science process, Data Science Process: Overview, Different steps, Machine Learning Definition and Relation with Data Science

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Some Other Correlational Caveats, Correlation and Causation Probability : Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution		

Unit–III:	No. of Lectures: 09 Hours	Marks: 12
Data Analysis Theory and Methods: Clustering –Overview, K-means- overview of method, determining number of clusters, Association Rules- Overview of method, Apriori algorithm, evaluation of association rules, Regression-Overview of linear regression method, model		

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12
Introduction to data visualization, challenges of data visualization, Definition of Dashboard, Their type, Evolution of dashboard, dashboard design and principles, display media for dashboard.		

Unit–V:	No. of Lectures: 09 Hours	Marks: 12
Types of Data visualization: Basic charts scatter plots, Histogram, advanced visualization Techniques like streamline and statistical measures, Plots, Graphs, Networks, Hierarchies, Reports.		

Text Books:

1. Data Mining: Concepts and Techniques, 3rd Edition. Jiawei Han, Micheline Kamber, Jian Pei.
2. Information visualization perception for design, colin ware, MK publication

Reference Books:

1. Data Science from Scratch : Joel Grus, O'Reilly Media Inc., ISBN: 9781491901427
2. Big data black book, Dream tech publication
3. Getting Started with Business Analytics: Insightful Decision-Making , David Roi Hardoon, GalitShmueli, CRC Press
4. Business Analytics, James R Evans, Pearson

NPTEL Links:

1. Essential Mathematics for Engineers by Prof S.K. Gupta and Prof Sajeev Kumar Department of Mathematics Indian Institute of Technology Roorkee. https://archive.nptel.ac.in/courses/111/107/111107137/
2. Data science for Engineers byPROF. RAGUNATHAN RENGASAMY ,PROF. SHANKAR NARASIMHAN Department Of Chemical Engineering IIT Madras https://archive.nptel.ac.in/courses/106/106/106106179/
3. Biological data analysis and visualization with R By Prof. Riddhiman Dhar | IIT Kharagpur https://onlinecourses.nptel.ac.in/noc25_bt43/preview

DATA SCIENCE AND VISUALIZATION LAB (Minor : PCC)							
COURSE OUTLINE							
Course Title:	**DATA SCIENCE AND VISUALIZATION LAB**			**Short Title:**	DSV	**Course Code:**	CS-314A
	Hours/week	**No. of weeks**	**Total hours**			**Semester credits**	
Practical	02	15	30			1	
COURSE CONTENT							
DATA SCIENCE AND VISUALIZATION LAB		**Semester:**		**III**			
Teaching Scheme:		**Examination scheme**					
Practical:	**02**						
		End Semester Examination (ESE) UA: PR		**25 marks**			
		Internal Continuous Assessment (ICA) CA		**25 marks**			
End Semester Exam (ESE)		**Practical (PR)**					

Concerned faculty member should suitably frame SIX laboratory assignments from the following list.

1: Introduction to Data Science and Python Libraries
- Install and set up Python environment (Anaconda, Jupyter Notebook).
- Introduction to NumPy, Pandas, Matplotlib, and Seaborn.
- Load and manipulate datasets using Pandas.

2: Data Preprocessing and Cleaning
- Handling missing values, duplicates, and outliers.
- Data transformation techniques (scaling, normalization, encoding categorical variables).
- Exploratory Data Analysis (EDA) using Pandas and Seaborn.

3: Statistical Analysis and Probability
- Compute descriptive statistics (mean, median, variance, standard deviation).
- Correlation analysis and visualization using heat maps.
- Implement Bayes' Theorem for probability estimation.

4: Data Visualization Basics
- Generate histograms, scatter plots, and box plots using Matplotlib and Seaborn.
- Design interactive visualizations using Plotly.
- Create dashboards using Tableau or Power BI.

5: Clustering Techniques
- Implement K-Means clustering on a real dataset (e.g., customer segmentation).
- Determine the optimal number of clusters using the Elbow Method and Silhouette Score.
- Visualize clustering results using scatter plots and PCA.

6: Association Rule Mining
- Implement Apriori algorithm using Python (MLxtend library).
- Generate association rules for market basket analysis.
- Interpret and visualize the results.

7: Regression Analysis
- Implement Linear Regression using Scikit-learn.
- Evaluate model performance using R-squared and Mean Squared Error (MSE).
- Visualize regression line and residual plots.

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) Essential Mathematics for Machine Learning, IIT Roorkee, Pro. S.K Gupta and Pro. Sanjeev Kumar https://archive.nptel.ac.in/courses/111/107/111107137/ 2) Data science For Engineers, IIT Madras, Prof. Raghunathan Rangaswami https://archive.nptel.ac.in/courses/106/106/106106179/ 3) Biological Data analysis and Visualization with R, IIT Kharagpur, Prof. Ridhimman Dhar https://onlinecourses.nptel.ac.in/noc25_bt43/preview

STATISTICS AND MACHINE LEARNING (Minor : PCC)					
COURSE OUTLINE					
Course Title:	**STATISTICS AND MACHINE LEARNING**	**Short Title:**	SML	**Course Code:**	CS-416A

Course description:
This course covers fundamental statistical concepts and their applications in machine learning. Topics include statistical inference, hypothesis testing, regression analysis, Bayesian models, and probability theory. Students will explore supervised, unsupervised, and reinforcement learning, along with decision trees and Naïve Bayes classifiers.

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

Prerequisite course(s):
Date Science and Visualization

Course objectives:
The objective of this course is to:
1. To understand basis of statistics and mathematics for Machine Learning
2. To understand basis of descriptive statistics measures and hypothesis
3. To learn various statistical inference methods
4. To introduce basic concepts and techniques of Machine Learning
5. To learn different linear regression methods used in machine learning

Course outcomes:
After successful completion of this course the student will be able to:
1. Apply appropriate statistical measure for machine learning applications
2. Usage of appropriate descriptive statistics measures for statistical analysis
3. Usage of appropriate statistics inference for data analysis
4. Identify types of suitable machine learning techniques
5. Apply regression techniques to machine learning problems

COURSE CONTENT

STATISTICS AND MACHINE LEARNING		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**		
		End Semester Examination (ESE) UA:	**60 marks**
		Internal Sessional Exam (ISE) CA:	**40 marks**

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

Types of Statistical Inference, Descriptive Statistics, Inferential Statistics, Importance of Statistical Inference in Machine Learning. Descriptive Statistics, Measures of Central Tendency: Mean, Median, Mode, Mid-range, Measures of Dispersion: Range, Variance, Mean Deviation, Standard Deviation. One sample hypothesis testing, Hypothesis, Testing of Hypothesis, Chi-Square Tests, t-test, ANOVA and ANOCOVA. Pearson Correlation, Bi-variate regression, Multi-variate regression, Chi-square statistics

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

Measure of Relationship: Covariance, Karl Pearson's Coefficient of Correlation, Measures of Position: Percentile, Z-score, Quartiles, Bayes' Theorem, Bayes Classifier, Bayesian network, Discriminative learning with maximum likelihood, Probabilistic models with hidden variables, Linear models, regression analysis, least squares.

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

What is Machine Learning? Well posed learning problems, Designing a Learning system,Machine Learning types-Supervised learning, Unsupervised learning, and Reinforcement Learning, Applications

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

Introduction, types of regression. Simple regression- Types, Making predictions, Cost function, Gradient descent, Training, Model evaluation.
Multivariable regression : Growing complexity, Normalization, Making predictions, Initialize weights,
Cost function, Gradient descent, Simplifying with matrices, Bias term, Model evaluation

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

Decision tree representation, Constructing Decision Trees, Classification and Regression Trees, hypothesis space search in decision tree learning Bayes' Theorem, Working of Naïve Bayes' Classifier, Types of Naïve Bayes Model, Advantages, Disadvantages and Application of Naïve Bayes Model

Text Books:

1. Tom M. Mitchell, "Machine Learning", India Edition 2013, McGraw Hill Education.

Reference Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand and Sons, New Delhi, 2009,
2. Kothari C.R., "Research Methodology. New Age International, 2004, 2nd Ed; ISBN:13: 978- 81-224-1522-3
3. Peter Harrington, Machine Learning In Action, DreamTech Press 2.ISBN: 9781617290183
4. Alpaydin, Ethem. Machine learning: the new AI. MIT press, 2016, ISBN: 9780262529518
5. Stephen Marsland, Machine Learning An Algorithmic Perspective, CRC Press, ISBN: : 978-

NPTEL Links:

1. Essential Mathematics for Machine Learning, IIT Roorkee, Prof. S.K Gupta and Prof. Sanjeev Kumar
   https://archive.nptel.ac.in/courses/111/107/111107137/

STATISTICS AND MACHINE LEARNING LAB (Minor : PCC)					
COURSE OUTLINE					
Course Title:	**Program Core Course** Statistics and Machine Learning Lab		**Short Title:**	SML	**Course Code:** CS-417A
	Hours/week	**No. of weeks**	**Total hours**		**Semester credits**
Practical	02	15	30		1
COURSE CONTENT					
STATISTICS AND MACHINE LEARNING 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)**			

Concerned faculty member should suitably frame SIX laboratory assignments from the following list

1. **Descriptive Statistics and Data Visualization**
   Load a dataset (e.g., Titanic, Iris, or any open dataset).
   Calculate measures of central tendency (Mean, Median, Mode).
   Compute measures of dispersion (Variance, Standard Deviation).
   Visualize data distributions using histograms, boxplots, and scatter plots (Matplotlib/Seaborn).
2. **Hypothesis Testing – One-Sample t-test**
   Perform a one-sample t-test to compare a sample mean with the population mean.
   Interpret the p-value and significance level.
3. **Hypothesis Testing – Chi-Square Test**
   Conduct a Chi-Square test to analyze categorical data relationships.
   Interpret test results and significance.
4. **Hypothesis Testing – ANOVA**
   Apply ANOVA to compare means across multiple groups in a dataset.
   Analyze the significance and interpret the F-statistic.
5. **Correlation and Simple Linear Regression**
   Compute Karl Pearson's Correlation Coefficient between two variables.
   Implement Simple Linear Regression to predict a target variable (e.g., house prices).
   Evaluate the model using R^2-score and residual plots.
6. **Multiple Linear Regression**
   Implement Multiple Linear Regression on a dataset.
   Interpret model coefficients and analyze performance using R^2-score.
7. **Bayesian Probability and Naïve Bayes Classification**
   Implement Bayes' Theorem for probability calculations.
   Train and test a Naïve Bayes Classifier for spam classification.
   Evaluate model performance using precision, recall, and F1-score.

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

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 – Minor
in
Virtual Reality and Augmented Reality
for Second Year Bachelor of Engineering
offered by
Computer
(As per NEP 2020 Guidelines)

Faculty of Science and Technology

1990
'A' Grade
NAAC Re-Accredited
(4th Cycle)

SYLLABUS STRUCTURE & COURSE OUTLINE
For Affiliated Colleges
Semester – III & IV
W.E.F. 2025 – 26

Specialization Minor in "Virtual Reality and Augmented Reality"

Syllabus Structure for Minor in Virtual Reality and Augmented Reality**: 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)		
CS -313B	Computer Graphics for Virtual Reality	PCC	3			3	40	60			100	3
CS -314B	Computer Graphics for Virtual Reality Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Minor in Virtual Reality and Augmented Reality: **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)		
CS -416B	Virtual Reality	PCC	3			3	40	60			100	3
CS -417B	Virtual Reality Lab	PCC			2	2			25	25 (PR)	50	1

COMPUTER GRAPHICS FOR VIRTUAL REALITY (Minor : PCC)					
COURSE OUTLINE					
Course Title:	**COMPUTER GRAPHICS FOR VIRTUAL REALITY**	**Short Title:**	CGFVR	**Course Code:**	**CS-313B**

Course Description:
This course introduces the principles of computer graphics with a focus on Virtual Reality (VR). Students will learn 3D modeling, real-time rendering, lighting, shading, and optimization techniques specific to VR environments. Topics include VR hardware integration, interaction methods, and performance optimization. Through hands-on projects, students will gain the skills needed to design and develop immersive VR applications.

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

Prerequisite course(s):

Introduction to Computer Graphics or equivalent basic knowledge of 3D graphics and programming.

Course objectives:

The objective of this course is to:

1. Provide an understanding of computer graphics fundamentals and their role in Virtual Reality (VR).
2. Explain geometric transformations, 3D rendering, shading models, and lighting techniques.
3. Introduce texturing, ray tracing, volume rendering, and fractal modeling for realistic image synthesis.
4. Familiarize students with Virtual Reality Modelling Language (VRML) and interactive VR environments.
5. Explore applications of VR, including stereo display systems, fly-through navigation, and multi-screen interactions.

Course outcomes:

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

1. Describe computer graphics architectures, imaging systems, and transformation techniques.
2. Implement 3D transformations, clipping, and hidden surface removal using OpenGL.
3. Apply shading, lighting models, and texture mapping in rendering scenes.
4. Develop ray tracing and fractal models for complex graphics applications.
5. Design VR environments using VRML, incorporating navigation, interaction, and visualization.

COURSE CONTENT

COMPUTER GRAPHICS FOR VIRTUAL REALITY		**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**

Graphics Systems and Transformations : Introduction to computer graphics and applications, Graphics architectures and imaging systems,3D coordinate systems and transformations (translation, rotation, scaling),Homogeneous coordinates, transformation matrices, and OpenGL implementation		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Rendering and Shading: Clipping techniques: line and polygon clipping, Hidden surface removal and polygon rasterization, Light sources and shading models (Phong reflection, per-fragment lighting),Global illumination and scene representation		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Texturing and Advanced Rendering: Texture mapping and environment mapping, Ray tracing fundamentals and radiosity, Volume rendering and mesh simplification, Image-based rendering techniques		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Fractals and Virtual Reality Modelling: Fractal geometry, recursive curves, fractal Brownian motion, Mandelbrot set and procedural terrain generation, Virtual Reality Modelling Language (VRML) basics, Building virtual environments: objects, lighting, sound, and interaction		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Applications in Virtual Reality: Stereo display programming and multi-screen systems, Fly-mode and walk-through navigation, Virtual trackball navigation and immersive interaction		
Text Books:		
1. "Computer Graphics with Virtual Reality System, John Wiley & Sons" by Rajesh K. Maurya.		
Reference Books: 1. "Interactive Computer Graphics: A Top-Down Approach Using OpenGL" by Edward Angel, Addison-Wesley. 2. "Computer Graphics: Principles and Practice" by Foley James D, Van Dam, Feiner and Hughes, Pearson Education. 3. "Computer Graphics C Version" by Donald Hearn and Pauline Baker, Pearson Education, Optics – Ajoy Ghatak, McGraw Hill Publishing.		
NPTEL Links: 1. The **"Virtual Reality"** course offered by **IIT Madras** on NPTEL is presented by **Dr. S. G. Gopi**. https://archive.nptel.ac.in/courses/106/106/106106138/?utm_source=chatgpt.com **2.** The **"Virtual Reality Engineering"** course offered by **IIT Madras** is presented by **Dr. S. G. Gopi.** https://archive.nptel.ac.in/courses/121/106/121106013/?utm_source=chatgpt.com **3.** The **"Computer Graphics"** course offered by **IIT Guwahati** on NPTEL is presented by Prof. Samit Bhattacharya**.** https://onlinecourses.nptel.ac.in/noc21_cs97/preview?utm_source=chatgpt.com		

<table>
<tr><th colspan="6">COMPUTER GRAPHICS FOR VIRTUAL REALITY LAB (Minor : PCC)</th></tr>
<tr><th colspan="6">COURSE OUTLINE</th></tr>
<tr><td>Course Title:</td><td colspan="2">COMPUTER GRAPHICS FOR VIRTUAL REALITY LAB</td><td>Short Title:</td><td>CGFVR</td><td>Course Code: CS-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">COMPUTER GRAPHICS FOR VIRTUAL REALITY</td><td colspan="3">Semester:</td><td>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">End Semester Exam (ESE) UA:PR</td><td>25 marks</td></tr>
<tr><td colspan="2" rowspan="2"></td><td colspan="3"></td><td></td></tr>
<tr><td colspan="3">Internal Continuous Assessment (ICA) CA</td><td>25 marks</td></tr>
<tr><td colspan="6">Concerned faculty member should suitably frame SIX laboratory assignments from the following list. (Using OpenGL, WebGL, or Python with OpenCV/Blender)
1: Basics of Computer Graphics
• Implement basic 2D transformations (translation, rotation, scaling).
• Use OpenGL/GLUT for rendering simple objects.
2: 3D Transformations & Viewing
• Implement 3D coordinate transformations and viewing in OpenGL.
• Experiment with camera movement using LookAt function.
3: Clipping and Hidden Surface Removal
• Implement Cohen-Sutherland Line Clipping Algorithm.
• Apply Z-buffer for hidden surface removal.
4: Lighting and Shading
• Implement Phong Reflection Model for lighting.
• Compare Gouraud vs. Phong Shading.
5: Texture Mapping
• Apply texture mapping techniques (environment maps, bump mapping).
• Implement UV mapping in OpenGL.
6: Ray Tracing
• Develop a basic ray tracer with reflection and shadows.
7: Fractals and Procedural Generation
• Generate Mandelbrot Set and Fractal Terrain using recursive algorithms.
8: Virtual Reality Modelling
• Create a simple VR environment using VRML/WebGL.
• Implement basic user interaction and navigation controls.</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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VIRTUAL REALITY (Minor : PCC)					
COURSE OUTLINE					
Course Title:	**VIRTUAL REALITY**	**Short Title:**	VR	**Course Code:**	**CS-416B**

Course description:
This course provides an introduction to Virtual Reality (VR), covering its history, key concepts, and human perception in VR environments. Students will explore VR systems, input-output interfaces, visual and aural representation, and haptic feedback.

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

Prerequisite course(s):
Computer fundamentals is essential

Course objectives:
The objective of this course is to:
1. To introduce the fundamental concepts and history of Virtual Reality (VR).
2. To provide an understanding of VR systems, including input and output interfaces.
3. To explain the representation of the virtual world through visual, aural, and haptic modalities.
4. To discuss geometric modeling, transformations, and human vision physiology in VR.
5. To study visual perception principles and rendering techniques used in VR.

Course outcomes:
After successful completion of this course the student will be able to:
1. Define Virtual Reality and describe its historical development.
2. Identify key components of a VR system, including input and output devices.
3. Analyse various applications of VR in industry and research.
4. Understand and implement different methods for representing the virtual world.
5. Apply geometric transformations and understand human vision for VR applications.

COURSE CONTENT

VIRTUAL REALITY		**Semester:**	**IV**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**		
		End Semester Examination (ESE) UA:	**60 marks**
		End Semester Examination Duration	**3 Hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

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

Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience,

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

Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays Applications of Virtual Reality.

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

Representing the Virtual World: Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR

Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
The Geometry of Virtual Worlds &The Physiology of Human Vision: Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Visual Perception & Rendering Visual Perception - Perception of Depth, Perception of Motion, Perception of Color Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates		

Text Books:

1. LaValle, S. M. (2016). Virtual Reality. Cambridge University Press.

Reference Books:

1. Craig, A. B., Sherman, W. R., & Will, J. D. (2009). Developing Virtual Reality Applications: Foundations of Effective Design. Morgan Kaufmann.
2. Kim, G. J. (2005). Designing Virtual Systems: The Structured Approach.
3. Bowman, D. A., Kuijff, E., LaViola, J. J., Jr., & Poupyrev, I. (2005). 3D User Interfaces, Theory and Practice. Addison Wesley.
4. Bimber, O., & Raskar, R. (2005). Spatial Augmented Reality: Merging Real and Virtual

NPTEL Links:

1. Virtual Reality Engineering, https://nptel.ac.in/courses/121106013
2. https://nptel.ac.in/courses/106/106/106106138

VIRTUAL REALITY LAB (Minor : PCC)						
COURSE OUTLINE						
Course Title:	**VIRTUAL REALITY LAB**		**Short Title:**	VRL	**Course Code:**	**CS-417B**
	Hours/week	**No. of weeks**	**Total hours**		**Semester credits**	
Practical	02	15	30		1	

COURSE CONTENT			
VIRTUAL REALITY 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)**	

Concerned faculty member should suitably frame SIX laboratory assignments from the following

1. Installation and Setup of Unity for VR Development
- Install and configure Unity and required VR SDKs.
- Set up a basic VR environment and test a sample scene.

2. VR Object Interaction – Shooting Game
- Develop a VR game where cubes placed on a plane are destroyed when the player clicks the gun trigger.
- Implement a scoring system and display the score on the UI.

3. VR Golf Game
- Create a VR golf course with multiple holes.
- Assign different scores to each hole and display a scorecard.

4. VR Basketball Game
- Develop a VR basketball court for a single-player game.
- Implement mechanics for shooting the ball into the basket and track the score.

5. VR Driving/Flying Simulation
- Create a VR environment for a helicopter or car simulation.
- Implement movement controls and realistic navigation.

6. VR Object Manipulation and Physics
- Implement object grabbing, throwing, and interactions using VR controllers.
- Apply physics to objects for realistic interactions.

7. VR Environment Navigation
- Create a VR scene where users can walk or teleport using controllers.
- Implement smooth and teleportation-based movement mechanics.

8. VR Escape Room/Puzzle Game
- Develop an interactive VR escape room or puzzle-solving game.
- Include object interactions and clues to unlock different levels.

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

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. Virtual Reality Engineering, https://nptel.ac.in/courses/121106013
2. https://nptel.ac.in/courses/106/106/106106138

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON

(M.S.)

Bachelor of Engineering – Minor
in
Cyber Security
for Second Year Bachelor of Engineering
offered by
Computer
(As per NEP 2020 Guidelines)

Faculty of Science and Technology

1990
'A' Grade
NAAC Re-Accredited
(4th Cycle)

SYLLABUS STRUCTURE & COURSE OUTLINE
For Affiliated Colleges
Semester – III & 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		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
CS-313C	Information Theory for Cybersecurity	PCC	3			3	40	60			100	3
CS-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		Total	
			Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE (CA)	ESE (UA)	ICA (CA)	ESE (UA)		
CS-416C	Data Encryption	PCC	3			3	40	60			100	3
CS-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**	**Short Title:**	**ITCS**	**Course Code:**	CS-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.

<table>
<tr><th colspan="8">INFORMATION THEORY FOR CYBER SECURITY LAB (Minor : PCC)</th></tr>
<tr><th colspan="8">COURSE OUTLINE</th></tr>
<tr><td>Course Title:</td><td colspan="3">INFORMATION THEORY FOR CYBER SECURITY LAB</td><td>Short Title:</td><td>ITCSL</td><td>Course Code:</td><td>CS-314C</td></tr>
<tr><td></td><td colspan="2">Hours/week</td><td>No. of weeks</td><td colspan="2">Total hours</td><td colspan="2">Semester credits</td></tr>
<tr><td>Practical</td><td colspan="2">02</td><td>15</td><td colspan="2">30</td><td colspan="2">01</td></tr>
<tr><th colspan="8">COURSE CONTENT</th></tr>
<tr><td colspan="3">INFORMATION THEORY FOR CYBER SECURITY LAB</td><td colspan="3">Semester:</td><td colspan="2">III</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="5">Examination scheme</td></tr>
<tr><td>Practical:</td><td colspan="2">2 hours/week</td><td colspan="4">End Semester Exam (ESE) UA</td><td>25 marks</td></tr>
<tr><td colspan="3"></td><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 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.
8. Asymmetric Encryption (RSA)
Generate RSA key pairs and encrypt/decrypt messages using Python.
Compare RSA with symmetric encryption techniques.</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. Faculty in charge will assess the assignments</td></tr>
</table>

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**	**Short Title:**	**DE**	**Course Code:**	CS-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.

<table>
<tr><th colspan="8">DATA ENCRYPTION LAB (Minor : PCC)</th></tr>
<tr><th colspan="8">COURSE OUTLINE</th></tr>
<tr><td>Course Title:</td><td colspan="3">DATA ENCRYPTION LAB</td><td>Short Title:</td><td>DEL</td><td>Course Code:</td><td>CS-417C</td></tr>
<tr><td></td><td colspan="2">Hours/week</td><td>No. of weeks</td><td colspan="2">Total hours</td><td colspan="2">Semester credits</td></tr>
<tr><td>Practical</td><td colspan="2">02</td><td>15</td><td colspan="2">30</td><td colspan="2">01</td></tr>
<tr><th colspan="8">LAB COURSE CONTENT</th></tr>
<tr><td colspan="3">DATA ENCRYPTION LAB</td><td colspan="3">Semester:</td><td colspan="2">IV</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="3">Examination scheme</td><td colspan="2"></td></tr>
<tr><td colspan="2">Practical:</td><td>2 hours/week</td><td colspan="3">End Semester Exam (ESE) UA:</td><td colspan="2">25 marks (PR)</td></tr>
<tr><td colspan="2"></td><td></td><td colspan="3">Internal Continuous Assessment (ICA) CA</td><td colspan="2">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 FOUR 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.</td></tr>
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