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

Third 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 – V to VI

W.E.F. 2026 – 27

Syllabus Structure for Third Year Engineering (Semester – V, Level – 5.5) (Computer) (w.e.f. 2026 – 27)

(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 -501	Software Engineering and Automation Testing*	PCC	3			3	40	60			100	3
CS -502	Software Engineering and Automation Testing Lab*	PCC			2	2			25	25 (PR)	50	1
CS -503	Theory of Computation and Compiler Design	PCC	3			3	40	60			100	3
CS -504	Theory of Computation and Compiler Design Lab	PCC			2	2			25	25 (PR)	50	1
CS -505	Mobile Application Development Lab	PCC	3		4	7			50	25 (PR)	75	5
CS -506	Program Elective Course – I	PEC	3			3	40	60			100	3
CS -507	Program Elective Course – I- Lab	PEC			2	2			25		25	1
CS -508	Industry 4.0 *	MD M	2			2	40	60	25		125	2
OE -509	Open Elective – III	OE	2			2			25		25	2
			16		**10**	**26**	**160**	**240**	**175**	**75**	**650**	**21**

***** Syllabus common with T.E. (AIDS)

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment
CA: College Assessment UA: University Assessment

Program Elective Course – I		
Course Code		**Name of the Subject / Course**
CS -506	A	Block chain Platforms and Use cases
CS -506	B	Data Analytics
CS -506	C	Quantum Computing*

Syllabus Structure for Third Year Engineering (Semester – VI, Level – 5.5) (Computer) (w.e.f. 2026 – 27)

(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 -601	Operating Systems	PCC	3			3	40	60			100	3
CS -602	Operating Systems Lab	PCC			2	2			25	25 (PR)	50	1
CS -603	Computer Networks *	PCC	3			3	40	60			100	3
CS -604	Computer Network Lab *	PCC			2	2			25	25 (PR)	50	1
CS -605	Program Elective Course – II Lab *	PEC	3		4	7			50	25 (PR)	75	5
CS -606	Program Elective Course – III *	PEC	3			3	40	60			100	3
CS -607	Program Elective Course – III Lab *	PEC			2	2			25		25	1
CS -608	Industrial Automation *	MD M	2			2	40	60	25		125	2
CS -609	Introduction to Network Management and Virtualization *	VSEC	1		2	3			25		25	2
			15		**12**	**27**	**160**	**240**	**175**	**75**	**650**	**21**

* Syllabus common with T.E. (AIDS)

ISE: Internal Sessional Examination ESE: End Semester Examination ICA: Internal Continuous Assessment
CA: College Assessment UA: University Assessment

Program Elective Course – II Lab			Program Elective Course – III		
Course Code		Name of the Subject / Course	Course Code		Name of the Subject / Course
CS -605	A	Web Technology Lab *	CS-606	A	Block Chain Security and Performance *
CS -605	B	User Interface and User Experience Design Lab *	CS -606	B	Deep Learning and Neural Network *
CS -605	C	Internet of Things Lab *	CS-606	C	Database Security and Access Control *

EXIT COURSE FOR U. G. B. VOCATIONAL 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 -610	Internship / Apprenticeship	OJT							125			4
CS -611	Mini Project	Project							25			4
									150			8

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COURSE OUTLINE

For Affiliated Colleges

Semester – V

W.E.F. 2026 – 27

SOFTWARE ENGINEERING AND AUTOMATION TESTING (PCC)					
COURSEOUTLINE					
Course Title:	**SOFTWARE ENGINEERING AND AUTOMATION TESTING**	**Short Title:**	**SEAT**	**Course Code:**	**CS-501**

Course description: The course is aimed to provide students with different aspects of Software Engineering including requirements engineering, software design and testing.

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

Prerequisite course(s):

Basic Knowledge of Software Development ,Fundamentals of Programming ,Data Structures

Course objectives:

The objective of this course is to:

1. Understand principles, phases, and models of Software Engineering.
2. Learn software requirement analysis and system modeling techniques.
3. Apply software design concepts and architectural styles.
4. Understand software testing principles with emphasis on automation.
5. Familiarize with modern tools and practices used in software quality assurance.

Course outcomes:

1. After successful completion of this course the student will be able to:
2. Explain fundamental concepts and processes of software engineering.
3. Analyze and document software requirements using standard techniques.
4. Design software systems using appropriate design models and patterns.
5. Apply various software testing strategies and automation concepts.

COURSECONTENT

Software Engineering and Automation Testing		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**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**

Introduction to Software Engineering:

Software Engineering: Definition and need, Software crisis and evolution, Software characteristics and applications, Software Development Life Cycle (SDLC), Software process models: Waterfall,

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

Software Requirements Engineering:

Requirement engineering process, Functional and non-functional requirements, Requirement elicitation techniques, Software Requirement Specification (SRS), Requirement validation and management

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

Software Design and Architecture:

Software design concepts and principles, Architectural design styles, UML Modeling: Use case, Sequence, Class, Component and Deployment diagrams, Component-level and data design

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

Software Testing Fundamentals :

Software testing principles, Levels of testing: Unit, Integration, System, Acceptance , Black-box and White-box testing techniques, Test planning and test case design

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

Automation Testing:

Introduction to automation testing, Automation testing life cycle, Selenium overview and architecture, Automation frameworks, Continuous Integration and testing

TextBooks:

1. Software Engineering: A Practioner's Approach by Roger S. Pressman, McGraw Hill, 7th Edition, 2010
2. Ian Sommerville, Software Engineering, Pearson Education

ReferenceBooks:

1. PankajJalote, An Integrated Approach to Software Engineering, Springer.
2. Alan C. Gillies, Software Quality ,Theory and Management, Chapman & Hall.

NPTEL Links:

1. **Software Engineering**, Prof. Rajib Mall **https://nptel.ac.in/courses/106105182**
2. **Software Engineering**, Prof. Rushikesh K Joshi, Prof. Umesh Bellur, Prof. N.L. Sarda **https://nptel.ac.in/courses/106101061**

SOFTWARE ENGINEERING AND AUTOMATION TESTING LAB (PCC)					
LAB COURSEOUTLINE					
Course Title:	**SOFTWARE ENGINEERING AND AUTOMATION TESTING LAB**	**Short Title:**	**SEATL**	**Course Code:**	**CS-502**

Course description: The laboratory provides students an ability to apply software engineering analysis, design and testing concepts for developing software.

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

Pre requisite course(s): Basic Knowledge of Software Development ,Fundamentals of Programming

COURSECONTENT

SOFTWARE ENGINEERING AND AUTOMATION TESTING LAB		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**2hours/week**	**End Semester Examination (ESE) UA: PR**	**25 marks**
		Internal Continuous Assessment (ICA):CA	**25 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

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

1. Case study on SDLC models.
2. Preparation of Software Requirement Specification (SRS).
3. UML diagrams for a given system.
4. Manual test case design and execution.
5. Introduction to Selenium tool.
6. Automation of test cases using Selenium.
7. Testing of web application using automation framework.
8. Mini project integrating software engineering and testing concepts.

Text Books:

1. Software Engineering: A Practioner's Approach by Roger S. Pressman, McGraw Hill, 7th Edition, 2010
2. Software Engineering, Ian Sommerville, Pearson Education

Reference Books:

1. Pankaj Jalote, An Integrated Approach to Software Engineering, Springer.
2. Alan C. Gillies, Software Quality – Theory and Management, Chapman & Hall.

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.

THEORY OF COMPUTATION AND COMPILER DESIGN (PCC)					
COURSE OUTLINE					
Course Title:	**THEORY OF COMPUTATION AND COMPILER DESIGN (PCC)**	**Short Title:**	**TOCCD**	**Course Code:**	**CS-503**

Course description:

Understand the role of language processors such as assemblers, compilers, and interpreters, and study the phases of a compiler. The unit also introduces formal languages and automata concepts from the Theory of Computation that form the theoretical foundation for lexical and syntax analysis.

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

Pre requisite course(s):

Basic knowledge of programming languages, discrete mathematics, and fundamental concepts of automata theory.

Course objectives:

1. To introduce the fundamental concepts of formal languages, automata, regular expressions, and properties of regular languages used in language recognition.
2. To study context-free grammars, pushdown automata, and Turing machines as computational models for recognizing more complex languages.
3. To understand the structure of a compiler, lexical analysis, and parsing techniques, including LL and LR parsing methods.
4. To learn syntax-directed translation and semantic analysis for constructing syntax trees and evaluating attributes during compilation.
5. To study intermediate code generation, storage organization, and code optimization techniques for efficient target code generation.

Course outcomes:

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

1. Apply concepts of finite automata, regular expressions, and regular language properties to analyze and design language recognizers.
2. Analyse context-free grammars, pushdown automata, and Turing machines to understand computational models and language hierarchy.
3. Design lexical analysers and parsers using techniques such as recursive-descent, LL(1), SLR, and LR parsing.
4. Apply syntax-directed definitions and translation schemes to construct syntax trees and perform semantic analysis.
5. Generate intermediate representations and apply basic code optimization techniques for efficient program execution

COURSECONTENT

FLAT CD		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End-of-semester exam (ESE):UA TH**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE): CA TH	**40 marks**

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

Sets, Relations, and Languages, Alphabet, Strings, and Languages, Operations on Languages, Finite State Systems, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA),ε–

NFA and ε–closure, Equivalence of DFA and NFA (Subset Construction)
Regular Expressions: Definition of Regular Expressions, Equivalence between Regular Expressions and Finite Automata
Properties of Regular Languages: Closure Properties, Pumping Lemma for Regular Languages, Applications of Pumping Lemma, Minimization of Finite Automata

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

Chomsky Hierarchy, Derivations and Parse Trees: Ambiguity in Grammars, Simplification of CFGs, Chomsky Normal Form
Pushdown Automata (PDA): Definition of PDA, Acceptance by Final State and Empty Stack, Equivalence of PDA and CFG
Turing Machines: Definition and Formal Model of Turing Machine, Variants of Turing Machines

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

Introduction: Language Processors; Structure of a Compiler; Applications of Compiler Technology Role of the Lexical Analyzer; Input Buffering; The Lexical-Analyzer Generator (LEX)
Introduction to Parsing: Recursive-Descent Parsing, FIRST and FOLLOW sets; LL (1) Grammars
Introduction to LR Parsing: Simple LR, Why LR Parsers? Items and the LR(O) Automaton, The LR-Parsing Algorithm, Constructing SLR-Parsing Tables, Viable Prefixes, Canonical LR(l), Constructing LR(l) Sets of Items, Canonical LR(l) Parsing Tables, The Parser Generator Yacc, Using Yacc with Ambiguous Grammar

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

Syntax-Directed Definitions, Evaluating an SDD on the Parse Tree; Dependency Graphs**,** Construction of Syntax Trees; The Structure of a Type, Postfix Translation Schemes; Parser-Stack Implementation of Postfix SDTs, SDTs with Actions Inside Productions; Eliminating Left Recursion from SDTs; SDTs for L-Attributed Definitions

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

Variants of Syntax Trees; DAGs for Expressions; Value-Number Method for DAGs, Three-Address Code: Addresses & Instructions; Quadruples; Triples; Static Single Assignment (SSA) form Storage Organization: Static vs Dynamic Storage Allocation, Target Machine Model; Program & Instruction Costs, Optimization of Basic Blocks: DAG Representation

Text Books:

1. Lewis H., Papadimitriou C., "Elements of Theory of Computation", Second Edition
2. John Martin, “Introduction to Languages and the Theory of Computation”, TMH.
3. J. R. Levine, T. Mason, D. Brown, "Lex&Yacc", O'Reilly, 2000
4. S. Chattopadhyay, "Compiler Design", Prentice-Hall of India, 2005

NPTEL Link:

1. **Introduction to Automata, Languages and Computation** By Prof. Sourav Mukhopadhyay https://onlinecourses.nptel.ac.in/noc21_cs19/preview
2. **Compiler Design,** Prof. Santanu Chattopadhyay https://nptel.ac.in/courses/106105190

THEORY OF COMPUTATION AND COMPILER DESIGN LAB (PCC)					
COURSE OUTLINE					
Course Title:	**THEORY OF COMPUTATION AND COMPILER DESIGN LAB**	**Short Title:**	**TOCCD Lab**	**Course Code:**	**CS-504**

Course description:

This laboratory gives hands-on experience in formal language processing, automata simulation, parser construction, lexical analysis, syntax-directed translation and intermediate code generation. Students build and test automata and parsers, use parser-generator tools, and implement intermediate representations and simple optimizations

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

Pre requisite course(s):

Discrete Mathematics, Theory of Computation (or Automata & Formal Languages), Data Structures & Algorithms, and basic Programming (C/C++/Python).

COURSECONTENT

THEORY OF COMPUTATION AND COMPILER DESIGN LAB		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme:**	
Practical:	**2 hours/week**	**End semester exam (ESE): UA PR**	**25 marks**
		Internal Continuous Assessment (ICA):CA PR	**25 marks**

Concerned faculty member should suitably frame at least TWO Laboratory assignments from Group - A and FOUR Laboratory assignments from Group – B from the following list.

(Group A)

1. Implementation of Deterministic Finite Automaton.
2. To implement basic operations on formal languages such as union, concatenation, and Kleene closure.
3. To construct a finite automaton equivalent to a given regular expression.
4. To design and simulate a Pushdown Automaton (PDA) for a context-free language.
5. To design and simulate a Turing Machine model for recognizing a specific language and demonstrate its working using tape and state transitions.

(Group B)

1 Implement a lexical analyzer for a subset of C using LEX Implementation should support Error Handling.

2 To Implement a lexical analyzer of identification of numbers.

3 To Implement a Calculator using LEX and YACC.

4 Implementation of Context Free Grammar.

5 Implementation of Code Generator.

6 To generate three-address intermediate code for arithmetic expressions.

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

Text Books:

1. J. E. Hopcroft, R. Motwani & J. D. Ullman, Introduction to Automata Theory, Languages, and Computation.
2. John Martin, Introduction to Languages and the Theory of Computation.

Reference Books:

1. Sipser, Introduction to the Theory of Computation.
2. Appel, Modern Compiler Implementation in C/Java.
3. Tremblay & Sorenson, The Theory and Practice of Compiler Writing.

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 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.

MOBILE APPLICATION DEVELOPMENT LAB (PCC)					
COURSE OUTLINE					
Course Title:	**MOBILE APPLICATION DEVELOPMENTLAB (PCC)**	**Short Title:**	**MADL**	**Course Code:**	**CS-505**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3 Hours / Week**	**15 Weeks**	**45 Hours**	**5**
Practical	**4 Hours/ Week**	**15 Weeks**	**60 Hours**	

Prerequisite course(s):

Programming (Java/Kotlin),DBMS basics ,Web basics ,OS & Networking fundamentals ,Basic UI/UX concepts

Course objectives:

The objective of this course is to:

1. To introduce students to mobile application development concepts.
2. To develop Android applications using modern tools and frameworks.
3. To understand UI design, activity lifecycle, and event handling.
4. To enable database integration and API usage in mobile apps.
5. To build complete real-world mobile applications.

Course outcomes:

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

1. Develop basic mobile applications using standard tools and environments.
2. Design interactive and user-friendly mobile interfaces.
3. Implement data storage and retrieval in mobile applications.
4. Integrate device features and web services into mobile apps.
5. Test, debug, and deploy a functional mobile application.

COURSE CONTENT

Mobile Application Development		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**		
		End Semester Examination (ESE) UA: PR	**25 marks**
		Internal Continuous Assessment (ISE) CA:	**50 marks**

Unit–I:	**No. of Lectures: 09 Hours**

Introduction to Mobile Application Development: Overview of mobile computing, Types of mobile applications: Native, Web, Hybrid, Introduction to Android architecture, Android OS features and versions, Development environment setup (Android Studio)

Unit–II:	**No. of Lectures:09 Hours**

Android App Components: Activities and Activity Lifecycle, Intents (Explicit & Implicit), Services and Broadcast Receivers, Content Providers, Android Manifest file

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

User Interface Design: Layouts: Linear, Relative, Constraint Layout, UI components: TextView, EditText, Button, ImageView, Event handling and listeners, Material Design principles, Responsive UI

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

Data Storage and Networking: Shared Preferences, SQLite Database, File Storage (Internal/External), JSON Parsing, API integration using HTTP/REST

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

Advanced Concepts: Recycler View and Adapters, Fragments, Notifications, Location-based services (GPS), Publishing apps on Play Store (basic idea)..

LAB COURSE CONTENT

Concerned faculty member should suitably frame at least SIX Laboratory assignments

List of Experiments

1. Installation of Android Studio / Flutter, SDK setup, and emulator configuration.
2. Create and run a basic Hello World mobile application.
3. Design user interface with text fields, buttons, and images using layout managers.
4. Implement button clicks, user input handling, and Toast messages.
5. Navigate between screens and pass data using Intents or Routes.
6. Save and retrieve simple user data using local storage.
7. Fetch and display data from a web API using JSON parsing.
8. Develop a real-world mobile application integrating UI, storage, and connectivity.

Text Books:

1. Dawn Griffiths & David Griffiths, *Head First Android Development,* O'Reilly Media
2. Herbert Schildt – Android Programming, McGraw Hill Education, 2th edition
3. Bill Phillips & Chris Stewart – Android Programming, Big Nerd Ranch Guides (PearsonTechnology Group), 4th edition

Reference Books:

1. Sipser, Introduction to the Theory of Computation.
2. Appel, Modern Compiler Implementation in C/Java.
3. Tremblay & Sorenson, The Theory and Practice of Compiler Writing.
4. Reto Meier – Professional Android Development, Wiley Publishing, 3rd edition.
5. Mark L. Murphy – Beginning Android Development, CommonsWare publication.

NPTEL Links:

1. Android Application Development (with Flutter) https://swayam-plus.swayam2.ac.in/courses/course-details?id=P_SMARTBRIDGE_06
2. Android Mobile Application Development https://onlinecourses.swayam2.ac.in/e-learning/preview/nou21_ge41

Guidelines for ICA:

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Guidelines for ESE:

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

BLOCKCHAIN PLATFORMS AND USE CASES (PEC)					
COURSE OUTLINE					
Course Title:	**Program Elective Course 1: BLOCKCHAIN PLATFORMS AND USE CASES**	**Short Title:**	**BPUC**	**Course Code:**	**CS-506A**

Course description:

This course provides an in-depth understanding of modern blockchain platforms, decentralized applications, scalability challenges, and real-world industry use cases. It explores both permissioned and permission less ecosystems, distributed storage solutions, and next-generation consensus mechanisms. The course combines theoretical foundations with practical insights into enterprise and decentralized blockchain deployments.

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

Prerequisite course(s):

Fundamentals of Blockchain

Course objectives:

1. Students should be able to learn different types of block chain platforms.
2. Students should be able to understand different types of Decentralized applications developed using blockchain technology.
3. Students should be able to evaluate key blockchain challenges including consensus mechanisms, scalability limitations, privacy and confidentiality issues
4. Students should be able to apply the concepts of decentralized storage and alternative distributed ledger technologies.
5. Students should be able to understand several types of blockchain use cases.

Course outcomes:

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

1. Analyze and compare permissioned and public blockchain platforms.
2. Design and evaluate decentralized applications.
3. Assess blockchain scalability, privacy, and security challenges.
4. Understand alternative decentralized technologies such as IPFS and Hashgraph.
5. Identify and propose blockchain-based solutions for real-world industry problems.

COURSE CONTENT

Blockchain Platforms and Use cases		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

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

Permissioned Blockchains: Hyperledger Fabric Services, Model and Functions, Hyperledger Composer, Microsoft Azure Blockchain Platform and Services, Other Platforms: IOTA, TRON, Ziliqa, Cosmos, Ripple.		
Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**
Decentralized Application Platforms: Augur-Decentralised Prediction Market Platform, Grid+-Energy Ecosystem Platform.		
Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**
Challenges and Solutions Related to Blockchain: Consensus, Scalability, Privacy and Confidentiality, Escrow, and Multi signature.		
Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**
Alternative Decentralized Solutions: Interplanetary File System (IPFS) Working and Uses, Hashgrapgh- Working, Benefits, And Use-Cases.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Blockchain Use Cases: Financial Services Related Use Cases, Revolutionization of Global Trade, Digital Identity, Auditing Services, Supply Chain Management, Healthcare Related Services, Blockchain and IOT, Blockchain and AI.		
Text Books:		
1. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashir, Packt Publishing (March 17, 2017). 2. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.		
Reference Books:		
1. Building Blockchain Projects, Narayan Prusty, Packt Publishing. 2. Blockchain: Blueprint for a New Economy by Melanie Swan, Shroff Publisher publisher/O'Reilly Publisher Media; 1st edition (2015)		
NPTL Link: **1.** Introduction to Blockchain Technology and Applications, https://swayam.gov.in/nd1_noc20_cs01/preview		

Program Elective Course – I (PEC)					
DATA ANALYTICS					
COURSE OUTLINE					
Course Title:	**Program Elective Course – I DATA ANALYTICS**	**Short Title:**	**D.A.**	**Course Code:**	**CS–506 B**

Course Description:

This course introduces students to the fundamental concepts and techniques used in data analytics. It focuses on understanding different types of data, the data analysis lifecycle, and the modern data ecosystem. Students learn how to access, read, manipulate, transform, and prepare data from various sources and formats. The course also introduces exploratory data analysis, data visualization, and basic predictive analytics techniques such as ANOVA, Naïve Bayes, and Decision Trees. Emphasis is placed on practical data processing, data quality management, and visualization methods to support decision-making in real-world business scenarios.

Lecture	**Hours/week**	**No. of weeks**	**Total Hours**	**Semester Credits**
	3	**15**	**45**	**3**

Pre Requisite Course(s): Basic knowledge of - Database, SQL, Basic Data Structures, Basic Math, Basic Statistics, Basic Programming Skill.

Students should have basic knowledge of:
Fundamental programming concepts (Python / R / any programming language)
Basic statistics and probability concepts
Basic database concepts and spread sheet usage
Basic understanding of computer applications and data handling

Course Objectives:

The objectives of this course are:

1. To introduce the concepts and lifecycle of data analytics and different types of data sources.
2. To develop the ability to access, read, and validate data from multiple formats and repositories.
3. To enable students to manipulate, transform, and prepare datasets for analysis.
4. To understand exploratory data analysis and data visualization techniques for effective data interpretation.
5. To provide an introduction to basic predictive analytics and data-driven decision-making techniques

Course Outcomes:

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

1. Understand the fundamentals of data analytics, types of data, and the data analysis lifecycle.
2. Access and read data from different sources and formats while handling missing or inconsistent data.
3. Apply techniques for data manipulation, processing, and dataset integration.
4. Perform data transformation, feature preparation, and data quality checks to prepare datasets for analysis.
5. Apply exploratory data analysis, visualization techniques, and basic predictive analytics methods for extracting meaningful insights.

COURSE CONTENT

Data Analytics		**Semester:**	**V**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End-of-semester Exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**

	Internal Sessional Exams (ISE):	**40 marks**
Unit–I:	**No. of Lectures: 09 Hours**	**Marks:12**
Introduction to Data Analytics Definition of Data Analysis, Types of Data (Structured, Semi-structured, Unstructured), Data Analysis Lifecycle, Modern Data Ecosystem, Sources of Data, Data Repositories, Overview of Analytics Tools, Introduction to Data Wrangling.		
Unit–II:	**No. of Lectures:09 Hours**	**Marks:12**
Accessing and Reading Data Understanding File Formats (CSV, TXT, JSON, XML), Reading Raw and Delimited Data, Handling Missing Data, Reading Spreadsheet Data, Reading Data from Databases, Data Validation, and Customization. **Data Manipulation and Processing** Data Sub-setting, Sorting and Grouping, Using Functions, Conditional Processing (for example - IF, Loops), Working with Arrays/Lists, Combining Data Sets (Concatenation, One-to-One and One-to-Many Merging), Creating Summary Reports.		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks:12**
Data Transformation and Preparation Manipulating Character and Numeric Variables, Date and Time-based Transformations, Data Type Conversion, Feature Engineering Basics, Debugging Techniques, Data Quality Checks		
Unit– IV:	**No. of Lectures:09 Hours**	**Marks:12**
Data Analysis, Visualization Exploratory Data Analysis (EDA), Descriptive Statistics, Role of Data Visualization, Types of Charts: Bar, Line, Pie, Scatter, Bubble, Chart Selection Techniques, Applying Filters and Parameters, Business Scenario Analysis, Designing Dashboards and Report Components, Interactive Dashboards, Tables and Gauges		
Unit– V:	**No. of Lectures:09 Hours**	**Marks:12**
Predictive Analytics Introduction to Predictive Analytics, ANOVA, Naïve Bayes Classifier, Decision Trees, Data Forecasting, Overview of Text Analytics, Recent trends in data analytics.		
Text Books:		
1. Wes Mckinney, "Python for Data Analysis", Third Edition, O'Reilly. 2. Peter Bruce, Andrew Bruce & Peter Gedeck, "Practical Statistics for Data Scientists", Second Edition, O'Reilly.		
Reference Books: 1. Gareth James, Daniela Witten, Trevor Hastie and Robert Tivshirani, "An Introduction to Statistical Learning with Applications in R", Springer. 2. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers. 3. EMC Education services, "Data Science and Big Data Analytics".		
NPTEL Video: 1. https://nptel.ac.in/courses/106107220 2. https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr24_ed70 3. https://nptel.ac.in/courses/106104846 4. https://nptel.ac.in/courses/110106072		
YouTube Videos: https://www.youtube.com/playlist?list=PLa7VYi0yPIH0KbnJQcMv5N9iW8HkZHztH		

QUANTUM COMPUTING (PEC)					
COURSE OUTLINE					
Course Title:	**QUANTUM COMPUTING (PEC)**	**Short Title:**	**QC**	**Course Code:**	**CS-506 C**

Course description: This course introduces the fundamental principles of quantum mechanics applied to computation. It covers mathematical foundations, qubits, entanglement, quantum gates, circuits, quantum communication protocols, and major quantum algorithms. The course also explores real-world applications and future challenges in quantum computing.

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

Prerequisite course(s):

Linear Algebra, Probability Theory, Discrete Mathematics

Course objectives:

The objective of this course is to:

1. Introduce the fundamental principles of quantum mechanics for computation.
2. Develop the mathematical foundations required for quantum computing.
3. Understand qubits, entanglement, and quantum communication protocols.
4. Design and analyze quantum gates, circuits, and algorithms.
5. Explore applications and future impact of quantum computing.

Course outcomes:

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

1. Explain fundamental quantum principles used in quantum computing.
2. Apply linear algebra concepts to represent quantum states and operations.
3. Analyze qubits, entanglement, and quantum measurements.
4. Design and evaluate quantum gates, circuits, and algorithms.
5. Assess applications and the impact of quantum computing.

COURSE CONTENT

QUANTUM COMPUTING		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE)**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

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

Fundamentals of Quantum Mechanics and Linear Algebra

Quantum systems, quantum clock, measurement theory, randomness, photons and polarization, spin, complex numbers, vectors, orthogonality, bra–ket notation, matrices, unitary and orthogonal matrices.

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

Qubits and Quantum States

Probability, quantum spin mathematics, equivalent state vectors, qubits, probability amplitudes, quantum interference, BB84 quantum key distribution protocol.

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

Quantum Entanglement and Bell's Inequality
Tensor products, entangled and unentangled states, CNOT-based entanglement generation, Bell's inequality, EPR paradox, local realism, Ekert quantum key distribution protocol.

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

Quantum Gates, Circuits and Communication
Classical logic, reversible computation, quantum gates, CNOT gate, universal gates, no-cloning theorem, Bell circuit, superdense coding, quantum teleportation, quantum error correction.

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

Quantum Algorithms and Applications
Complexity classes, Deutsch's algorithm, Deutsch–Jozsa algorithm, Simon's algorithm, Shor's algorithm, Grover's algorithm, quantum supremacy, cryptanalysis, chemistry simulation, hardware challenges

Text Books:

1. Chris Bernhardt, Quantum Computing for Everyone, MIT Press.

Reference Books:

1. Nielsen & Chuang, Quantum Computation and Quantum Information, Cambridge University Press.
2. Kaye, Laflamme & Mosca, An Introduction to Quantum Computing, Oxford University Press.
3. Rieffel & Polak, Quantum Computing: A Gentle Introduction, MIT Press.

NPTEL Links:

1. Introduction to Quantum Computing: Quantum Algorithms and Qiskit, IBM and IITM
   Prof. Prabha Mandayam Prof. Anupama Ray Prof. Sheshashayee Raghunathan
   https://nptel.ac.in/courses/106106232

BLOCKCHAIN PLATFORMS AND USE CASES LAB (PEC)						
COURSE OUTLINE						
Course Title:	**Program Elective Course I-Lab: BLOCKCHAIN PLATFORMS AND USE CASES LAB**		**Short Title:**	**BPUL**	**Course Code:**	**CS-507A**
Practical	**Hours/week**	**No. of weeks**	**Total hours**		**Semester credits**	
	02	**15**	**30**		**1**	
Prerequisite course(s):						
Fundamentals of Blockchain						
COURSE CONTENT						
BLOCKCHAIN PLATFORMS AND USE CASES LAB			**Semester:**	**VI**		
Teaching Scheme:			**Examination scheme**			
Practical:	**02 Hours/week**		**Internal Continuous Assessment (ICA): CA**		**25 marks**	

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. Develop a simple blockchain application using Hyperledger Fabric to store and manage data on a distributed ledger.
2. Deploy a simple blockchain network using Microsoft Azure Blockchain Service and interact with a smart contract.
3. Develop a simple DApp.
4. Write and deploy a **smart contract that acts as an escrow** between a buyer and seller.
5. Implement blockchain for supply chain tracking.
6. Implement blockchain-based identity system.
7. Predicting a patient's risk of developing diabetes based on historical health metrics stored on a blockchain ledger.

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.

Text Books:

1. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashir, Packt Publishing (March 17, 2017).
2. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.

Reference Books:

1. Building Blockchain Projects, Narayan Prusty, Packt Publishing.
2. Blockchain: Blueprint for a New Economy by Melanie Swan, Shroff Publisher publisher/O'Reilly Publisher Media; 1st edition (2015)

NPTEL Links:

1. https://nptel.ac.in/courses/106105184/
2. Introduction to Blockchain Technology and Applications, https://swayam.gov.in/nd1_noc20_cs01/preview

DATA ANALYTICS LAB (PEC)					
COURSE OUTLINE					
Course Title:	**Program Elective Course – I Lab Data Analytics Lab**	**Short Title:**	**DAL**	**Course Code:**	**CS-507 B**

Course Description:

This laboratory course provides hands-on experience in data acquisition, cleaning, manipulation, analysis, visualization, and dashboard creation using modern analytics tools such as Python, R, or Tableau/Power BI. Students will work with datasets from different domains, such as sales, healthcare, education, finance, and social media, to perform exploratory data analysis and generate meaningful insights. The lab emphasizes data preprocessing, visualization techniques, predictive analytics basics, and interactive dashboard development to support data-driven decision making.

Practical	**Hours/week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	2	**15**	**30**	**1**

Pre Requisite Course(s): Basic knowledge of - SQL, Basic Programming Skill, CSV & Excel file, Python/R programming language.

COURSE CONTENT

Data Analytic Lab		**Semester:**	**V**
Teaching Scheme:		**Examination Scheme:**	
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA):**	**25 marks**

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

1. To import and read datasets from different file formats such as CSV, TXT, JSON, XML, and spreadsheets.
2. To perform data cleaning by identifying and handling redundant data, duplicate records, and missing values in a dataset.
3. To perform data sub-setting, sorting, and grouping operations to organize and analyse dataset attributes.
4. To apply functions, conditional statements, and loops for processing and analyzing dataset values.
5. To combine multiple datasets using techniques such as concatenation, joins, and merging.
6. To perform data transformation operations, including data type conversion, string manipulation, and date-time transformations.
7. To perform exploratory data analysis (EDA) using descriptive statistics to identify patterns and trends in data.
8. To create different types of data visualizations such as bar charts, line charts, pie charts, scatter plots, and bubble charts.
9. To design and develop interactive dashboards for data analysis using visualization tools.
10. To understand the basics of Apache Kafka and implement a simple real-time data streaming pipeline using Kafka producer and consumer.
11. To perform real-time analytics by integrating Apache Kafka with Python for streaming data processing and visualization.

The concerned faculty may design one mini project based on a specific domain (Health Care, Sales, Education, etc.).

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

Text Books:

1. Wes Mckinney, "Python for Data Analysis", Third Edition, O'Reilly.
2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly.
3. Gareth James, Daniela Witten, Trevor Hastie and Robert Tivshirani, "An Introduction to Statistical Learning with Applications in R", Springer.

Reference Books

1. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers.
2. EMC Education services, "Data Science and Big Data Analytics".

Guidelines for ICA:

Students must submit ICA in the form of a 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.

QUANTUM COMPUTING LAB (PEC-I)					
COURSE OUTLINE					
Course Title:	**Program Elective Course I: QUANTUM COMPUTING LAB (PEC-I)**	**Short Title:**	**QCL**	**Course Code:**	**CS-507 C**

Course description: This course introduces the fundamental principles of quantum mechanics applied to computation. It covers mathematical foundations, qubits, entanglement, quantum gates, circuits, quantum communication protocols, and major quantum algorithms. The course also explores real-world applications and future challenges in quantum computing.

Practical	**Hours/week**	**No. of**	**Total Hours**	**Semester Credits**
	2	**15**	**30**	**1**

COURSE CONTENT

QUANTUM COMPUTING		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**2 hours/week**	**Internal Continuous assessments (ICA)**	**25 marks**

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

List of Practical (ANY SIX)

1. Assignment 1: Install and Setup Qiskit
   Tasks: Install Qiskit in Google Colab. Import required libraries. Create an empty quantum circuit. Draw the circuit.
2. Assignment 2: Create and Measure a Single Qubit
   Tasks: Create 1-qubit circuit, Measure without applying any gate, Execute with 1000 shots. Display result histogram. Observation: Output should be mostly 0.
3. Assignment 3: Apply Pauli-X Gate
   Tasks: Initialize qubit in $|0\rangle$. Apply X gate. Measure result. Compare with classical NOT gate.
4. Assignment 4: Create Superposition Using Hadamard Gate
   Tasks: Apply H gate on $|0\rangle$. Measure with 1024 shots. Plot histogram.
   Explain why results are nearly 50%-50%.
5. Assignment 5: Multiple Shots Analysis
   Tasks: Run superposition experiment with: 10 shots,100 shots,1000 shots
   Compare distribution, Write conclusion.
6. Assignment 6: Two-Qubit Circuit
   Tasks: Create 2 qubits , Apply H on both, Measure, Analyze output probabilities.
7. Assignment 7: Create Bell State (Basic Entanglement)
   Tasks: Apply H on qubit 0. Apply CNOT. Measure both qubits.
   Show that outputs are correlated (00 and 11).
8. **Assignment 8: Compare Entangled vs Non-Entangled State**

NPTEL Links:

1. Introduction to Quantum Computing: Quantum Algorithms and Qiskit, IBM and IITM
   Prof. Prabha Mandayam Prof. Anupama Ray Prof. Sheshashayee Raghunathan
   https://nptel.ac.in/courses/106106232

INDUSTRY 4.0 (MD M)					
COURSE OUTLINE					
Course Title:	**INDUSTRY 4.0 (MD M)**	**Short Title:**	**I 4.0**	**Course Code:**	**CS-508**

Course description:

Industry 4.0 represents the fourth industrial revolution, where digital technologies, automation, and intelligent systems transform modern business operations. This course introduces key concepts such as cyber-physical systems, IoT, artificial intelligence, big data, cloud computing, blockchain, and smart manufacturing. Students will understand how digital technologies improve efficiency, enable real-time decision-making, and support secure and innovative business environments. By the end of the course, learners will gain the knowledge and analytical skills required to support digital transformation and enhance organizational competitiveness in the Industry 4.0 era.

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

Pre requisite course(s):

Principles of Economics, Fundamentals of Accounting, and Business Mathematics or a program or courses of similar content.

Course objectives:

1. Understand the fundamental concepts, technologies, and frameworks driving Industry 4.0.
2. Explore the role of IoT, AI, robotics, and cyber-physical systems in modern industrial ecosystems.
3. Analyze how digital transformation impacts manufacturing, supply chains, and business models.
4. Develop awareness of challenges such as cybersecurity, data privacy, and workforce adaptation in Industry 4.0.
5. Apply Industry 4.0 principles to evaluate organizational readiness and design strategies for sustainable competitiveness.

Course outcomes:

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

1.Demonstrate knowledge of Industry 4.0 technologies and their integration into business processes.
2.Evaluate the impact of smart manufacturing and digital tools on productivity and efficiency.
3.Apply data-driven approaches (big data analytics, digital twins, AI) to solve industrial problems.
4.Assess organizational digital maturity and recommend strategies for Industry 4.0 adoption.
5.Contribute to innovation and transformation initiatives by aligning technological solutions with business goals.

COURSE CONTENT

Industry 4.0		**Semester:**	
Teaching Scheme:		**Examination scheme:**	
Lectures:	**2 hours/week**	**End semester exam (ESE): UA TH**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE):CA TH	**40 marks**

	Internal Continuous Assessment (ICA) PR	**25 marks**
Unit–I:	**No. of Lectures: 06 Hours**	**Marks:12**
Introduction to Industry 4.0 Evolution of Industrial Revolutions (1.0 to 4.0) ,Definition, scope, and significance of Industry 4.0,Historical background and emergence of the Fourth Industrial Revolution, Characteristics: speed, scale, and systemic impact, Convergence of physical, digital, and biological technologies		
Unit–II:	**No. of Lectures: 06 Hours**	**Marks:12**
Drivers and Enabling Technologies Megatrends driving Industry 4.0 ,Physical technologies: Autonomous vehicles, Advanced robotics, Additive manufacturing (3D printing),Smart and advanced materials, Digital technologies: Internet of Things (IoT),Big Data and analytics, Cloud computing, Blockchain ,Biological technologies: Biotechnology, Genetic engineering, Bio-manufacturing		
Unit–III:	**No. of Lectures: 06 Hours**	**Marks:12**
Smart Manufacturing and Intelligent Systems Smart factories and connected production systems ,Cyber-Physical Systems (CPS) ,Sensor-based monitoring and automation ,Machine-to-machine (M2M) communication ,Digital Twin concept Human–machine collaboration		
Unit– IV:	**No. of Lectures: 06 Hours**	**Marks:12**
Impact of Industry 4.0 on Engineering and Industry Impact on manufacturing systems ,Transformation of supply chains ,Productivity and efficiency improvements ,Industry 4.0 and engineering job roles ,Skill requirements and workforce transformation ,Data-driven products and services		
Unit– V:	**No. of Lectures: 06 Hours**	**Marks:12**
Challenges, Ethics, and Future Trends Cybersecurity and data privacy challenges, Ethical issues and social implications, Technological unemployment and inequality ,Regulatory and policy challenges ,Future trends and tipping points ,Introduction to Industry 5.0		
Text Books:		
1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Springer.		
Reference Books		
1. Klaus Schwab, The Fourth Industrial Revolution, World Economic Forum, 2016. 2. Albrecht Enders & Ramge, Industry 4.0: Managing the Digital Transformation, Springer. 3. Ramjee Prasad, Cyber-Physical Systems and Industry 4.0, River Publishers.		
NPTEL Link- https://nptel.ac.in/courses/106105195		

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

Third Year Bachelor of Engineering

in

(Common for all)

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



COURSE OUTLINE FOR OPEN ELECTIVE - III

For Affiliated Colleges

Semester – V

W.E.F. 2026 – 27

Open Elective – III

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 - III (w.e.f. 2026 - 27 at Semester - V, Third Year Engineering)			
OE – 509 A	Legal Aspects of Business	Comm. & Mgmt.	Management
OE – 509 B	Modern Office Management	Comm. & Mgmt.	Commerce
OE – 509 C	Food Adulteration and Safety	Sci. & Tech.	Environment
OE – 509 D	Insurance Management	Comm. & Mgmt.	Commerce
OE – 509 E	Indian Social Problems	Humanities	Sociology
OE – 509 F	Disaster Management	Sci. & Tech.	Environment
OE – 509 G	Pharma Marketing Management	Sci. & Tech.	Pharmacy
OE – 509 H	Circular Economy	Humanities	Economics

LEGAL ASPECTS OF BUSINESS (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**LEGAL ASPECTS OF BUSINESS**	**Short Title:**	LAB	**Course Code:**	OE – 509 A

Course description:

This course provides a concise overview of the legal framework governing business in India, covering contracts, sale of goods, negotiable instruments, intellectual property rights, company law, and cyber law. It equips students with basic legal knowledge and practical understanding required for lawful, ethical, and effective business decision-making in a digital environment.

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

Prerequisite course(s):

Basics of Law, Legal Environment of Business, Mercantile Law

Course objectives:

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

1. To understand the basic concepts and rules of contracts as per the Indian Contract Act.
2. To learn the legal provisions related to sale of goods and negotiable instruments.
3. To know the importance and protection of intellectual property rights with reference to the Patents Act, Copyright Act, and Trade Marks Act.
4. To understand the basic structure and working of companies according to the Companies Act.
5. To understand digital laws, cybercrimes, and data protection as guided by the Information Technology Act.

Course outcomes:

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

1. Understand the basic principles and essentials of contracts under the Indian Contract Act.
2. Apply provisions of Sale of Goods and Negotiable Instruments laws in business transactions.
3. Explain the importance and protection of Intellectual Property Rights in business.
4. Understand the formation and legal framework of companies under company law.
5. Identify cyber laws, digital transactions, and data protection under the Information Technology Act.

COURSE CONTENT

LEGAL ASPECTS OF BUSINESS		Semester:	V
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Unit–I:	No. of Lectures: 06 Hours

INDIAN CONTRACT ACT, 1872

Contract: Definition and meaning-Essentials of contract
Classification of Contracts, Offer and Acceptance
Consideration: Definition, Essentials of a Valid Consideration –Capacity to contract

Free Consent: Coercion, Undue influence, Fraud, Misrepresentation and Mistake		
Unit–II:	**No. of Lectures: 06 Hours**	
SALES OF GOODS ACT, 1930 & Negotiable Instruments Act 1881		
Sale of Goods Act 1930: Sale and agreement to sell, Conditions and warranties, Transfer of ownership, rights of unpaid seller. Negotiable Instruments Act 1881: Meaning, type of negotiable instruments; promissory note, bill of exchange, cheque. Endorsement and negotiation, Dishonour and legal remedies		
Unit–III:	**No. of Lectures: 06 Hours**	
INTELLECTUAL PROPERTY RIGHTS		
Intellectual Property Rights-Meaning, Need and Importance of Intellectual Property Patents Act, 1970 (2002): Definition, Objectives, Nature, and Types of Patents, Transfer of Patent Rights, Rights of Patentee. Copyright Act, 1957-Concept, Objectives, Nature, Criteria for protection, Ownership, Duration, and Copy Right in Computer Programmes. Trademark Act 1999 (Amendment Act 2010)- Concept, Registration, rights of registered proprietor, infringement and defenses.		
Unit–IV:	**No. of Lectures: 06 Hours**	
COMPANIES ACT, 1956 (Amended 2013)		
Meaning, Definition and characteristics and kinds of company. Memorandum of Association - Meaning, Purpose, Contents Doctrine of Ultra-Vires Articles of Association - Meaning Purpose, Content. Alternation, Constructive Notice		
Unit–V:	**No. of Lectures: 06 Hours**	
The Information Technology Act, 2000 (Amended 2008)		
Introduction, Digital Signatures and Electronic records, Electronic governance Cyber-crimes: hacking, phishing, identity theft, cyber fraud and remedies Data protection, privacy and digital compliance Important Provision of Information Technology Act 2000		
Text Books:		
1. Legal Aspects of Business (8th ed.). McGraw Hill Education. - Akhileshwar Pathak		
Reference Books:		
1. Legal Aspects of Business – David Albuquerque 2. Business Law – N.D.Kapoor 3. Mercantile Law – M. C. Kuchhal and Vivek Kuchhal		
NPTEL Links: • https://nptel.ac.in/courses/129106006 • https://onlinecourses.swayam2.ac.in/e-learning/preview/cec21_mg02 • https://onlinecourses.nptel.ac.in/noc26_mg30/preview		
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.		

MODERN OFFICE MANAGEMENT (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**MODERN OFFICE MANAGEMENT**	**Short Title:**	MOM	**Course Code:**	OE – 509 B

Course description:

This course introduces the concepts and practices of modern office management in a technology-driven environment. It covers office structure, layout, communication, documentation, and record management, along with digital office tools and automation. The course also focuses on office personnel management, professional behaviour, productivity skills, and emerging trends preparing students to manage contemporary offices effectively.

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

Prerequisite course(s):

Fundamentals of Office Administration, Business Communication, Office Administration and Secretarial Practice

Course objectives:

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

1. To understand basics of modern office management and emerging office trends.
2. To learn office layout, systems, and workplace environment management.
3. To develop skills in office communication, documentation, and services.
4. To understand records management, meetings, and office automation.
5. To build competencies in personnel management and productivity skills.

Course outcomes:

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

1. Explain concepts and modern trends of office management.
2. Apply office layout, systems, and environmental principles.
3. Demonstrate office communication, documentation, and services.
4. Analyze records management, meetings, and office automation.
5. Evaluate personnel management, productivity, and emerging trends.

COURSE CONTENT

MODERN OFFICE MANAGEMENT		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

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

Introduction to Modern Office Management

Modern Office: Meaning, Definition, Characteristics, Functions and Past–Present–Future
Office Management: Meaning, Elements and Office as Service & Information Centre
Office Organisation: Office Manager- Functions, Duties, Responsibilities
Modern Trends in Office: Paperless Office and Virtual Office

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

Office Layout and Environment

Office Systems: Objectives, Flow of Work, Planning and Scheduling
Office Layout: Meaning, Objectives, Principles, Types
Office Infrastructure & Facilities Management
Office Environment: Meaning, Factors & Importance Office Safety & Remedies

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

Office Communication, Forms and Services

Office Communication: Internal & External Communication, Digital Communication
Business Documentation: Report Writing, Documentation and Office Correspondence
Office Forms: Types, Control, Stationery- Standardisation and Issues
Mail & Communication Services: Courier, Speed Post, Fax and E-mail Services

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

Office Record Management

Records Management: Meaning, Objectives and Organisation of Record Department
Office Meetings - Meaning, Definition, Purpose, Types of meeting
Filing & Retrieval Systems: Physical and Electronic Records, Retention and Disposal
Digital Office & Automation: E-Office, Office Software Tools and Automation Systems

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

Office Personnel Management and Emerging Trends

Office Personnel Management: Types, Qualities, Recruitment, and Training
Professional Behaviour: Ethics, Discipline, Leadership and Team Coordination
Productivity Skills: Time Management and Stress Management
Emerging Trends in Office: Remote Work and Green Office Practices

Text Books:

- Office Management & Control – G.R.Terry

Reference Books:

1. Office Organization and Management – S. P. Arora, Vikas Publishing House Pvt. Ltd., New Delhi.
2. Office Organisation & Management – R.K. Chopada & Ankita Chopada, Himalaya Publishing House, Mumbai.
3. Office Management – I. M. Sahai, Kitab Mahal, Allahabad.
4. Office Management – P. K. Ghosh, Sultan Chand & Sons, New Delhi.

NPTEL Links:

- https://onlinecourses.swayam2.ac.in/e-learning/preview/nou23_mg05
- https://onlinecourses.swayam2.ac.in/e-learning/preview/cec21_mg24
- https://onlinecourses.swayam2.ac.in/e-learning/preview/imb24_mg54

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.

FOOD ADULTERATION AND SAFETY (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**FOOD ADULTERATION AND SAFETY**	**Short Title:**	FAS	**Course Code:**	**OE – 509 C**

Course description:
This course is designed to impart basic knowledge on identifying major types of food adulterants and contamination, food safety hazards using engineering and microbiological principles, Interpret food laws and regulatory standards relevant to engineering practice.
Also, to emphasize the roles of students in basic food safety management frameworks.

	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:

1. To introduce the principles of food safety, food adulteration, and regulatory standards.
2. To explain types, sources, and detection of food adulterants using scientific and engineering approaches.
3. To familiarize students with national and international food safety regulations including FSSAI, Codex, ISO and HACCP.
4. To develop understanding of food contaminants, toxicants, and risk assessment methodologies.
5. To apply quality assurance and analytical techniques relevant to food safety monitoring.

Course outcomes:

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

1. Explain concepts of food safety, hazards, and adulteration mechanisms.
2. Identify and classify food adulterants and contaminants in different food matrices.
3. Apply analytical and instrumental techniques for detection of adulterants.
4. Interpret regulatory frameworks and food safety management systems.
5. Analyze risk assessment models and quality control measures in food systems.

COURSE CONTENT

FOOD ADULTERATION AND SAFETY		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

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

Fundamentals of Food Safety and Adulteration

- Concept and importance of food safety
- Definitions: Food safety, food quality, food security
- Types of food hazards: Biological, Chemical, Physical
- Concept of food adulteration
- Intentional and incidental adulteration
- Food contamination vs adulteration
- Food safety challenges in developing countries
- Overview of global food safety issues
- Role of regulatory bodies

- Food standards and their significance

Unit–II:	No. of Lectures: 06 Hours	

Food Adulterants and Contaminants

- Common food adulterants in cereals, pulses, milk, fats & oils, spices
- Chemical contaminants: Pesticide residues, heavy metals, industrial chemicals
- Natural toxins: Mycotoxins, plant toxins, marine toxins
- Veterinary drug residues
- Food additives and misuse
- Packaging contaminants
- Emerging contaminants
- Health effects of adulterants
- Case studies of major food adulteration incidents.

Unit–III:	No. of Lectures: 06 Hours	

Detection and Analytical Techniques

- Sampling methods and protocols
- Classical methods of detection
- Chromatographic techniques (HPLC, GC)
- Analytical Methods (UV-Vis, IR, NMR, Mass Spectrometry)
- Biosensors in food safety
- Molecular methods (PCR-based detection)
- Rapid detection kits
- Validation of analytical methods

Unit–IV:	No. of Lectures: 06 Hours	

Food Safety Regulations and Standards

- Codex Alimentarius Commission
- WTO agreements (SPS & TBT)
- Food Safety and Standards Act (India)
- FSSAI regulations
- ISO 22000 and Food Safety Management Systems
- HACCP principles and implementation
- Good Manufacturing Practices (GMP)
- Good Hygienic Practices (GHP)
- Risk analysis framework
- Traceability and recall systems.

Unit–V:	No. of Lectures: 06 Hours	

Risk Assessment and Quality Assurance

- Risk assessment framework
- Hazard identification
- Exposure assessment
- Dose-response assessment
- Risk characterization
- Quality control tools
- Statistical quality control in food industry
- Validation and verification

- Food safety auditing
- Emerging technologies in food safety monitoring.

Text Books:

1. Food Safety and Standards, K. Ramawat & J. Kumar, CRC Press / Springer
2. Food Safety & Quality Assurance: Principles and Practices, Sunetra Roday, Wiley
3. Food Safety and Standards in India, B. Srilakshmi, New Age International

Reference Books:

1. Food Analysis, S. Suzanne Nielsen, Springer
2. Principles of Food Toxicology, D. R. Heldman & D. B. Lund (Ed.), Springer / CRC Press

NPTEL Links:

- **Food Safety and Quality Management**
  https://nptel.ac.in/courses/126105011
- **Food Packaging Technology**
  https://nptel.ac.in/courses/126105010
- **Food Chemistry and Technology**
  https://nptel.ac.in/courses/126105013
- **Food Processing and Preservation**
  https://nptel.ac.in/courses/126105012

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.

INSURANCE MANAGEMENT (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**INSURANCE MANAGEMENT**	**Short Title:**	IM	**Course Code:**	**OE – 509 D**

Course description:
This course provides a fundamental understanding of insurance concepts, principles, and practices. It covers life and general insurance products, legal and regulatory frameworks, underwriting and claims management, and the role of insurance in economic development. The course equips students with essential knowledge of insurance operations and industry practices, preparing them for opportunities in the insurance and financial services sector.

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

Prerequisite course(s):

Basic knowledge of Commerce / Economics
Fundamental understanding of Financial Systems and Banking

Course objectives:

The objective of this course is:
1. To introduce students to the basic concepts, principles, and functions of insurance.
2. To provide knowledge of life and general insurance products and their features.
3. To familiarize students with the legal and regulatory framework of insurance in India.
4. To understand the role of insurance in economic development and financial stability.
5. To develop understanding of insurance operations including underwriting and claims management.

Course outcomes:

After successful completion of this course the student will be able to:
1. Explain the fundamental principles and functions of insurance.
2. Differentiate various life and general insurance products.
3. Describe the legal and regulatory framework governing insurance in India.
4. Analyze the contribution of insurance to economic development.
5. Understand underwriting, claims settlement, and operational practices in insurance companies.

COURSE CONTENT

INSURANCE MANAGEMENT		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

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

Fundamentals of Insurance

Meaning and definition of insurance Nature, scope and functions of insurance
Evolution and importance of insurance
Principles of insurance – Utmost Good Faith, Insurable Interest, Indemnity, Subrogation, Contribution, Proximate Cause
Types of insurance

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

Life and General Insurance Products

Life Insurance – Term, Whole Life, Endowment, Annuities & Pension Plans
Basic concept of premium and mortality table
General Insurance – Fire, Marine, Motor and Health Insurance
Crop, Rural and Group Insurance

Maturity and Death Claims		
Unit–III:	**No. of Lectures: 06 Hours**	
Legal and Regulatory Framework of Insurance		
LIC Act, 1956 General Insurance Act, 1972 IRDA Act, 1999 and Functions of IRDA Actuaries Act, 2006 Regulatory and ethical practices in insurance		
Unit–IV:	**No. of Lectures: 06 Hours**	
Insurance and Economic Development		
Role of insurance in economic development Growth of life and general insurance in India Liberalization of insurance sector and its impact Issues, challenges and future potential of insurance industry		
Unit–V:	**No. of Lectures: 06 Hours**	
Insurance Operations and Governance		
Underwriting – Meaning and principles (Life & General Insurance) Claims Management – Life and General Insurance Insurance agents – Licensing, functions and code of conduct Consumer protection and grievance redressal mechanism		
Text Books:		
1. **Fundamentals of Insurance** – Dr. P.K. Gupta, Himalaya Publishing House		
Reference Books: 1. Insurance: Principles And Practice – M.N. Mishra & S B Mishra, S Chand Publishing 2. Principles of Insurance Management – Neelam C Gulati, Excel Books 3. **Principles and Practice of Insurance by P. Periasamy** A.K. Basu, Himalaya Publishing House		
ONLINE COURSES SWAYAM Links: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec20_mg24		
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.		

INDIAN SOCIAL PROBLEMS (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**INDIAN SOCIAL PROBLEMS**	**Short Title:**	ISP	**Course Code:**	**OE-509 E**

Course description:
This course introduces students to the sociological understanding of major social problems in India. The course includes the concept, characteristics, and approaches to the study of social problems and proceeds to examine key issues such as poverty, unemployment, population growth, and urbanization. It further explores violence against women, child labour, crime, and corruption as structural challenges affecting Indian society.

	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:
1. Understand the concept and approaches to social problems in the Indian context.
2. Analyze fundamental economic and demographic social issues in India.
3. Examine population growth and urbanization and their effects on society.
4. Understand gender and child-related social problems with sociological insight.
5. Identify and evaluate crime and corruption as structural social problems.

Course outcomes:

After successful completion of this course the student will be able to:
1. Explain the sociological concept and approaches to social problems.
2. Discuss poverty and unemployment with causes and consequences.
3. Analyze the issues of population growth and urbanization in India.
4. Describe violence against women and child labour with social impacts.
5. Explain crime and corruption as social problems and suggest measures.

COURSE CONTENT

INDIAN SOCIAL PROBLEMS		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Unit–I:	**No. of Lectures: 06 Hours**

Social Problems: Meaning, Characteristics of Social Problems, Types of Social Problems, Approaches to the Study of Social Problems: Social Pathology Approach, Social Disorganization Approach, Value-Conflict Approach, Deviance Approach, Methods of Studying Social Problems

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

Poverty: Meaning & Types, Causes of Poverty, Consequences of Poverty, Measures for Eradication
Unemployment: Meaning & Types, Causes, Consequences, Measures to Reduce Unemployment

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

Population Growth: Growth of Population in India, Causes & Consequences, Population Control Measures
Urbanization: Meaning of Urbanization, Causes of Urbanization, Problems of Urbanization, Remedies for Urban Problems

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

Violence Against Women: Meaning & Forms, Causes & Consequences, Measures to Control
Child Labour & Child Abuse: Meaning & Causes, Problems of Child Labour & Abuse, Measures

to Eliminate		
Unit–V:	**No. of Lectures: 06 Hours**	
Crime and Criminals: Meaning of Crime, Types of Crime, Causes, Prevention & Control Corruption: Meaning of Corruption, Causes & Consequences, Measures to Control Corruption		
Text Books:		
1. Ahuja, Ram. *Social Problems in India*. 4th ed., Rawat Publications, 2021.		
Reference Books: 1. G. R. Madan – Indian Social Problems, Allied Publishers 2. C. N. Shankar Rao – Sociology of Indian Society, S. Chand Publications 3. Vidya Bhushan & D. R. Sachdeva – Introduction to Sociology, Kitab Mahal Publications 4. M. N. Srinivas – Social Change in Modern India, Orient Longman / Oxford University Press 5. R. Desai – Rural Sociology in India, Bombay Popular Prakashan		
NPTEL Links: 1. https://onlinecourses.swayam2.ac.in/cec25_hs92/preview 2. https://onlinecourses.nptel.ac.in/noc24_hs140/preview		
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.		

DISASTER MANAGEMENT (Open Elective-III)					
COURSE OUTLINE					
Course Title:	**DISASTER MANAGEMENT**	**Short Title:**	**DM**	**Course Code:**	**OE – 509 F**

Course description:
The course aims to develop an understanding of disaster management concepts, disaster risk reduction, preparedness, response, and recovery, with emphasis on managing natural and man-made disasters effectively.

	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:

1. Understand fundamental concepts of disasters, hazard, vulnerability, risk and their engineering relevance.
2. Identify and classify natural and anthropogenic disasters and their underlying causes.
3. Explain disaster management principles, phases of disaster cycle and mitigation strategies.
4. Describe institutional frameworks, stakeholders, tools, and technologies used in Disaster Management in India and globally.
5. Apply learned skills to analyze disaster case studies, ethical issues and engineering interventions for disaster risk reduction.

Course outcomes:

Upon successful completion of the course, the students will be able to:

1. Define and explain key disaster concepts, types and impacts.
2. Distinguish between natural and man-made disasters and summaries control measures.
3. Illustrate stages of disaster management cycle and preparedness planning.
4. Evaluate roles of different stakeholders and tools in managing disaster events.
5. Analyze disaster case studies and articulate ethical, legal and policy issues.

COURSE CONTENT

DISASTER MANAGEMENT		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 Marks**

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

Introduction & Disasters Fundamentals

Overview of Disaster Management: Definitions: Disaster, Hazard, Risk, Vulnerability, Capacity, Historical perspective & impacts (environment, society, economy)
Understanding Disasters: Nature, causes & classification of disasters, Concept of exposure, resilience, capacity

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

Natural & Anthropogenic Disasters

Natural Disasters: Earthquakes, Tsunami, Volcanoes, Cyclones, Floods, Droughts, Landslides, Extreme weather events and climate change impacts.
Anthropogenic (Man-made) Disasters: Industrial accidents, fires, pollution events, Transportation failures, structural failures.

Unit–III:	**No. of Lectures: 06 Hours**	
Pandemics, Environmental Disasters & Management Principles		
Pandemics and Environmental Disasters: COVID-19 case insights and environmental disaster context. **Objectives & Principles of Disaster Management**: Prevention, preparedness, mitigation, response and recovery concepts. **Disaster Management Cycle**: Phases, actions and key engineering considerations		
Unit–IV:	**No. of Lectures: 06 Hours**	
Stakeholders & Institutional Framework		
Stakeholders in Disaster Management: Government agencies, NGOs, community groups, Technological tools (Early Warning Systems, GIS, Remote Sensing). **International Cooperation & Organizational Structures**: UN agencies, regional alliances and global frameworks **Disaster Management in India**: Institutional framework, NDMA, policy & legal context.		
Unit–V:	**No. of Lectures:06 Hours**	
Ethical Issues & Case Studies		
Ethical Issues in Disaster Management: Resource allocation, social equity and engineering ethics **Case Studies**: Natural and man-made disaster case analyses, Lessons learnt, best practices.		

Text Books:

1. R. Subramanian, Disaster Management, Vikas Publishing House.
2. S.C.Sharma, Disaster Management Khanna Publishing House, New Delhi.
3. G. K. Ghosh, Disaster Management, APH Publishing Corporation, New Delhi

Reference Books:

1. A.K. Singh, Disaster Management in India, New Royal Book Company, Lucknow
2. Anu Kapur Vulnerable India: A Geographical Study of Disasters, Sage Publications, New Delhi
3. Tushar Bhattacharya, Disaster Science and Management, McGraw-Hill Education (India)
4. Jagbir Singh (Ed.), Disaster Management: Future Challenges and Opportunities, Disaster, I.K. International Publishing House

Online Courses:

NIDM E-Learning Courses (National Institute of Disaster Management)
https://elearning.nidm.gov.in/local/home/index.php
SWAYAM & NPTEL MOOCs
https://archive.nptel.ac.in/courses/105/104/105104183/
iGOT Karmayogi (For Govt. Officials)
https://igotkarmayogi.gov.in/#/

Guidelines for ICA:

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PHARMA MARKETING MANAGEMENT (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**PHARMA MARKETING MANAGEMENT**	**Short Title:**	PMM	**Course Code:**	OE – 509 G

Pharmaceutical Marketing Management focuses on the planning, implementation, and control of marketing strategies specific to the pharmaceutical industry, where ethical considerations, regulatory compliance, and patient safety play a critical role. It involves understanding healthcare markets, consumer and physician behavior, product life-cycle management, pricing strategies, distribution channels, and promotional activities such as medical detailing, digital marketing, and relationship management with healthcare professionals. The discipline integrates market research, brand management, and strategic decision-making to ensure effective product positioning while complying with national and international regulations. In an increasingly competitive and technology-driven environment, pharmaceutical marketing management emphasizes value-based marketing, patient-centric approaches, and sustainable growth.

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

Course objectives:

The objective of this course is to:

1. To study the scope of marketing.
2. To study the quantitative and qualitative aspects of pharmaceutical market.
3. To study the products decision in product life cycle, product portfolios, packaging and labelling decisions.
4. To study the promotion of products.
5. To study marketing channels and management of logistics.

Course outcomes:

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

1. Understand and explain core marketing concepts and their application in the pharmaceutical industry.
2. Understand quantitative and qualitative aspects of pharmaceutical market.
3. Understand the product cycle, product portfolios.
4. Assess promotional tools including personal selling, advertising, digital marketing, and ethical promotion practices.
5. Understand the marketing channels and management of logistics.

COURSE CONTENT

PHARMA MARKETING MANAGEMENT		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA)CA:**	**25 marks**

Unit–I:	**No. of Lectures: 6 Hours**	

Marketing:

Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior.

Pharmaceutical Market:

Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation & targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.

Unit–II:	**No. of Lectures: 6 Hours**	

Product Decision:		
Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.		
Unit–III:	**No. of Lectures: 6 Hours**	
Promotion:		
Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.		
Unit–IV:	**No. of Lectures: 6 Hours**	
Pharmaceutical Marketing Channels		
Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management. **Management of Logistics:** Supply Chain, Cold Chain, Applications of IT & management information systems for efficient marketing, controlling expiry and returned goods.		
Unit–V:	**No. of Lectures: 6 Hours**	
Pricing:		
Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority). **Emerging concepts in marketing:** Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing. **AI in Pharma Marketing:** Introduction to AI in Pharma Marketing: Role of AI in modern pharmaceutical marketing, Benefits, limitations, and future scope of AI in pharma, AI-driven market research and forecasting		
Text Books:		
1. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India. 2. Ramaswamy, U.S & Nanakamari, S: Marketing Management: Global Perspective, Indian Context, Macmilan India, New Delhi.		
Reference Books: 1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India New Delhi		
NPTEL Links: 1. https://youtu.be/iOZxUvq1JNE 2. https://nptel.ac.in/courses/110104068		
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.		

CIRCULAR ECONOMY (Open Elective – III)					
COURSE OUTLINE					
Course Title:	**CIRCULAR ECONOMY**	**Short Title:**	**CE**	**Course Code:**	**OE-509 H**

Course description:
This course introduces the concept of Circular Economy, its principles, and its relevance in sustainable development. Students will learn about linear economy limitations, circular economy frameworks, business models, and its implementation in India.

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

Prerequisite course(s):

Basic understanding of **Linear Economy and environmental sustainability concepts**.

Course objectives:

The objective of this course is:
1. To understand the basics of Circular Economy and its significance.
2. To familiarize students with circular economy frameworks, business models, and case studies.
3. To compare linear and circular economies, and understand traditional circular practices.
4. To understand the prospect of circular economy in India.
5. To analyze the role of government and benefits of circular economy.

Course outcomes:

After successful completion of this course the student will be able to:
1. Describe the principles and benefits of Circular Economy.
2. Apply circular economy frameworks and business models.
3. Compare and contrast linear and circular economies.
4. Identify opportunities for circular economy in India.
5. Understand the role of government and benefits of circular economy for various stakeholders.

COURSE CONTENT

CIRCULAR ECONOMY		Semester:	V
Teaching Scheme:		**Examination scheme**	
Lectures:	**2 hours/week**	**Internal Continuous Assessment (ICA) CA:**	**25 marks**

Unit–I:	No. of Lectures: 06 Hours	

Linear Economy and Circular Economy Basics

Linear Economy - Our Crumbling Planet: Law of Obsolescence, Disadvantages of Linear Economy,

Circular Economy: Think Ahead - Our Last Chance:- Elements of a Circular Economy, Why do we need to switch to a circular economy?

Unit–II:	No. of Lectures: 06 Hours	

Circular Economy Frameworks and Business Models

Fundamental Characteristics of Circular Economy - A Resource Multiplier: Innovation, Collaboration, Value optimization, Design out Waste, Renewable Energy, Closed and tighter loops, Business Models in a Circular Economy- Circular supply chain, Product as a service, Collaborations and sharing, Recovery and recycling, Product life extension, McKinsey Center for Business and Environment - the ReSOLVE framework

Unit–III:	No. of Lectures: 06 Hours	

Linear Vs. Circular Economy and Traditional Practices

Linear Vs Circular Economy: Differential that whither the Planet and Us? - Material value preservation, Eco-effectiveness from eco-efficiency, Shift from Raw material to residual flows,

Linear VS Circular economy, SWOT analysis of Circular Economy, Circular Economy - Old wine in new bottle: - Yoga – a circular alternate to gyms, Ayurveda – An old circular alternate to modern medicine, Earthen Pots – An old circular practice, Sun Drying – A circular alternate to laundry dryers		
Unit–IV:	**No. of Lectures: 06 Hours**	
Circular Economy in India		
India and Circularity - Showcasing Sustainable Future - Circularity in India, Prospect of Circular Economy in India, Role of Indian businesses, Invest in circular economy opportunities		
Unit–V:	**No. of Lectures: 06 Hours**	
Circular Economy Implementation and Benefits		
Role of Government -Set direction and show commitment, Enabling regulatory frameworks, Platforms for multi-stakeholder collaboration, Support circular models through public procurement and infrastructure Benefits of Circular Economy for India- Benefits for businesses and the Economy, Benefits for the environment, Benefits for citizens		
Text Books:		
Reference Books: Circular Economy: (Re)Emerging Movement by Shalini Goyal Bhalla		
NPTEL Links: SWAYAM https://onlinecourses.swayam2.ac.in/e-learning/preview/aic21_ge19		
Guidelines for ICA:		
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Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Third Year Bachelor of Engineering

in

(Computer)

(As per NEP 2020 Guidelines)

Faculty of Science and Technology



COURSE OUTLINE

For Affiliated Colleges

Semester – VI

W.E.F. 2026 – 27

OPERATING SYSTEMS (PCC)					
COURSE OUTLINE					
Course Title:	**OPERATING SYSTEMS (PCC)**	**Short Title:**	**OS**	**Course Code:**	**CS-601**
Course description:					

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

Prerequisite course(s):

Data Structures, Computer Organization, Programming Fundamentals

Course objectives:

The objective of this course is to:

1. Understand the fundamental concepts and functions of operating systems.
2. Learn process management, memory management, and file system concepts.
3. Analyze CPU scheduling and deadlock handling techniques.
4. Understand concurrency, synchronization, and system security.

Course outcomes:

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

1. Explain operating system structures and services.
2. Analyze process scheduling and synchronization mechanisms.
3. Apply memory management and virtual memory techniques.
4. Explain file system organization and I/O management.
5. Understand protection, security, and modern OS concepts.

COURSE CONTENT

Operating Systems		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**Duration of ESE:**	**03 hours**
		End Semester Examination (ESE)	**60 marks**
		Internal Sessional Exam (ISE) CA:	**40 marks**

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

Introduction to Operating Systems:- What operating systems do: user and system view, Computer-system organization and architecture, Operating system structure and operations, OS services, system programs, and system calls, OS design, implementation, and system boot.

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

Process Management and CPU Scheduling- Process concept, process states, and PCB, Operations on processes and inter-process communication, Threads and multithreading models, CPU scheduling

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

Process Synchronization and Deadlocks: - Critical section problem and synchronization hardware, Mutex locks, semaphores, and monitors, Classic synchronization problems, Deadlock characterization and system model, Deadlock prevention, avoidance, detection, and recovery.

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

Memory Management and Virtual Memory: - Main memory concepts and swapping, Contiguous memory allocation, paging, and segmentation, Page table structure and hardware support, Virtual memory concepts and demand paging, Page replacement algorithms and thrashing.		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
File System, I/O, and Protection: - File system interface: file concept, access methods, and directories, File system implementation and allocation methods, Disk structure, disk scheduling, and mass-storage management, I/O system structure and kernel I/O subsystem, Protection and security		
Text Books:		
1. Avi Silberschatz, Peter Galvin, Greg Gagne, Operating System Concepts Essentials, Wiley Asia Student Edition9th Edition.		
Reference Books: 1. William Stallings, Operating Systems: Internals and Design Principles, 5th Edition, Prentice Hall of India. 2. Charles Crowley, Operating System: A Design-oriented Approach, 1st Edition, Irwin		
NPTEL Links: https://onlinecourses.nptel.ac.in/noc25_cs141/preview		

OPERATING SYSTEMS LAB (PCC)					
LAB COURSE OUTLINE					
Course Title:	**OPERATING SYSTEMS LAB (PCC)**	**Short Title:**	**OSL**	**Course Code:**	**CS-602**

Course description:

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

Prerequisite course(s):

COURSE CONTENT

Operating Systems Lab	**Semester:**	**VI**
Teaching Scheme:	**Examination scheme**	
Practical: **2 hours/week**		
	End Semester Examination (ESE) UA: PR	**25 marks**
	Internal Continuous Assessment (ICA):CA	**25 marks**

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

List of Experiments

1. Study of Linux/UNIX OS architecture and system calls.
2. Process creation using fork(), exec(), wait().
3. Implementation of CPU scheduling algorithms.
4. Multithreading using POSIX threads.
5. Implementation of synchronization problems using semaphores.
6. Deadlock detection and avoidance simulation.
7. Memory allocation and paging simulation.
8. File system operations using system calls.

Text Books:

1. Avi Silberschatz, Peter Galvin, Greg Gagne, Operating System Concepts Essentials, Wiley Asia Student Edition9th Edition.

Reference Books:

1. William Stallings, Operating Systems: Internals and Design Principles, 5th Edition, Prentice Hall of India.
2. Charles Crowley, Operating System: A Design-oriented Approach, 1st Edition, Irwin Publishing
3. Gary J. Nutt, Operating Systems: A Modern Perspective, 2nd Edition, Addison-Wesley

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

COMPUTER NETWORKS (PCC)					
COURSEOUTLINE					
Course Title:	**COMPUTER NETWORKS (PCC)**	**Short Title:**	**CN**	**Course Code:**	**CS-603**

Course description:

The Internet has become one of the most important components of our life. We browse the Web, check e-mails, make VoIP phone calls, and have video conferences via computers. All of these applications are made possible by networking computers together, and this complex network of computers is usually referred to as the Internet. This course is designed to give you a clear understanding of how networks, from in-home local area networks, or LANS, to the massive and global Internet, are built and how they allow us to use computers to share information and communicate with one another.

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

Pre requisite course(s):

Introduction to Computer Systems, Data Structures and Algorithms, and Program Design or a Program or courses of similar content.

Course objectives:

1. To study general principles of data communication.
2. To study OSI reference model and the TCP-IP reference model.
3. To study IP Layer.
4. To study transport layer.
5. To study application layer and network security.

Course outcomes:

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

1. Summarize fundamental concepts of Computer Networks & Illustrate the working & functions of data link layer
2. Analyze IP Protocol Mechanism
3. Analyze the working of different routing protocols and mechanisms
4. **Analyze** the structure and working of TCP & UDP at transport layer
5. Illustrate the role of application layer & comprehend the basics of Network Security

COURSECONTENT

Computer Networks		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams(ISE):	**40 marks**

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

Data Communications: Components, Types of Data Flow, Networks, Topologies, Categories

Network Models: Layered Task, The OSI Model, TCP/TP Protocol Suite
Addressing: Physical Addresses, Logical Addresses, Port Addresses, and Specific Addresses.
Data Link Layer: Framing, Flow and Error Control
Wired LANs Ethernet: IEEE Standards, Standard Ethernet,802.3MACFrameFormat Changes in the standard Ethernet

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

Logical Addressing: IPv4 Addresses: Address Space, Notations, Classfull Addressing, Classless Addressing, Network Address Translation (NAT).
Internet Protocol: IPv4: Datagram, Fragmentation, Checksum, Options. IPv6: Structure, Address Space, Advantages, Packet Format, Extension Headers, Transition from IPv4 to IPv6: Dual Stack, Tunneling, Header Translation.
Address Mapping: Mapping Logical to Physical Address: ARP, Mapping Physical to Logical Address: RARP, BOOTP and DHCP.

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

Error Reporting: ICMP: Types of Messages, Message Format, Error Reporting Messages, Query Massages, Ping and Trace route Debugging Tools.
Delivery: Direct Versus Indirect Delivery.
Forwarding: Forwarding Techniques, Routing Table.
Unicast Routing Protocols: Intra and Interdomain Routing, Distance Vector Routing, RIP, Link State Routing, OSPF, Path Vector Routing, BGP

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

Transport Layer: Transport-layer services: Process-to-Process Communication, Addressing: Port Numbers, Encapsulation and Decapsulation, Multiplexing and Demultiplexing, Flow Control and Error Control.
User Datagram Protocol (UDP): User Datagram, UDP Operation, Uses of UDP
Transmission Control Protocol (TCP): TCP Services, TCP Features, TCP Segment, TCP Connection, Flow Control, Error Control and Congestion Control: open-loop congestion control and closed-loop congestion control techniques.

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

Application Layer: Introduction to Domain Name System, Remote Logging, Electronic Mail: SMTP & POP, and File Transfer: FTP, WWW and HTTP
Network Security: Introduction to cryptography, symmetric-key and asymmetric key Cryptography, XOR Cryptography and RSA cryptography, Firewall

Text Books:

1. B. A. Forouzan, "Data Communications and Networking", TMH, Fourth Edition.

Reference Books:

1. B.A.Forouzan and Firouz Mosharraf, "Computer Networks: A Top Down Approach", TMH, 2018.
2. A.S.Tanenbaum, "ComputerNetworks",Pearson Education,Fourth Edition
3. S.Keshav,“AnEngineeringApproachto Computer Networking”,Addison Wesley.
4. Mayank Dave,“ComputerNetworks”,CengageLearningIndia,Firstedition,2012
4.Bhavneet Sidhu,“An Integrated Approach to Computer Networks”,Khanna Publications.
6. Comer,“Internetworking with TCP/IP",Vol.1,Pearson Education,Fourth Edition.
7. W.Stallings,“Data and Computer Communications",Pearson Education,Fifth Edition.
8. B.A.Forouzan,“TCP/IP Protocol Suite",TMH,Fourth Edition.

NPTEL Link:

https://onlinecourses.nptel.ac.in/noc23_cs48/preview

COMPUTER NETWORKS LAB (PCC)					
COURSEOUTLINE					
Course Title:	**COMPUTER NETWORKS LAB (PCC)**	**Short Title:**	**CNL**	**Course Code:**	**CS-604**

Course description:

This laboratory provides students with a comprehensive study of the Computer Networking and protocols. Classroom lectures stress the strengths of Computer Networks, which provide students with the means of writing efficient, maintainable, and portable code and simulating protocols and networks

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

Pre requisite course(s):

Introduction to Computer Systems, Data Structures and Algorithms, and Program Design or a Program or courses of similar content.

COURSECONTENT

Computer Networks		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme:**	
Practical:	**2 hours/week**	**End semester exam (ESE):UA PR**	**25 marks**
		Internal Continuous Assessment(ICA):CA PR	**25 marks**

Concerned faculty member should suitably frame at least FOUR Laboratory assignments from Group - A and ALL Laboratory assignments from Group – B from the following list.

(Group A)

1. Implementation of Bit-Stuffing and Un-stuffing in Framing
2. Implementation of RLE data compression algorithm.
3. Write a program to demonstrate Sub-netting and find subnet masks
4. Write a program to implement link state /Distance vector routing protocol to find suitable path for transmission
5. Implementation of TCP Socket.
6. Implementation of UDP Socket.
7. Write a program for DNS lookup. Given an IP address as input, it should return URL and vice-versa
8. Encryption/Decryption using XOR symmetric-key cryptography algorithm.
9. Encryption/Decryption using RSA asymmetric-key cryptography algorithm.

(Group B)

1. Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool
2. Configuring DHCP, DNS, SMTP and HTTP Server in any Packet Tracer
3. Simulation of TCP in Cisco Packet Tracer
4. Use packet Tracer tool for configuration of 3 router network using one of the following protocol RIP/OSPF/BGP

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

Text Books:

1. B. A. Forouzan, "Data Communications and Networking", TMH, Fourth Edition.

Reference Books:

1. B.A.Forouzan and Firouz Mosharraf, "Computer Networks: A Top Down Approach", TMH, 2018.
2. A. S. Tanenbaum, "Computer Networks", Pearson Education, Fourth Edition
3. S. Keshav, “An Engineering Approach to Computer Networking”, Addison Wesley.
4. Mayank Dave, “Computer Networks”, Cengage Learning India, First edition, 2012
5. Bhavneet Sidhu, “An Integrated Approach to Computer Networks”, Khanna Publications.
6. Comer, “Internetworking with TCP/IP", Vol. 1, Pearson Education, Fourth Edition.
7. W. Stallings, “Data and Computer Communications", Pearson Education, Fifth Edition.
8. B. A. Forouzan, “TCP/IP Protocol Suite", TMH, Fourth Edition

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 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.

WEB TECHNOLOGY LAB (PEC-II)					
LAB COURSE OUTLINE					
Course Title:	**Program Elective Course-II: WEB TECHNOLOGY LAB**	**Short Title:**	**WTL**	**Course Code:**	**CS- 605A**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3 Hours / Week**	**15 Weeks**	**45 Hours**	**5**
Practical	**4 Hours /Week**	**15 Weeks**	**60 Hours**	

Prerequisite course(s):

Course objectives:

The objective of this course is to:
1. Understand the fundamentals of client-side and server-side web technologies.
2. Design and develop interactive and responsive web pages.
3. Implement form handling, validation, and dynamic content.
4. Develop database-driven web applications.
5. Deploy and test complete web applications

Course outcomes:

After successful completion of this course the student will be able to:
1. Design structured and styled web pages using HTML and CSS.
2. Implement client-side scripting for dynamic web interactions.
3. Develop server-side programs to process user data.
4. Create database-driven web applications with CRUD operations.
5. Build and deploy a complete functional web application.

COURSE CONTENT

Web Technology - Lab		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**4 hours/week**		
		End Semester Examination (ESE) UA: PR	**25 marks**
		Internal Continuous Assessment (ICA):CA	**50 marks**
End Semester Exam (ESE) Pattern:		**Practical (PR)**	

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

Introduction to Web Technologies: Basics of Internet and World Wide Web, Web browsers and web servers, HTTP/HTTPS protocol, Client-server architecture, Introduction to HTML and web page structure

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

HTML and CSS: HTML5 elements and attributes, Forms, tables, multimedia elements, CSS: Inline, internal, external styles, CSS selectors, box model, Responsive design basics.

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

Client-Side Scripting: Introduction to JavaScript, Variables, operators, control structures, Functions and events, DOM manipulation, Form validation using JavaScript

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

Server-Side Scripting: Introduction to server-side programming, Basics of Node.js / PHP, Handling requests and responses, Session and cookies, File handling

Unit–V:	No. of Lectures: 09 Hours	

Database Integration and Web Applications: Introduction to databases (MySQL / MongoDB), CRUD operations, Connecting web app to database, Introduction to REST APIs, Basics of web

Text Books:

1. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley Publications
2. Jon Duckett, JavaScript and jQuery: Interactive Front-End Web Development, Wiley Publications

Reference Books:

1. Jeffrey C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education
2. Achyut S. Godbole & Atul Kahate, Web Technologies, Tata McGraw Hill
3. Deitel & Deitel, Internet & World Wide Web: How to Program, Pearson.

Lab Experiments

Concerned faculty member should suitably frame at least **TWELVE** Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

List of Experiments

1. Create a webpage using headings, paragraphs, lists, links, and images.
2. Design forms with text fields, radio buttons, checkboxes, dropdowns, and submit buttons.
3. Apply Styling using CSS using inline, internal, and external CSS. Format text, colors, borders, spacing.
4. Page Layout and Responsive Design using CSS Box Model, Flexbox or Grid to create structured and responsive layouts.
5. Write basic JavaScript programs using variables, operators, and alerts.
6. Implement conditions, loops, and user-defined functions using javascript
7. Validate user inputs like email, phone number, and password using JavaScript.
8. Access and modify HTML elements dynamically. Handle click, hover, and keyboard events.
9. Store and retrieve data in browser local storage using JSON.
10. Create a basic server-side script to process form data.
11. Connect web application with MySQL / MongoDB database.
12. Implement Create, Read, Update, Delete operations in a database-driven web app.
13. Implement login/logout system using sessions and cookies.
14. Fetch data from a public API and display it on a webpage dynamically.
15. Deploy a website on a local server or free hosting platform.
16. Develop a small full-stack web application such as Online Quiz System, Student Record System, Feedback/Blog Application (Must include frontend, backend, and database)

Text Books:

1. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley Publications
2. Jon Duckett, JavaScript and jQuery: Interactive Front-End Web Development, Wiley Publications

Reference Books:

1. Jeffrey C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education
2. Achyut S. Godbole & Atul Kahate, Web Technologies, Tata McGraw Hill
3. Deitel & Deitel, Internet & World Wide Web: How to Program, Pearson

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.

USER INTERFACE AND USER EXPERIENCE DESIGN LAB (PEC-II)					
LAB COURSE OUTLINE					
Course Title:	**Program Elective Course – II USER INTERFACE AND USER EXPERIENCE DESIGN LAB**	**Short Title:**	**UIUEDL**	**Course Code:**	**CS- 605B**

Course description:

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3 Hours / Week**	**15 Weeks**	**45 Hours**	**5**
Practical	**4 Hours /Week**	**15 Weeks**	**60 Hours**	

Prerequisite course(s):

Course objectives:

The objective of this course is to:
1. To introduce students to the fundamentals of User Interface (UI) and User Experience (UX) design.
2. To develop skills in designing user-centered digital interfaces.
3. To train students in wire framing, prototyping, and usability testing.
4. To apply design principles to web and mobile applications.
5. To enable students to evaluate and improve user experiences through testing and feedback.

Course outcomes:

After successful completion of this course the student will be able to:
1. Apply UI design principles to create intuitive interfaces
2. Perform user research and create user personas.
3. Develop wireframes and interactive prototypes.
4. Conduct usability testing and analyze user feedback.
5. Design complete UI/UX solutions for real-world applications.

COURSE CONTENT

User Interface and User Experience Design Lab		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**4 hours/week**		
		End Semester Examination (ESE) UA: PR	**25 marks**
		Internal Continuous Assessment (ICA):CA	**50 marks**

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

Introduction to UI/UX Design: Definition of UI and UX, Importance of UX in software development, Difference between UI and UX, UX design lifecycle, Human-Computer Interaction (HCI) basics.

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

User-Centered Design (UCD): User research techniques, Personas and user scenarios, User journey mapping, Information architecture, Task analysis.

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

UI Design Principles: Design principles: Contrast, Alignment, Proximity, Repetition, Typography and color theory, Layout and composition, Responsive design, Accessibility (WCAG basics)

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

Wireframing and Prototyping: Low-fidelity vs high-fidelity design, Wireframing tools and techniques, Prototyping concepts, Interaction design basics, Design systems and components

Unit–V:	No. of Lectures: 09 Hours	

Usability and Evaluation: Usability principles, Heuristic evaluation, Usability testing methods, A/B testing, Feedback and iteration.

Text Books:

1. Don Norman – The Design of Everyday Things
2. Ben Shneiderman et al. – Designing the User Interface

Reference Books:

1. Steve Krug – Don't Make Me Think
2. Jesse James Garrett – The Elements of User Experience.

LAB COURSE OUTLINE

Concerned faculty member should suitably frame at least **TWELVE** Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

List of Experiments

1. **Study of UI/UX Design Tools** – Familiarization with tools like Figma/Adobe XD.
2. **Analysis of UI Design Principles** – Evaluating interfaces based on contrast, alignment, consistency, and hierarchy.
3. **User Research Activity** – Creating surveys and conducting mock user interviews.
4. **User Persona Development** – Designing personas with goals, behaviors, and pain points.
5. **Information Architecture Design** – Creating sitemaps and user flow diagrams.
6. **Low-Fidelity Wireframing** – Sketching basic layouts for web/mobile screens.
7. **High-Fidelity Wireframing** – Designing detailed digital wireframes with typography and color.
8. **Interactive Prototyping** – Building clickable prototypes with navigation links.
9. **Mobile App UI Design** – Designing key screens for a mobile application.
10. **Web Application UI Design** – Designing homepage, dashboard, and form interfaces.
11. **UI Components and Design System** – Creating reusable components like buttons, cards, and navbars.
12. **Accessibility-Focused UI Design** – Applying color contrast and readability standards.
13. **Usability Testing** – Conducting user testing and documenting usability issues.
14. **Heuristic Evaluation** – Evaluating interface using usability heuristics.
15. **Mini Project: Complete UI/UX Case Study** – End-to-end design from research to prototype and testing.

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.

INTERNET OF THINGS LAB (PEC-II)					
COURSE OUTLINE					
Course Title:	**Program Elective Course – II INTERNET OF THINGS LAB**	**Short Title:**	**IOTL**	**Course Code:**	**CS-605C**

Course description: This course provides a comprehensive understanding of IoT fundamentals, platform design, sensors and hardware interfacing, communication protocols, security challenges, and modern computing paradigms (Cloud–Edge–Fog) through practical and research-oriented learning.

	Hours/week	No. of weeks	Total hours	Semester credits
Theory	**3**	**15 Weeks**	**45 Hours**	**5**
Practical	**4**	**15 Weeks**	**60 Hours**	

Prerequisite course(s):

Digital Electronics and Computer Organization **is essential.**

Course objectives:

The objective of this course is to:

1. To understand the fundamentals, reference architectures, communication models, and enabling technologies of the Internet of Things (IoT).
2. To apply IoT platform design methodology for modeling system requirements, functionality, and integration.
3. To explore sensor types, development boards, and communication interfaces relevant to IoT applications.
4. To analyze communication protocols and security mechanisms used in IoT systems for ensuring reliable and secure data exchange.

Course outcomes:

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

1. Interpret IoT architectures, communication models, enabling technologies, and associated challenges in IoT systems..
2. Apply IoT platform design methodology to define functional, operational, and integration views of IoT systems.
3. Select appropriate sensors, actuators, development boards, and communication interfaces for IoT applications.
4. Analyze IoT communication protocols and security mechanisms to determine suitable strategies for secure and reliable data transmission.
5. To analyze IoT security fundamentals and evaluate suitable hardware platforms and computing models (Cloud, Edge, Fog) for secure IoT applications.

COURSE CONTENT

Internet of Things		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**		
		End Semester Examination (ESE): UA PR:	**25 marks**
		Internal Continuous Assessment (ICA) :CA PR	**50 marks**
Unit–I:		**No. of Lectures: 09 Hours**	

Fundamentals of IoT: Definition, Characteristics, Applications, Architecture (Physical & Logical), Communication Models and APIs (REST, WebSocket), IoT Levels, Enabling Technologies (WSN, RFID, Cloud, Big Data), Challenges (Security, Interoperability, Scalability)

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

IoT Platform Design Methodology: Purpose and Requirement Specification, Process Specification, Domain model specification, Information Model Specification, Service specifications, IoT Level Specifications, Functional view specification, Operational View Specification, Device and Component

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

Sensors and IoT Hardware: Sensor types and categories, Actuators, Development Boards (Arduino, ESP8266, Raspberry Pi), Basics of Interfacing (GPIO, I2C, SPI)

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

IoT Protocol Stack: PHY/MAC (BLE, Zigbee, Z-Wave, LoRa), Network (6LoWPAN, RPL), Application (CoAP, MQTT, XMPP, AMQP), Introduction to Next Generation Networks

IoT Security: Types of Attacks, Vulnerabilities in IoT, Key Elements of IoT Security, Security Model

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

IoT Security and Computing Paradigms:

IoT Security basics: Encryption, Authentication, and Privacy Challenges, Comparing Arduino vs. Raspberry Pi vs. ESP32 for IoT Projects, Comparison between Cloud, Edge, and Fog Computing in IoT,

Text Books:

1. **A. Bahga and V. Madisetti**, *Internet of Things: A Hands-On Approach*, 1st ed., Hyderabad, India: Universities Press, 2015. ISBN: 978-8173719547.
2. **T. Pulver and M. Wuebbeling**, *Hands-On Internet of Things with MQTT*, 1st ed., Birmingham, UK: Packt Publishing, 2022. ISBN: 978-1800567993.
3. **A. Kaushik**, *6G: The Road to the Future Wireless Technologies 2030*, 1st ed., Hoboken, NJ, USA: Wiley-IEEE Press, 2023. ISBN: 978-1119903802.

Reference Books:

1. **P. Waher**, *Mastering Internet of Things: Design and Create Your Own IoT Applications Using Raspberry Pi 3*, 2nd ed., Birmingham, UK: Packt Publishing, 2020. ISBN: 978-1800205260.
2. **P. A. Morreale and J. M. Anderson**, *Software Defined Networking: Design and Deployment*, 2nd ed., Boca Raton, FL, USA: CRC Press, 2021. ISBN: 978-0367332154
3. **A. Kurniawan**, *Internet of Things Projects with Arduino and ESP32*, 1st ed., Independently Published, 2021. ISBN: 979-8724812744.
4. **F. Hu (Ed.)**, *Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and*

NPTEL Links:

1. Introduction To Internet Of Things, by Prof. Sudip Misra **https://nptel.ac.in/courses/106105166**
2. Foundation of Cloud IoT Edge ML, by Prof. Rajiv Misra **https://nptel.ac.in/courses/106104242**

LAB COURSE OUTLINE

COURSE CONTENT

Concerned faculty member should suitably frame at least EIGHT Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

List of Experiments

1. A startup is developing an IoT-based home monitoring system. Engineers need to decide between Raspberry Pi and Arduino based on project requirements.
2. Design a system to monitor room temperature and alert the elderly if it crosses a safe limit. Interface LM-35 temperature sensor with Arduino. Display temperature values and activate a buzzer if it exceeds the threshold.
3. Build a wearable device for visually impaired users that alerts them to nearby obstacles. Interface an IR sensor with Arduino or Raspberry Pi. Light an LED or trigger a buzzer when an obstacle is detected.
4. Automate the Chrome Dino game using real-world sensors and actuators for STEM education tools. Use a light- dependent resistor (LDR) and servo motor with Arduino. Make the servo "jump" automatically based on game screen brightness.
5. A remote warehouse requires an automatic fire detection and alert system via SMS. Interface flame sensor with Arduino. Send SMS using GSM module or trigger buzzer when fire is detected.
6. An agricultural firm wants to remotely monitor field conditions using cloud services. Interface DHT11 or soil moisture sensor with Arduino. Push sensor data to ThingSpeak / Blynk platform for visualization.
7. Municipalities aim to monitor dustbin levels and optimize waste collection routes. Use ultrasonic sensor to detect fill level of a bin.Send alert when bin is full.
8. A smart greenhouse sends temperature and humidity data to a remote monitoring system using MQTT. Implement MQTT protocol using a NodeMCU or Raspberry Pi. Use DHT11 sensor, NodeMCU (ESP8266), Mosquitto broker or public broker (e.g., HiveMQ), MQTT Dash App, Publish sensor data to MQTT broker. Subscribe to data using mobile/PC.
9. Mini Project: Implement any societal problem using suitable IoT hardware and protocols.
   - Security management
   - Health emergencies
   - Road traffic management
   - Energy Conservation
   - Agricultural Problems
   - Rural development
   - Smart city

Text Books:

1. **A. Bahga and V. Madisetti**, *Internet of Things: A Hands-On Approach*, 1st ed., Hyderabad, India: Universities Press, 2015. ISBN: 978-8173719547.
2. **T. Pulver and M. Wuebbeling**, *Hands-On Internet of Things with MQTT*, 1st ed., Birmingham, UK: Packt Publishing, 2022. ISBN: 978-1800567993.
3. **A. Kaushik**, *6G: The Road to the Future Wireless Technologies 2030*, 1st ed., Hoboken, NJ, USA:

Reference Books:

1. **P. Waher**, *Mastering Internet of Things: Design and Create Your Own IoT Applications Using Raspberry Pi 3*, 2nd ed., Birmingham, UK: Packt Publishing, 2020. ISBN: 978-1800205260.
2. **P. A. Morreale and J. M. Anderson**, *Software Defined Networking: Design and Deployment*, 2nd ed., Boca Raton, FL, USA: CRC Press, 2021. ISBN: 978-0367332154
3. **A. Kurniawan**, *Internet of Things Projects with Arduino and ESP32*, 1st ed., Independently Published, 2021. ISBN: 979-8724812744.
4. **F. Hu (Ed.)**, *Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations*, 1st ed., Boca Raton, FL, USA: CRC Press, 2022. ISBN: 978-0367558363.

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

Online Sources:

1. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
2. https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT
3. https://www.zdnet.com/article/what-is-the-internet-of-things-everything-you-need-to-know about-the-iot-right-now/

BLOCKCHAIN SECURITY AND PERFORMANCE(PEC-III)					
COURSE OUTLINE					
Course Title:	**Program Elective Course – III BLOCKCHAIN SECURITY AND PERFORMANCE**	**Short Title:**	**BSP**	**Course Code:**	**CS-606A**

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.

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

Prerequisite course(s):

Fundamentals of Blockchain , Cryptography Techniques

Course objectives:

1. Students should be able to understand the security and performance-related issues of blockchain.
2. Students should be able to learn techniques and tools to tackle the security related issues of blockchain.
3. Students should be able to learn new approaches required for enhancing blockchain performance.

Course outcomes:

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

1. To understand the security perspective of blockchain technology.
2. To learn the various Tools for Smart Contracts.
3. To understand performance related issues in blockchain
4. To learn and apply security analysis and performance-enhancing techniques related to blockchain.
5. To understand the real-life applications of blockchain technology and apply it to provide solutions to some real-life problems.

COURSE CONTENT

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

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

Security Issues: Blockchain Related Issues, Higher-Level Language (Solidity) Related Issues, EVM Bytecode Related Issues, Real-Life Attacks on Blockchain Applications/ Smart Contracts, Trusted Execution Environments.

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

Security Tools for Smart Contracts: Working, Advantages, And Disadvantages of Tools- Oyente, Securify, Maian, Manticore, Mythril, SmartCheck, Verx. Secure Key Management, Quantum Resilience Keys.		
Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**
Performance Related Issues: Transaction Speed, Transaction Fees, Network Size, Complexity, Interoperability Problems, Lack of Standardization. Lack of Supportive Regulations Related to Blockchain Applications.		
Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**
Performance Improvements: Off-Chain State Channels, Sidechains, Parallels Chains, Concurrent Smart Contract Transactions, Sharding Technique and Its Benefits, Atomic Swaps Between Smart Contracts.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Blockchain Applications: Decentralized Cryptocurrency, Distributed Cloud Storage, E-Voting, Insurance Claims, Cross-Border Payments, Asset Management, Smart Appliances.		
Text Books:		
1. Mastering Ethereum: Building Smart Contracts and Dapps Book by Andreas Antonopoulos and Gavin Wood, Shroff Publisher/O′Reilly Publisher.		
Reference Books:		
1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015 2. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing		
Online Resources: 1. https://www.edx.org/course/blockchain-and-fintech-basics-applications-and-limitations		

BLOCKCHAIN SECURITY AND PERFORMANCE LAB (PEC-III)					
COURSE OUTLINE					
Course Title:	**Program Elective Course – III BLOCKCHAIN SECURITY AND PERFORMANCE LAB**	**Short Title:**	**BSPL**	**Course Code:**	**CS-607A**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Fundamentals of Blockchain, Cryptography Techniques					
COURSE CONTENT					
BLOCKCHAIN SECURITY AND PERFORMANCE LAB		**Semester:**	**VI**		
Teaching Scheme:		**Examination scheme**			
Practical:	**02 hours/week**	**Internal Continuous Assessment (ICA):CA**		**25 marks**	

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. Design, develop, and deploy a smart contract on the blockchain that securely handles data storage and user interaction.
2. Design and implement a smart contract to demonstrate how integer overflow and underflow vulnerabilities can occur in blockchain applications.
3. To design and simulate a 51% attack in a controlled blockchain environment and analyze how majority control can compromise network security, transaction integrity, and consensus.
4. Develop a blockchain wallet with multi-signature security that requires multiple approvals before a transaction can be executed.
5. Study the factors affecting blockchain performance and explore techniques to improve it.
6. Design and develop a smart contract to implement a secure and transparent electronic voting system on the blockchain
7. Design a blockchain-based insurance system that offers a transparent, secure, and automated platform to accelerate claim settlements and enhance trust between insurers and policyholders

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 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

Text Books:

1. Mastering Ethereum: Building Smart Contracts and Dapps Book by Andreas Antonopoulos and Gavin Wood, Shroff Publisher/O′Reilly Publisher.

Reference Books:

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015
2. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing

Online Resources:

1. HKUx: Blockchain and FinTech: Basics, Applications, and Limitations
https://www.edx.org/course/blockchain-and-fintech-basics-applications-and-limitations

DEEP LEARNING AND NEURAL NETWORK (PEC-III)					
COURSE OUTLINE					
Course Title:	**Program Elective Course – III DEEP LEARNING AND NEURAL NETWORK**	**Short Title:**	**DLNN**	**Course Code:**	**CS-606B**

Course description: This course provides a comprehensive introduction to the principles and applications of neural networks and deep learning. It covers the mathematical foundations and computational techniques used to design, train, and evaluate artificial neural networks. Topics include single-layer and multi-layer perceptrons, activation functions, loss functions, backpropagation, and optimization algorithms. The course further explores advanced deep learning architectures such as convolutional neural networks (CNNs), recurrent neural networks (RNNs), and an introduction to modern architectures used in vision and sequence modeling. Emphasis is placed on practical implementation using deep learning frameworks, model evaluation, and real-world applications in areas such as image recognition, natural language processing, and predictive analytics.

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

Prerequisite course(s):

Fundamentals of Linear algebra

Data Structures and programming skills

Basic Knowledge of Data handling skills like date preprocessing, Normalization and standardization.

Course objectives:

The objective of this course is to:

1. Understand the fundamentals of deep learning.
2. Learn the working of Convolutional neural networks and RNN in decision making.
3. Study and Understand concept of advanced neural network
4. Understand Simple machine learning algorithms
5. Familiarize with GAN and challenges in NN training with pytorch , Tensorflow tool

Course outcomes:

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

1. Understand the learning components of neural network and apply standard neural network models to learning problems.
2. Analyze the learning strategies of deep learning – regularization, generalization, optimization , bias and variance
3. Analyze regular deep learning models for training, testing and validation in standard datasets.
4. Apply neural network for deep learning using standard tools.
5. Understand the mathematics for deep learning.

COURSE CONTENT

DEEP LEARNING AND NEURAL NETWORK		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures: 03	**3 hours/week**	**End Semester Examination (ESE)**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

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

Introduction :
What is a Neural Network?, The Human Brain, Models of a Neuron, Neural Networks Viewed As Directed Graphs, Feedback, Network Architectures, Rosenblatt‟s Perceptron: Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment.

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

Supervised and Unsupervised Neural Networks
Hebb Network theory and training algorithm, Perceptron Networks architecture and training algorithm, Backpropagation Network architecture and training algorithm, Associative Memory Network architecture and training algorithm, Hopfield Networks architecture and training algorithm, Counterpropagation Networks architecture and training algorithm, Adaptive Resonance Theory

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

Advanced Neural Networks
Kohonen Self-Organising Feature Maps architecture and training algorithm, Learning Vector Quantization architecture and training algorithm, Boltzmann Machine, Cognitron Network, Neocognitron Network, Optical Neural Networks Electro-optical Multipliers and Holographic

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

Deep Learning
Machine learning basics, Simple Machine Learning Algorithm -- Linear Regression, underfitting and overfitting challenges in Machine Learning, Supervised Learning approach for Support Vector Machine, Deep Feedforward Networks, Convolutional Networks, Deep Recurrent Networks, Deep Boltzmann Machine, Applications in Speech Recognition and Natural Language Processing.

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

Introduction to GAN – Encoder/Decoder, Generator/Discriminator architectures; Challenges in NN training – Data Augmentation – Hyper parameter Settings; Transfer Learning – Developing and Deploying ML Models (e.g., Tensor Flow/PyTorch)

Text Books:

1) Ian Goodfellow, Yoshua Bengio and Aaron Courville.”Deep Learning”,MIT Press, Second Edition 2016.

2) Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016

Reference Books:

1)Koller, D and Friedman, N.”Probablistic Graphical Models”.MIT Press 2009
2)Hastie,T., Tibshirani, R. and Friedman, J. “The Elements of Statistical Learning”.Second edition
3)Bishop, C. M. “Neural Networks for pattern Recognition.”Oxford University Press: 1995.
4)Aggarwal, Charu C.”Neural networks and deep learning.”Springer, 2018.,Springer;2009

NPTEL Links:

1. https://onlinecourses.nptel.ac.in/noc22_cs22/preview
2. https://www.coursera.org/learn/neural-networks-deep-learning#modules

DEEP LEARNING AND NEURAL NETWORK LAB (PEC-III)						
COURSE OUTLINE						
Course Title:	**Program Elective Course – III DEEP LEARNING AND NEURAL NETWORK LAB**		**Short Title:**	**DLNNL**	**Course Code:**	**CS-607B**
Practical	**Hours/week**	**No. of weeks**	**Total hours**		**Semester credits**	
	02	**15**	**30**		**1**	
Prerequisite course(s):						
1. Data Structures and programming skills 2. Basic Knowledge of Data handling skills like date preprocessing, Normalization etc						
COURSE CONTENT						
DEEP LEARNING AND NEURAL NETWORK LAB (PEC-III)			**Semester:**	**VI**		
Teaching Scheme:			**Examination scheme**			
Practical:	**02 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. Faculty may use following list of experiment as a reference.

1. To Write a program to implement Perceptron. OR Identify the problem with single unit Perceptron. Classify using Or, And and XOR data and analysis the result.
2. To write a program to implement AND OR gates using Perceptron.
3. To write a program to implement Wine Classification using Back propagation
4. Write a program for object detection using image labeling tools
5. Write a program for character recognition using CNN.
6. Write a program to detect Dog image using YOLO Algorithm
7. To study Image Net, Google Net, ResNet convolutional Neural Networks.
8. To study Convolutional Neural Network and Recurrent Neural 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

Text Books:

1. Navin Kumar Manaswi ,Deep Learning with Applications Using Python Chatbots and Face, Object, and Speech Recognition With TensorFlow and Keras , Apress,2018.
2. Josh Patterson and Adam Gibson, “Deep learning: A practitioner's approach”, O'Reilly Media, First Edition, 2017.
3. M.Arif Wani Farooq Ahmad Bhat Saduf Afzal Asif Iqbal Khan, Advances in Deep Learning Springer, 2020

Reference Books:
1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press,2016. 2. N.D.Lewis, "Deep Learning Made Easy with R : A Gentle Introduction for Data Science",January 2016
Online Resources: 1. Mastering Deep Learning By Naveen Kumar Bhansali https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg36

DATBASE SECURITY AND ACCESS CONTROL(PEC-III)					
COURSEOUTLINE					
Course Title:	**Program Elective Course – III DATBASE SECURITY AND ACCESS CONTROL**	**Short Title:**	**DSAC**	**Course Code:**	**CS – 606C**

Course Description:

This course focuses on principles and mechanisms for securing databases and controlling access to sensitive data. It covers access control models such as DAC, MAC, and RBAC, along with modern security techniques, vulnerabilities, and enterprise-level implementations. The course also explores smart card security, secure DBMS design, and intrusion detection systems. Emphasis is placed on both theoretical foundations and real-world applications.

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

Pre Requisite Course(s):

Basic Knowledge of - Database Management Systems, Operating Systems, Computer Networks, Basic Programming (SQL, Python/Java)

Course Objectives:

1. Understand database security challenges, threats, and modern protection mechanisms.
2. Analyze and implement different access control models such as DAC, MAC, and RBAC.
3. Study advanced security models like Biba, Clark-Wilson, and role hierarchies.
4. Explore smart card security and secure system design principles.
5. Apply intrusion detection and statistical database protection techniques.

Course Outcomes:

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

1. Identify and analyze database vulnerabilities and security threats.
2. Implement and compare different access control mechanisms.
3. Design secure database systems using appropriate models.
4. Apply enterprise-level RBAC and security integration techniques.
5. Evaluate and implement intrusion detection and data protection strategies.

COURSECONTENT

DATBASE SECURITY AND ACCESS CONTROL		**Semester:**	**VI**
Teaching Scheme:		**Examination Scheme:**	
Lectures:	**3 hours/week**	**End-of-semester exam (ESE): UA TH**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):CA	**40 marks**

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

Database Security:

Recent trends in Database security and access control mechanisms, Case study of Role-Based Access Control (RBAC) systems, Recent Trends related to data security management, vulnerabilities in different DBMS.

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

Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of

Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control (DAC), Non- Discretionary Access Control, Mandatory Access Control (MAC).
Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations.

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

Models: Biba's integrity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view, Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructure: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multi-line Insurance Company

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

Smartcard Security:
Smart Card based Information Security, Smart card operating system fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR, PPS Security techniques- user identification, smart card security, quality assurance and testing, smart card life cycle-5 phases, smart card terminals.

Unit– V:	**No. of Lectures:9Hours**	**Marks:12**

Security Software Design: A Methodological Approach to Security Software Design, Secure Operating System Design, Secure DBMS Design, Security Packages, Database Security Design, Statistical Database Protection & Intrusion Detection Systems, Introduction Statistics Concepts and Definitions, Types of Attacks, Inference Controls evaluation, Criteria for Control Comparison, Introduction IDES System, RETISS System, ASES System Discovery.

Text Books:

1. **Hassan A. Afyouni, "Database Security and Auditing: Protecting Data Integrity and Accessibility", Thomson Course Technology.**
2. Silvana Castano, Mariagrazia Fugini, Giancarlo Martella,Pierangela Samarati, "Database Security", Pearson Education Ltd.

Reference Books:

1. **Alfred Basta, Melissa Zgola, "Database Security", COURSE TECHNOLOGY** CENGAGE Learning.

NPTEL VIDEO

1. http://kcl.digimat.in/nptel/courses/video/106106156/L19.html

DATABASE SECURITY AND ACCESS CONTROL LAB (PEC-III)					
LAB COURSE OUTLINE					
Course Title:	**Program Elective Course – III DATABASE SECURITY AND ACCESS CONTROL LAB**	**Short Title:**	**DSACL**	**Course Code:**	**CS-607C**

Course description: This lab provides hands-on experience in implementing database security mechanisms and access control techniques. Students will work with SQL-based privileges, RBAC models, encryption, and auditing. The lab also introduces practical aspects of intrusion detection and secure database design. Emphasis is on real-world implementation and security best practices.

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

Prerequisite course(s): Students should have prior knowledge of:
SQL (DDL, DML, DCL), Basic DBMS concepts, Basic Linux/OS commands (optional)

Course Objectives:

The objective of this course is to:

1. Implement access control mechanisms using SQL.
2. Design and simulate RBAC systems.
3. Apply encryption and security techniques on databases.
4. Perform auditing and intrusion detection tasks.
5. Analyze vulnerabilities and implement secure database practices.

Course Outcomes:

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

1. Implement user roles and privileges in DBMS.
2. Design secure database schemas with access control.
3. Apply encryption and authentication mechanisms.
4. Perform database auditing and monitoring.
5. Analyze and mitigate database security threats.

COURSE CONTENT

Database Security and Access Control		**Semester:**	**VI**
Teaching Scheme:		**Examination Scheme**	
Practical:	**2 hours/week**	**Internal Continuous Assessment (ICA)CA**	**25 Marks**

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

List of Experiments: -

1. Study of Role-Based Access Control (RBAC) in MySQL
2. Implementation of Discretionary Access Control (DAC) Using GRANT and REVOKE
3. Simulation of Mandatory Access Control (MAC) Using Sensitivity Labels
4. Implementation of Access Control Lists (ACL) in a Database System
5. Biba's Integrity Model Implementation
6. Clark-Wilson Integrity Model Simulation
7. Role Hierarchy and Separation of Duty (SoD) in RBAC
8. Statistical Database Protection Against Inference Attacks
9. SQL Injection Attack — Detection and Prevention
10. Database Audit Trail and Intrusion Detection

11. Temporal Constraints in RBAC — Time-Based Access Control
12. Secure DBMS Design — Vulnerability Assessment and Hardening

Text Books:

1. Hassan A. Afyouni, "Database Security and Auditing: Protecting Data Integrity and Accessibility", Thomson Course Technology.
2. Silvana Castano, Mariagrazia Fugini, Giancarlo Martella, Pierangela Samarati, "Database Security", Pearson Education Ltd.

Reference Books:

1. Alfred Basta, Melissa Zgola, "Database Security", COURSE TECHNOLOGY CENGAGE 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:

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

INDUSTRIAL AUTOMATION (MD M)					
COURSE OUTLINE					
Course Title:	**INDUSTRIAL AUTOMATION (MD M)**	**Short Title:**	**IA**	**Course Code:**	**CS-608**

Course description:

This course introduces the principles and applications of industrial automation, focusing on the integration of mechanical, electrical, and computer-based systems to improve manufacturing efficiency, safety, and productivity. Students will explore automation technologies such as PLCs, sensors, robotics, SCADA systems, and industrial communication protocols. Practical case studies and hands-on exercises will prepare learners to design, implement, and troubleshoot automation systems in modern industries.

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

Pre requisite course(s):

Basic Electrical Engineering, Basic Electronics Engineering, Control Systems, and Microprocessors/Microcontrollers.

Course objectives:

1. To provide foundational knowledge of industrial automation concepts and technologies.
2. To develop skills in programming and configuring PLCs, sensors, and actuators.
3. To understand industrial communication systems and SCADA applications.
4. To analyze automation requirements and design efficient control systems.
5. To prepare students for careers in manufacturing, robotics, and process industries.

Course outcomes:

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

1. Explain the role and importance of automation in industrial processes.
2. Design and implement PLC-based control systems for real-world applications.
3. Apply knowledge of sensors, actuators, and robotics in automation projects.
4. Use SCADA and industrial communication protocols for monitoring and control.
5. Evaluate and troubleshoot automation systems to improve efficiency and safety.

COURSE CONTENT

Industrial Automation		Semester:	
Teaching Scheme:		**Examination scheme:**	
Lectures:	**3 hours/week**	**End semester exam (ESE): UA TH**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exam (ISE): CA TH	**40 marks**

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

Fundamentals of Industrial Automation

Introduction to Industrial Automation,Types and levels of automation
Automation pyramid (Field level, Control level, Supervisory level, Enterprise level),Components of automation systems, Role of automation in manufacturing industries,Basic control concepts: open loop and closed loop control,Introduction to Industry 4.0

and smart manufacturing		
Unit–II:	**No. of Lectures:09 Hours**	**Marks:12**
Sensors and Actuators in Automation Principles of sensors and transducers, Types of sensors used in automation: Proximity sensors (Inductive, Capacitive, Photoelectric),Temperature sensors (RTD, Thermocouple),Pressure, flow and level sensors Signal conditioning and interfacing Actuators used in automation systems: Pneumatic actuators, Hydraulic actuators, Electric actuators (DC motor, AC motor, Stepper motor, Servo motor) Applications of sensors and actuators in industry		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks:12**
Programmable Logic Controllers (PLC) Introduction to PLC and its advantages ,PLC architecture and components ,Input and Output modules, PLC programming concepts, Ladder logic programming, Basic instructions: Logic instructions, Timers, Counters, Arithmetic operations , Simple PLC programming examples for industrial applications		
Unit– IV:	**No. of Lectures: 09 Hours**	**Marks:12**
Human Machine Interface (HMI) and Industrial Communication Introduction to Human Machine Interface (HMI), Functions and benefits of HMI ,HMI architecture and components ,Basics of HMI screen design, Communication between PLC and HMI ,Industrial communication networks ,Serial communication (RS-232, RS-485) :Modbus, Profibus, Industrial Ethernet		
Unit– V:	**No. of Lectures: 09 Hours**	**Marks:12**
Industrial Process Automation and Applications Introduction to process automation , Basic control strategies in industry, PID control basics ,Introduction to SCADA systems ,Automation in manufacturing industries ,Conveyor automation :Packaging systems, Automated assembly lines Safety and troubleshooting in industrial automation systems		
Text Books:		
1 Frank D. Petruzella — “Programmable Logic Controllers” (McGraw Hill)		
Reference Books: 1. **Frank D. Petruzella** — Programmable Logic Controllers, McGraw-Hill. 2. **Terry L. M. Bartelt** — Industrial Automated Systems: Instrumentation and Motion Control, Cengage Learning. 3. **Hugh Jack** — Automating Manufacturing Systems with PLCs. 4. **Olushola Akande** — Industrial Automation: Hands-On Guide to Sensors, Actuators, PLCs, HMIs, and SCADA, Packt Publishing. 5. **Chanchal Dey and Sunit Kumar Sen** — Industrial Automation Technologies, CRC Press.		
NPTEL Link- https://onlinecourses.nptel.ac.in/noc20_me39/preview		

INTRODUCTION TO NETWORK MANAGEMENT & VIRTUALIZATION (VSEC)					
COURSEOUTLINE					
Course Title:	**INTRODUCTION TO NETWORK MANAGEMENT & VIRTUALIZATION (VSEC)**	**Short Title:**	**INMV**	**Course Code:**	**CS-609**

Course description:

Network Management and Virtualization form the backbone of modern enterprise IT infrastructure. Network management is essential for ensuring that computer networks operate efficiently, securely, and reliably in organizations of all sizes. Virtualization plays a key role in modern data centers and cloud environments by improving efficiency and flexibility.

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

Pre requisite course(s):

Introduction to Computer Systems, Computer Network

Course objectives:

1. To understand fundamental concepts and architecture of network management.
2. To learn performance monitoring and troubleshooting in computer networks.
3. To understand virtualization technologies and hypervisor architectures.
4. To analyze server and desktop virtualization solutions.
5. To study network and storage virtualization in enterprise systems.

Course outcomes:

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

1. Explain fundamental concepts of network management and SNMP.
2. Analyze and evaluate network performance using monitoring tools.
3. Describe virtualization architectures and hypervisors.
4. Apply server and desktop virtualization in enterprise environments.
5. Design basic network and storage virtualization solutions.

COURSECONTENT

Introduction to Network Management & Virtualization		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme:**	
Lectures:	**1 hours/week**	**Internal Continuous Assesment (ICA):**	**25 marks**

Unit–I:Basics of Network Management	**No. of Lectures: 03 Hours**

Need for Network Management, FCAPS Model, Network Management Framework and Architecture: Manager, Agent, MIB, SNMP Concepts, SNMP Versions (v1, v2, v3), SNMP Architecture and Operations, Protocol Data Units, Packet monitoring using Wireshark

Unit–II: Network Monitoring and Performance	**No. of Lectures: 03 Hours**

Fault Management and Performance Management, Network Performance Metrics: Throughput, Delay, Jitter, Packet Loss, Network Troubleshooting Methods, Introduction to Monitoring Tools: Nagios, Zabbix.

Unit–III: Introduction to Virtualization	**No. of Lectures: 03 Hours**	
Virtualization and Cloud Computing, Need for Virtualization, Cost Reduction, Administration, Fast Deployment, Infrastructure Optimization, Limitations, Types of Hardware Virtualization: Full Virtualization, Partial Virtualization, Paravirtualization, Types of Hypervisors		
Unit– IV: Server and Desktop Virtualization	**No. of Lectures:03 Hours**	
Virtual Machine Basics, Types of Virtual Machines, Server Virtualization, Types of Server Virtualization, Uses of Virtual Servers, Server Consolidation, Platform Selection, Desktop Virtualization, Types of Desktop Virtualization.		
Unit– V: Network and Storage Virtualization	**No. of Lectures:03 Hours**	
Introduction to Network Virtualization, Advantages, Functions, Network Virtualization Tools, VLAN-WAN Architecture, WAN Virtualization, Memory Virtualization, Storage Virtualization, Types of Storage Virtualization.		
Text Books:		
1. Network Management: Principles and Practice – Mani Subramanian 2. Virtualization Essentials – Matthew Portnoy 3. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010. 4. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress,2005		
Reference Books:		
1. Andrew S. Tanenbaum,” Computer Networks” ,Pearson Publication 2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, “Cloud Computing (Principles and Paradigms)”, John Wiley & Sons, Inc. 2011. 3. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for systems and Processes”, Elsevier/Morgan Kaufmann, 2005. 4. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.		
NPTEL Link:		
1.Advanced Computer Networks By Sudeep Tanwar https://nptel.ac.in/courses/1061051600 2 Cloud Computing By Soumya K. Ghosh https://nptel.ac.in/courses/1061051677		

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 Third 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 – V & VI
W.E.F. 2026 – 27

Syllabus Structure for Specialization Honors in "Data Science": Additional Credit (Semester – V) (w.e.f. 2026 – 27)

(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-510A	Machine Learning and Data Science	PCC	3			3	40	60			100	3
CS-511 A	Machine Learning and Data Science Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Data Science": Additional Credit (Semester – VI) (w.e.f. 2026 – 27)

(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-612 A	Artificial Intelligence for Big Data Analytics	PCC	3			3	40	60			100	3
CS-613 A	Artificial Intelligence for Big Data Analytics Lab	PCC			2	2			25	25 (PR)	50	1

MACHINE LEARNING AND DATA SCIENCE (PCC)					
COURSE OUTLINE					
Course Title:	**Program Core Course (PCC)** Machine Learning and Data Science	**Short Title:**	MLDS	**Course Code:**	CS-510A

Course description: This course introduces the fundamentals of Machine Learning and Data Science, including data preprocessing, supervised and unsupervised learning, model evaluation, and practical implementation of machine learning algorithms for real-world applications.

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

Prerequisite course(s): Basic Statistics, Python Programming

Course objectives:

The objective of this course is to:

1. To understand and implement the complete machine learning pipeline, including data preprocessing, feature engineering, model building, and validation using real-world datasets.
2. To develop proficiency in supervised learning techniques such as regression and classification for solving practical engineering problems.
3. To apply unsupervised learning methods including clustering and dimensionality reduction for pattern discovery and data analysis.
4. To evaluate and optimize machine learning models using appropriate performance metrics, validation techniques, and hyperparameter tuning.
5. To design and deploy basic machine learning solutions using modern tools and frameworks for real-world applications.

Course outcomes:

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

1. Apply data preprocessing, feature engineering, and machine learning pipelines to prepare real-world datasets for analysis.
2. Implement and analyze supervised learning algorithms (regression and classification) to solve engineering problems.
3. Apply unsupervised learning techniques such as clustering and dimensionality reduction for pattern recognition and data insights.
4. Evaluate and optimize machine learning models using appropriate metrics, validation strategies, and hyper parameter tuning methods.
5. Design and develop end-to-end machine learning solutions, including basic deployment for real-world applications.

COURSE CONTENT

MACHINE LEARNING AND DATA SCIENCE		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA TH**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

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

Advanced Feature Engineering: Feature scaling (Standardization vs Normalization),Feature transformation (log, polynomial),Handling Imbalanced Data: SMOTE technique, Under sampling & Oversampling, Feature Selection Techniques: Filter methods (Correlation, Chi-square), Wrapper methods Embedded methods (Lasso) Handling High-Dimensional Data ,Introduction to automated pipelines using Scikit-learn		
Unit–II:	**No. of Lectures: 09 Hours**	**Marks: 12**
Supervised Learning–Advanced Models: Regression: Regularization (Ridge, Lasso) Classification: Logistic Regression (advanced concepts),Decision Trees (pruning techniques),Random Forest, Support Vector Machines (kernel trick),Ensemble Methods: Bagging, Boosting (AdaBoost, Gradient Boosting)		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Unsupervised Learning & Dimensionality Reduction :K-Means Clustering (advanced analysis, elbow method),Hierarchical Clustering, DBSCAN (density-based clustering),Principal Component Analysis (PCA),Feature Extraction vs Feature Selection.		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Unit IV: Model Evaluation & Optimization: Advanced Evaluation Metrics: Precision-Recall tradeoff ,ROC-AUC, Cross Validation (K-Fold, Stratified) :Hyperparameter Tuning: Grid Search Random Search ,Bias-Variance Tradeoff (practical perspective) ,Model Comparison & Selection		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Unit V: Modern ML Applications & Deployment: Introduction to Deep Learning ,Neural Networks (basic architecture) ,Introduction to NLP ,Time Series Forecasting Basics ,Model Deployment: Saving models (Pickle/Joblib) , API Integration (basic idea) ,*Case Studies:* Healthcare prediction ,Agriculture (crop disease detection) ,Finance analytics.		
Text Books:		
1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly Media, 2nd Edition. 2. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publishing. 3rd		
Reference Books: 1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson, 4th Edition. 2. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press. 3. Designing Machine Learning Systems, Chip Huyen, O'Reilly Media.		
NPTEL Links: 1. **Introduction to Machine Learning, Prof. Sudeshna Sarkar- IIT Kharagpur** https://nptel.ac.in/courses/106105152 2. **Introduction to Machine Learning, Prof. Balaraman Ravindran**, **IIT Madras** https://nptel.ac.in/courses/106106139		

MACHINE LEARNING AND DATA SCIENCE LAB (PCC)							
COURSE OUTLINE							
Course Title:	**MACHINE LEARNING AND DATA SCIENCE LAB (PCC)**			**Short Title:**	**MLDS**	**Course Code:**	**CS-511 A**
Practical	**Hours/week**	**No. of weeks**	**Total hours**			**Semester credits**	
	02	**15**	**30**			**1**	
Prerequisite course(s):							
Basic knowledge of programming in Python , Understanding of fundamental statistics and probability concepts							
COURSE CONTENT							
Name of the Subject: Machine Learning and Data Science Lab			**Semester:**		**V**		
Teaching Scheme:			**Examination scheme**				
Practical:	**02 hours/week**		**End semester exam (ESE):**				**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. K-Nearest Neighbors (KNN) Classification
   Implement the K-Nearest Neighbors (KNN) algorithm to classify a given dataset and analyze the effect of different values of K on model performance.
2. Decision Tree Classifier
   Develop a Decision Tree model for classification and study the impact of parameters such as depth and splitting criteria on accuracy.
3. Random Forest Classifier
   Implement the Random Forest algorithm and compare its performance with a Decision Tree classifier for improved prediction accuracy.
4. Support Vector Machine (SVM)
   Build a Support Vector Machine (SVM) model using different kernel functions and evaluate its performance on a classification dataset.
5. Principal Component Analysis (PCA)
   Apply Principal Component Analysis (PCA) for dimensionality reduction and analyze the variance explained by principal components.
6. Model Evaluation using Confusion Matrix and Performance Metrics
   Evaluate the performance of a classification model using confusion matrix and metrics such as accuracy, precision, recall, and F1-score.
7. Hyperparameter Tuning using Grid Search / Random Search
   Perform hyperparameter tuning using Grid Search and Random Search techniques to optimize the performance of a machine learning model.
8. Implementation of Ensemble Methods (Bagging / Boosting)
   Implement ensemble learning techniques such as Bagging and Boosting and compare their performance with individual models.

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

Text Books:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", Aurélien Géron, O'Reilly Media.
2. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publishing.
3. Machine Learning with Python Cookbook, Chris Albon, O'Reilly Media.

Reference Books:

1. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer.
2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer.
3. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press.
4. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press.
5. Data Science for Business, Foster Provost and Tom Fawcett, O'Reilly Media.

Online Resources:

1. Python for Data Science , Prof. Ragunathan Rengasamy, IIT Madras https://nptel.ac.in/courses/106106212

ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS (PCC)					
COURSE OUTLINE					
Course Title:	**ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS (PCC)**	**Short Title:**	**AIBDA**	**Course Code:**	**CS-612 A**

Course description: This course introduces the use of Artificial Intelligence techniques for analyzing and processing large-scale data. It covers big data frameworks, AI-based analytics, natural language processing, deep learning, recommendation systems, and real-time data processing, along with applications, security, and emerging trends in big data analytics.

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

Prerequisite course(s): Basic knowledge of programming, database management systems

Course objectives:

The objective of this course is to:

1. To understand the concepts of Big Data and the role of Artificial Intelligence in large-scale data analytics.
2. To learn techniques for storing, processing, and analyzing structured and unstructured big data.
3. To apply machine learning and deep learning algorithms for big data analytics applications.
4. To explore distributed computing frameworks and AI tools for handling big data efficiently.
5. To develop intelligent data-driven solutions for real-world applications using AI and big data technologies.

Course outcomes:

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

1. Explain the concepts, characteristics, and challenges of big data and AI-driven analytics.
2. Apply distributed computing and big data frameworks for storage and processing of large datasets.
3. Implement machine learning and deep learning techniques for big data analytics.
4. Analyze large-scale structured and unstructured data using AI tools and platforms.
5. Design intelligent solutions for real-world big data applications in domains such as healthcare, finance, and smart cities.

COURSE CONTENT

ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS		**Semester:**	VI
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE)**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

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

Unit I: Introduction to Big Data and Artificial Intelligence

Introduction to Big Data ,Characteristics of Big Data: Volume, Velocity, Variety, Veracity, Value Sources and Types of Big Data ,Challenges in Big Data Analytics, Introduction to Artificial Intelligence ,Role of AI in Big Data Analytics ,AI Techniques used in Big Data ,Applications of AI in Big Data Analytics.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12
Unit II: **Big Data Storage and Processing Frameworks** Big Data Architecture ,Distributed File Systems ,Hadoop Ecosystem: HDFS ,MapReduce,YARN ,Apache Spark Framework, Data Storage Techniques: NoSQL Databases ,MongoDB ,Cassandra ,Real-Time Data Processing		
Unit–III:	**No. of Lectures: 09 Hours**	**Marks: 12**
Unit III: Advanced AI Applications and Analytics for Big Data Distributed Machine Learning using Spark MLlib ,Natural Language Processing for Big Data: Text Mining ,Sentiment Analysis ,Topic Modeling ,Stream Data Analytics: Batch Processing vs Stream Processing ,Real-Time Analytics using Spark Streaming, Recommendation Systems: Content-Based Filtering ,Collaborative Filtering ,AI for Unstructured Big Data: Text Data ,Image Data Social Media Data		
Unit–IV:	**No. of Lectures: 09 Hours**	**Marks: 12**
Unit IV: Deep Learning and Predictive Analytics for Big Data Introduction to Deep Learning ,Artificial Neural Networks ,,Deep Neural Networks Convolutional Neural Networks (CNN),Recurrent Neural Networks (RNN) ,Predictive Analytics using Deep Learning ,Time Series Forecasting for Big Data ,AI-Based Decision Support Systems		
Unit–V:	**No. of Lectures: 09 Hours**	**Marks: 12**
Unit V: Applications, Security, and Emerging Trends AI for Healthcare Big Data ,AI for Financial Analytics ,AI for Smart Cities and IoT ,Fraud Detection and Cybersecurity Analytics ,Ethical Issues in Big Data Analytics ,Privacy and Security in AI-Based Big Data Systems ,Recent Trends:Generative AI for Big Data, Explainable AI ,Edge AI Federated Learning ,Case Studies and Industrial Applications		
Text Books:		
1. Artificial Intelligence for Big Data", Anand Deshpande and Manish Kumar, Packt Publishing Ltd., 2018. 2. "Big Data Analytics", Seema Acharya and Subhashini Chellappan, Wiley India Pvt. Ltd., 2nd Edition, 2019.		
Reference Books: 1. "Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale", Tom White, O'Reilly Media, 4th Edition, 2015. This is one of the most recommended references for Hadoop, HDFS, MapReduce, YARN, Hive, Pig, and Spark. 2. "Designing Data-Intensive Applications", Martin Kleppmann, O'Reilly Media, 2017. Recommended for understanding distributed systems, stream processing, scalability, and fault tolerance in big data environments. 3. "Deep Learning", Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016. "Artificial Intelligence: A Modern Approach", Stuart Russell and Peter Norvig, Pearson Education, 4th Edition, 2020.		
NPTEL Links: 1. https://nptel.ac.in/courses/106104189, Big Data Computing, Prof. Rajiv Misra,IIT Patna		

ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS LAB (PCC)**	**Short Title:**	**AIBDAL**	**Course Code:**	**CS-613 A**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Basic knowledge of programming in Python , Understanding of fundamental statistics and probability concepts					
COURSE CONTENT					
ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS LAB (PCC)		**Semester:**	**VI**		
Teaching Scheme:		**Examination scheme**			
Practical:	**02 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. Faculty may use following list of experiment as a reference.

1. Implement a big data environment using Hadoop and Spark and study their architecture and components.
2. Perform data ingestion from multiple structured and unstructured data sources using batch and real-time techniques.
3. Implement distributed storage and file management using HDFS in a Hadoop environment.
4. Perform data preprocessing, cleaning, and transformation on a large dataset using Apache Spark.
5. Implement batch data processing using MapReduce for large-scale analytical tasks.
6. Perform real-time stream data analytics using Apache Kafka and Spark Streaming.
7. Implement machine learning on big data using Spark MLlib for classification or clustering.
8. Implement text mining and natural language processing techniques on unstructured big data.
9. Develop a sentiment analysis model for social media or review data using AI techniques.
10. Build a recommendation system using content-based and collaborative filtering methods.
11. Apply deep learning techniques using TensorFlow or PyTorch for big data analytics applications.
12. Perform predictive analytics on a large-scale dataset using AI models. ,

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 practical, paper work and performance in the ESE

Text Books:

1. Artificial Intelligence for Big Data", Anand Deshpande and Manish Kumar, Packt Publishing Ltd., 2018.
2. "Big Data Analytics", Raj Kamal and Preeti Saxena, McGraw Hill Education (India) Pvt. Ltd., 2019. This book covers Hadoop, Spark, NoSQL, stream analytics, and machine learning for big data.

Reference Books:

1. "Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale", Tom White, O'Reilly Media, 4th Edition, 2015. Considered a standard reference for Hadoop, HDFS, MapReduce, YARN, Hive, Pig, and Spark.
2. "Learning Spark: Lightning-Fast Big Data Analysis", Holden Karau, Andy Konwinski, Patrick Wendell, and Matei Zaharia, O'Reilly Media, 2nd Edition, 2020. Recommended for practical Spark programming and distributed analytics

NPTL link:

1. https://nptel.ac.in/courses/106104189, Big Data Computing, Prof. Rajiv Misra,IIT Patna.

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY,

JALGAON (M.S.)

Bachelor of Engineering – Honors in Blockchain for Third 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 – V & VI
W.E.F. 2026 – 27

Specialization Honors in "Blockchain"

Syllabus Structure for Specialization Honors in "Blockchain": Additional Credit (Semester – V) (w.e.f. 2026 – 27)
(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-510B	Blockchain Platforms and Use cases	PCC	3			3	40	60			100	3
CS-511B	Blockchain Platforms and Use cases Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Blockchain": Additional Credit (Semester – VI) (w.e.f. 2026 – 27)
(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-612B	Blockchain Security and Performance	PCC	3			3	40	60			100	3
CS-613B	Blockchain Security and Performance Lab	PCC			2	2			25	25 (PR)	50	1

BLOCKCHAIN PLATFORMS AND USE CASES (PEC)

COURSE OUTLINE

Course Title:	**Program Elective Course-I: BLOCKCHAIN PLATFORMS AND USE CASES**	**Short Title:**	**BPUC**	**Course Code:**	**CS-510B**

Course description:

This course provides an in-depth understanding of modern blockchain platforms, decentralized applications, scalability challenges, and real-world industry use cases. It explores both permissioned and permission less ecosystems, distributed storage solutions, and next-generation consensus mechanisms. The course combines theoretical foundations with practical insights into enterprise and decentralized blockchain deployments.

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

Prerequisite course(s):

Fundamentals of Blockchain

Course objectives:

1. Students should be able to learn different types of block chain platforms.
2. Students should be able to understand different types of Decentralized applications developed using blockchain technology.
3. Students should be able to evaluate key blockchain challenges including consensus mechanisms, scalability limitations, privacy and confidentiality issues
4. Students should be able to apply the concepts of decentralized storage and alternative distributed ledger technologies.
5. Students should be able to understand several types of blockchain use cases.

Course outcomes:

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

1. Analyze and compare permissioned and public blockchain platforms.
2. Design and evaluate decentralized applications.
3. Assess blockchain scalability, privacy, and security challenges.
4. Understand alternative decentralized technologies such as IPFS and Hashgraph.
5. Identify and propose blockchain-based solutions for real-world industry problems.

COURSE CONTENT

Block-chain Platforms and Use cases		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):UA TH**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):CA	**40 marks**

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

Permissioned Blockchains: Hyperledger Fabric Services, Model and Functions, Hyperledger Composer, Microsoft Azure Blockchain Platform and Services, Other Platforms: IOTA, TRON, Ziliqa, Cosmos, Ripple.

Unit–II	**No. of Lectures: 09 Hours**	**Marks: 12**
Decentralized Application Platforms: Augur-Decentralised Prediction Market Platform, Grid+-Energy Ecosystem Platform.		
Unit–III	**No. of Lectures: 09 Hours**	**Marks: 12**
Challenges and Solutions Related to Blockchain: Consensus, Scalability, Privacy and Confidentiality, Escrow, and Multi signature.		
Unit–IV	**No. of Lectures: 09 Hours**	**Marks: 12**
Alternative Decentralized Solutions: Interplanetary File System (IPFS) Working and Uses, Hashgrapgh- Working, Benefits, And Use-Cases.		
Unit–V	**No. of Lectures: 09 Hours**	**Marks: 12**
Blockchain Use Cases: Financial Services Related Use Cases, Revolutionization of Global Trade, Digital Identity, Auditing Services, Supply Chain Management, Healthcare Related Services, Blockchain and IOT, Blockchain and AI.		
Text Books:		
1. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashir, Packt Publishing (March 17, 2017). 2. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.		
Reference Books:		
1. Building Blockchain Projects, Narayan Prusty, Packt Publishing. 2. Blockchain: Blueprint for a New Economy by Melanie Swan, Shroff Publisher publisher/O'Reilly Publisher Media; 1st edition (2015)		
Online Resources:		
1. . https://nptel.ac.in/courses/106105184/ 2. https://www.coursera.org/learn/blockchain-platforms. 3. Introduction to Blockchain Technology and Applications, https://swayam.gov.in/nd1_noc20_cs01/preview		

BLOCKCHAIN PLATFORMS AND USE CASES LAB(PCC)						
COURSE OUTLINE						
Course Title:	**BLOCKCHAIN PLATFORMS AND USE CASES LAB(PCC)**		**Short Title:**	**BPUCL**	**Course Code:**	**CS-511B**
Practical	**Hours/week**	**No. of weeks**	**Total hours**		**Semester credits**	
	02	**15**	**30**		**1**	
Prerequisite course(s):						
Fundamentals of Blockchain						
COURSE CONTENT						
Name of the Subject: Blockchain Platforms and Use cases Lab		**Semester:**	**V**			
Teaching Scheme:		**Examination scheme**				
Practical:	**02hours/week**	**End semester exam (ESE):UA**			**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. Develop a simple blockchain application using Hyperledger Fabric to store and manage data on a distributed ledger.
2. Deploy a simple blockchain network using Microsoft Azure Blockchain Service and interact with a smart contract.
3. Develop a simple DApp.
4. Write and deploy a **smart contract that acts as an escrow** between a buyer and seller.
5. Implement blockchain for supply chain tracking.
6. Implement blockchain-based identity system.
7. Predicting a patient's risk of developing diabetes based on historical health metrics stored on a blockchain ledger.

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

Text Books:

1. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashir, Packt Publishing (March 17, 2017).
2. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.

Reference Books:

1. Building Blockchain Projects, Narayan Prusty, Packt Publishing.
2. Blockchain: Blueprint for a New Economy by Melanie Swan, Shroff Publisher publisher/O'Reilly Publisher Media; 1st edition (2015)

Corresponding Online Resources:

1. https://nptel.ac.in/courses/106105184/
2. https://www.coursera.org/learn/blockchain-platforms.
3. Introduction to Blockchain Technology and Applications, https://swayam.gov.in/nd1_noc20_cs01/preview

BLOCKCHAIN SECURITY AND PERFORMANCE(PEC-III)					
COURSE OUTLINE					
Course Title:	**BLOCKCHAIN SECURITY AND PERFORMANCE(PEC-III)**	**Short Title:**	**BSP**	**Course Code:**	**CS-612B**

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.

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

Prerequisite course(s):

Fundamentals of Blockchain , Cryptography Techniques

Course objectives:

1. Students should be able to understand the security and performance-related issues of blockchain.
2. Students should be able to learn techniques and tools to tackle the security related issues of blockchain.
3. Students should be able to learn new approaches required for enhancing blockchain performance.

Course outcomes:

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

1. To understand the security perspective of blockchain technology.
2. To learn the various Tools for Smart Contracts.
3. To understand performance related issues in blockchain
4. To learn and apply security analysis and performance-enhancing techniques related to blockchain.
5. To understand the real-life applications of blockchain technology and apply it to provide solutions to some real-life problems.

COURSE CONTENT

BLOCKCHAIN SECURITY AND PERFORMANCE		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End semester exam (ESE):**	**60 marks**
		Duration of ESE:	**03 hours**
		Internal Sessional Exams (ISE):	**40 marks**

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

Security Issues: Blockchain Related Issues, Higher-Level Language (Solidity) Related Issues, EVM Bytecode Related Issues, Real-Life Attacks on Blockchain Applications/ Smart Contracts, Trusted Execution Environments.

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

Security Tools for Smart Contracts: Working, Advantages, And Disadvantages of Tools- Oyente, Securify, Maian, Manticore, Mythril, SmartCheck, Verx. Secure Key Management, Quantum Resilience Keys.

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

Performance Related Issues: Transaction Speed, Transaction Fees, Network Size, Complexity, Interoperability Problems, Lack of Standardization. Lack of Supportive Regulations Related to Blockchain Applications.

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

Performance Improvements: Off-Chain State Channels, Sidechains, Parallels Chains, Concurrent Smart Contract Transactions, Sharding Technique and Its Benefits, Atomic Swaps Between Smart Contracts.

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

Blockchain Applications: Decentralized Cryptocurrency, Distributed Cloud Storage, E-Voting, Insurance Claims, Cross-Border Payments, Asset Management, Smart Appliances.

Text Books:

1. Mastering Ethereum: Building Smart Contracts and Dapps Book by Andreas Antonopoulos and Gavin Wood, Shroff Publisher/O′Reilly Publisher.

Reference Books:

1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015
2. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing

Corresponding Online Resources:
1. https://www.edx.org/course/blockchain-and-fintech-basics-applications-and-limitations

BLOCKCHAIN SECURITY AND PERFORMANCE LAB (PEC-III-Lab)					
COURSE OUTLINE					
Course Title:	**BLOCKCHAIN SECURITY AND PERFORMANCE LAB (PEC-III)**	**Short Title:**	**BSPL**	**Course Code:**	**CS-613B**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Fundamentals of Blockchain, Cryptography Techniques					
COURSE CONTENT					
Name of the Subject: Blockchain Security and Performance Lab		**Semester:**	**VI**		
Teaching Scheme:		**Examination scheme**			
Practical:	**02 hours/week**	**End Semester Exam(ESE): UA PR**		**25 Marks**	
		Internal Continuous Assessment (ICA): CA		**25 Marks**	

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. Design, develop, and deploy a smart contract on the blockchain that securely handles data storage and user interaction.
2. Design and implement a smart contract to demonstrate how integer overflow and underflow vulnerabilities can occur in blockchain applications.
3. To design and simulate a 51% attack in a controlled blockchain environment and analyze how majority control can compromise network security, transaction integrity, and consensus.
4. Develop a blockchain wallet with multi-signature security that requires multiple approvals before a transaction can be executed.
5. Study the factors affecting blockchain performance and explore techniques to improve it.
6. Design and develop a smart contract to implement a secure and transparent electronic voting system on the blockchain
7. Design a blockchain-based insurance system that offers a transparent, secure, and automated platform to accelerate claim settlements and enhance trust between insurers and policyholders

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

Text Books:

1. Mastering Ethereum: Building Smart Contracts and Dapps Book by Andreas Antonopoulos and Gavin Wood, Shroff Publisher/O′Reilly Publisher.
Reference Books:
1. Melanie Swan, “Block Chain: Blueprint for a New Economy”, O’Reilly, 2015 2. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing
Online Resources: 1. https://www.edx.org/course/blockchain-and-fintech-basics-applications-and-limitations

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Honors
in
Cyber Security
for Third 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 – V & VI
W.E.F. 2026 – 27

Specialization Honors in "Cyber Security"

Syllabus Structure for Specialization Honors in "Cyber Security": Additional Credit (Semester – V) (w.e.f. 2026 – 27)

(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-510C	Steganography and Digital Watermarking	PCC	3			3	40	60			100	3
CS-511C	Steganography and Digital Watermarking Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Honors in "Cyber Security": Additional Credit (Semester – VI) (w.e.f. 2026 – 27)

(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-612C	Security Assessment and Risk Analysis	PCC	3			3	40	60			100	3
CS-613C	Security Assessment and Risk Analysis Lab	PCC			2	2			25	25 (PR)	50	1

STEGANOGRAPHY AND DIGITAL WATERMARKING (PCC)					
COURSE OUTLINE					
Course Title:	**STEGANOGRAPHY AND DIGITAL WATERMARKING (PCC)**	**Short Title:**	**SDW**	**Course Code:**	**CS-510C**

Course description:

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

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To understand the fundamental concepts, principles, and importance of steganography and digital watermarking in multimedia security.
2. To study various information hiding techniques used for secure data embedding in images, audio, video, and text.
3. To analyze different watermarking and steganographic algorithms with respect to security, robustness, and capacity.
4. To examine attacks, vulnerabilities, and countermeasures in multimedia information hiding systems.
5. To explore real-world applications and emerging trends in steganography, watermarking,

Course outcomes:

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

1. Explain the basic principles and techniques of steganography and digital watermarking.
2. Apply different data hiding and watermarking techniques to multimedia data.
3. Analyse and design secure multimedia information hiding systems.
4. Evaluate the robustness, security, and performance of steganography and watermarking methods.
5. Investigate advanced research trends and real-world applications in multimedia security and information hiding.

COURSE CONTENT

		Semester:	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**02 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40marks**

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

Introduction to Information Hiding

Overview of Information Security ,Information Hiding vs Cryptography vs Steganography Steganography Principles and Models ,Characteristics: Imperceptibility, Capacity, Robustness Applications of Steganography and Watermarking

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

Image Steganography Techniques

Spatial Domain Techniques (LSB Method) ,Transform Domain Techniques (DCT, DWT) Steganography Algorithms and Tools ,Image Formats and Their Impact ,Performance Metrics (PSNR, MSE)

Unit–III:	**No .of Lectures:09 Hours**	**Marks:12**
Audio and Video Steganography Audio Steganography Techniques ,Video Steganography Methods ,Compression Effects (MP3, MPEG) , Real-time Steganography Systems ,Case Studies		
Unit–IV:	**No .of Lectures:09 Hours**	**Marks:12**
Digital Watermarking Fundamentals of Digital Watermarking ,Types: Visible, Invisible, Robust, Fragile Watermark Embedding and Extraction ,Applications: Copyright Protection, Ownership Verification, Watermarking in Images, Audio, and Video		
Unit–V:	**No .of Lectures:09 Hours**	**Marks:12**
Security, Attacks, and Advanced Topics Steganalysis Techniques ,Attacks on Steganography and Watermarking ,Robustness and Security Evaluation ,Legal and Ethical Issues ,Emerging Trends and Research Directions		
Text Books: 1. Digital Image Steganography and Watermarking – Amine Bouchentouf, Digital Image Steganography and Watermarking, Wiley. 2. Information Hiding Techniques for Steganography and Digital Watermarking – Stefan Katzenbeisser& Fabien Petitcolas, Artech House. 3. Digital Watermarking and Steganography – Ingemar Cox et al., Morgan Kaufmann.		
Reference Books: 1. Multimedia Security – Borko Furht& Darko Kirovski, CRC Press. 2. Handbook of Image and Video Processing – Alan Bovik, Academic Press. 3. Network Security Essentials – William Stallings, Pearson.		
NPTEL Links: https://www.google.com/search?q=STEGANOGRAPHY+AND+DIGITAL+WATERMARKING+NPTL+Course+link		

STEGANOGRAPHY AND DIGITAL WATERMARKING LAB (PCC)					
COURSE OUTLINE					
Course Title:	**STEGANOGRAPHY AND DIGITAL WATERMARKING LAB (PCC)**	**Short Title:**	SDWL	**Course Code:**	**CS-511C**

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

COURSE CONTENT			
		Semester:	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2hours/week**		
		End Semester Examination (ESE) UA: PR	**25 marks**
		Internal Sessional Exam (ISE) CA:PR	**25marks**

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

List of Experiments

1. Implementation of LSB Image Steganography
2. Image Steganography using DCT/DWT
3. Audio Steganography Techniques
4. Video Steganography Demonstration
5. Watermark Embedding and Extraction
6. Performance Evaluation using PSNR/MSE
7. Steganoanlysis Tools Study
8. Mini Project on Multimedia Security

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 Practical, paper work and performance in the ESE

SECURITY ASSESSMENT AND RISK ANALYSIS(PCC)					
COURSEOUTLINE					
Course Title:	**SECURITY ASSESSMENT AND RISK ANALYSIS(PCC)**	**Short Title:**	**SARA**	**Course Code:**	**CS-612C**

Course description:

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

Prerequisite course(s):

Course Objectives:

The objective of this course is to:

1. To understand fundamental concepts of security assessment including CIA triad, threats, vulnerabilities, and risk.
2. To learn risk analysis and risk management techniques used in information security.
3. To study various security assessment techniques such as vulnerability assessment, penetration testing, and security auditing.
4. To analyze network and system security assessment methods including intrusion detection and log analysis.
5. To explore advanced security assessment topics such as cloud security, compliance standards, and incident response through real-world case studies.

Course Outcomes:

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

1. Explain basic security concepts, threats, vulnerabilities, and risk assessment principles.
2. Apply risk analysis and risk mitigation strategies in security management.
3. Perform vulnerability assessment, penetration testing, and security auditing using appropriate tools and methodologies.
4. Analyze network and system security issues and implement system hardening and monitoring techniques.
5. Evaluate cloud security, compliance standards, and incident response strategies using real-world case studies.

COURSECONTENT

SECURITY ASSESSMENT AND RISK ANALYSIS		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

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

Introduction to Security Assessment

Security concepts, CIA triad, threats, vulnerabilities, risk, security policies and standards.

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

Risk Analysis and Management

Risk assessment process, qualitative and quantitative analysis, risk mitigation strategies.

Unit–III:	No .of Lectures:09 Hours	Marks:12
Security Assessment Techniques Vulnerability assessment, penetration testing, security auditing, tools and methodologies.		
Unit–IV:	**No .of Lectures:09 Hours**	**Marks:12**
Network and System Security Assessment Network vulnerabilities, system hardening, intrusion detection, log analysis.		
Unit–V:	**No .of Lectures:09 Hours**	**Marks:12**
Advanced Topics and Case Studies Cloud security assessment, compliance standards, incident response, real-world case studies.		
TextBooks:		
1. Mike Chapple, James Stewart, Darril Gibson, CISSP Official Study Guide, Wiley. 2. Nina Godbole, Information Systems Security, Wiley.		
ReferenceBooks: 1. Ross Anderson, Security Engineering, Wiley. 2. Charles P. P fleeger, Security in Computing, Prentice Hall. 3. William Stallings, Network Security Essentials, Pearson.		
NPTEL Links: https://onlinecourses.nptel.ac.in/noc25_cs120/preview		

SECURITY ASSESSMENT AND RISK ANALYSIS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**SECURITY ASSESSMENT AND RISK ANALYSIS LAB (PCC)**	**Short Title:**	**SARAL**	**Course Code:**	**CS-613C**

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

Prerequisite course(s):

Course objectives:

COURSECONTENT			
SECURITY ASSESSMENT AND RISK ANALYSIS LAB		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical	**2 hours/week**		
		End Semester Examination (ESE) UA:PR	**25 marks**
		Internal Continuous Assessments(ICA):CA	**25marks**
	No. of Experiments:08	**Marks:12**	

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. Introduction to Information Security Tools
   Study of security concepts: CIA triad, threats, vulnerabilities, Installation of tools (Kali Linux / Virtual Machine setup), Familiarization with tools like Nmap, Wireshark
2. Network Scanning using Nmap
   Perform host discovery, Port scanning techniques (TCP, SYN, UDP), Service and OS detection
3. Packet Analysis using Wireshark
   Capture network traffic, Analyze protocols (HTTP, TCP/IP, DNS) ,Identify suspicious packets
4. Vulnerability Scanning
   Scan systems using vulnerability scanners, identify common vulnerabilities (CVEs), Generate scan reports
5. Password Cracking Techniques
   Dictionary and brute-force attacks ,Password strength evaluation ,Hash cracking basics
6. Web Application Security Testing
   Identify vulnerabilities like SQL Injection, XSS ,Perform basic web penetration testing
7. Risk Assessment and Analysis
   Identify assets, threats, and vulnerabilities ,Risk calculation (qualitative and quantitative methods) ,Risk mitigation strategies

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 – Minors
in
Data Science
for Third 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 – V & VI
W.E.F. 2026 – 27

Specialization Minors in "Data Science"

Syllabus Structure for Specialization Minors in "Data Science": Additional Credit (Semester – V) (w.e.f. 2026 – 27)

(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-512A	Machine Learning and Data Science	PCC	3			3	40	60			100	3
CS-513A	Machine Learning and Data Science Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Minors in "Data Science": Additional Credit (Semester – VI) (w.e.f. 2026 – 27)

(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-614A	Artificial Intelligence for Big Data Analytics	PCC	3			3	40	60			100	3
CS-615A	Artificial Intelligence for Big Data Analytics Lab	PCC			2	2			25	25 (PR)	50	1

MACHINE LEARNING AND DATA SCIENCE (PCC)					
COURSE OUTLINE					
Course Title:	**MACHINE LEARNING AND DATA SCIENCE (PCC)**	**Short Title:**	**MLDS**	**Course Code:**	**CS-512A**

Course description: This course introduces the fundamentals of Machine Learning and Data Science, including data preprocessing, supervised and unsupervised learning, model evaluation, and practical implementation of machine learning algorithms for real-world applications.

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

Prerequisite course(s): Basic Statistics, Python Programming

Course objectives:

The objective of this course is to:

1. To understand and implement the complete machine learning pipeline, including data preprocessing, feature engineering, model building, and validation using real-world datasets.
2. To develop proficiency in supervised learning techniques such as regression and classification for solving practical engineering problems.
3. To apply unsupervised learning methods including clustering and dimensionality reduction for pattern discovery and data analysis.
4. To evaluate and optimize machine learning models using appropriate performance metrics, validation techniques, and hyperparameter tuning.
5. To design and deploy basic machine learning solutions using modern tools and frameworks for real-world applications.

Course outcomes:

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

1. Apply data preprocessing, feature engineering, and machine learning pipelines to prepare real-world datasets for analysis.
2. Implement and analyze supervised learning algorithms (regression and classification) to solve engineering problems.
3. Apply unsupervised learning techniques such as clustering and dimensionality reduction for pattern recognition and data insights.
4. Evaluate and optimize machine learning models using appropriate metrics, validation strategies, and hyper parameter tuning methods.
5. Design and develop end-to-end machine learning solutions, including basic deployment for real-world applications.

COURSE CONTENT

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

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

Advanced Feature Engineering: Feature scaling (Standardization vs Normalization),Feature transformation (log, polynomial),Handling Imbalanced Data: SMOTE technique, Under sampling & Oversampling, Feature Selection Techniques: Filter methods (Correlation, Chi-square), Wrapper methods Embedded methods (Lasso) Handling High-Dimensional Data ,Introduction to automated pipelines using Scikit-learn

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

Supervised Learning–Advanced Models: Regression: Regularization (Ridge, Lasso) Classification: Logistic Regression (advanced concepts),Decision Trees (pruning techniques),Random Forest, Support Vector Machines (kernel trick),Ensemble Methods: Bagging, Boosting (AdaBoost, Gradient Boosting)

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

Unsupervised Learning & Dimensionality Reduction: K-Means Clustering (advanced analysis, elbow method),Hierarchical Clustering, DBSCAN (density-based clustering),Principal Component Analysis (PCA),Feature Extraction vs Feature Selection.

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

Unit IV: Model Evaluation & Optimization: Advanced Evaluation Metrics: Precision-Recall tradeoff ,ROC-AUC, Cross Validation (K-Fold, Stratified) :Hyperparameter Tuning: Grid Search Random Search ,Bias-Variance Tradeoff (practical perspective) ,Model Comparison & Selection

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

Unit V: Modern ML Applications & Deployment: Introduction to Deep Learning ,Neural Networks (basic architecture) ,Introduction to NLP ,Time Series Forecasting Basics ,Model Deployment: Saving models (Pickle/Joblib) , API Integration (basic idea) ,*Case Studies:* Healthcare prediction ,Agriculture (crop disease detection) ,Finance analytics.

Text Books:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly Media, 2nd Edition.
2. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publishing. 3rd

Reference Books:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson, 4th Edition.
2. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press.
3. Designing Machine Learning Systems, Chip Huyen, O'Reilly Media.

NPTEL Links:

1. Introduction to Machine Learning, Prof. Sudeshna Sarkar- IIT Kharagpur https://nptel.ac.in/courses/106105152
2. Introduction to Machine Learning, Prof. Balaraman Ravindran, IIT Madras https://nptel.ac.in/courses/106106139

MACHINE LEARNING AND DATA SCIENCE LAB (PCC)					
COURSE OUTLINE					
Course Title:	**MACHINE LEARNING AND DATA SCIENCE LAB (PCC)**	**Short Title:**	**MLDS**	**Course Code:**	**CS-513 A**
Practical	**Hours/week**	**No. of weeks**	**Total hours**	**Semester credits**	
	02	**15**	**30**	**1**	
Prerequisite course(s):					
Basic knowledge of programming in Python , Understanding of fundamental statistics and probability concepts					

COURSE CONTENT			
Name of the Subject: Machine Learning and Data Science Lab		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Practical:	**02 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. Faculty may use following list of experiment as a reference.

1. K-Nearest Neighbors (KNN) Classification
   Implement the K-Nearest Neighbors (KNN) algorithm to classify a given dataset and analyze the effect of different values of K on model performance.
2. Decision Tree Classifier
   Develop a Decision Tree model for classification and study the impact of parameters such as depth and splitting criteria on accuracy.
3. Random Forest Classifier
   Implement the Random Forest algorithm and compare its performance with a Decision Tree classifier for improved prediction accuracy.
4. Support Vector Machine (SVM)
   Build a Support Vector Machine (SVM) model using different kernel functions and evaluate its performance on a classification dataset.
5. Principal Component Analysis (PCA)
   Apply Principal Component Analysis (PCA) for dimensionality reduction and analyze the variance explained by principal components.
6. Model Evaluation using Confusion Matrix and Performance Metrics
   Evaluate the performance of a classification model using confusion matrix and metrics such as accuracy, precision, recall, and F1-score.
7. Hyperparameter Tuning using Grid Search / Random Search
   Perform hyperparameter tuning using Grid Search and Random Search techniques to optimize the performance of a machine learning model.
8. Implementation of Ensemble Methods (Bagging / Boosting)
   Implement ensemble learning techniques such as Bagging and Boosting and compare their performance with individual models.

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
Text Books:
1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", Aurélien Géron, O'Reilly Media. 2. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publishing. 3. Machine Learning with Python Cookbook, Chris Albon, O'Reilly Media.
Reference Books: 1. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer. 2. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer. 3. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press. 4. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press. 5. Data Science for Business, Foster Provost and Tom Fawcett, O'Reilly Media.
Online Resources: 1. Python for Data Science , Prof. Ragunathan Rengasamy, IIT Madras https://nptel.ac.in/courses/106106212

ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS (PCC)					
COURSE OUTLINE					
Course Title:	**ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS (PCC)**	**Short Title:**	**AIBDA**	**Course Code:**	**CS-614 A**

Course description: This course introduces the use of Artificial Intelligence techniques for analyzing and processing large-scale data. It covers big data frameworks, AI-based analytics, natural language processing, deep learning, recommendation systems, and real-time data processing, along with applications, security, and emerging trends in big data analytics.

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

Prerequisite course(s): Basic knowledge of programming, database management systems

Course objectives:

The objective of this course is to:

1. To understand the concepts of Big Data and the role of Artificial Intelligence in large-scale data analytics.
2. To learn techniques for storing, processing, and analyzing structured and unstructured big data.
3. To apply machine learning and deep learning algorithms for big data analytics applications.
4. To explore distributed computing frameworks and AI tools for handling big data efficiently.
5. To develop intelligent data-driven solutions for real-world applications using AI and big data technologies.

Course outcomes:

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

1. Explain the concepts, characteristics, and challenges of big data and AI-driven analytics.
2. Apply distributed computing and big data frameworks for storage and processing of large datasets.
3. Implement machine learning and deep learning techniques for big data analytics.
4. Analyze large-scale structured and unstructured data using AI tools and platforms.
5. Design intelligent solutions for real-world big data applications in domains such as healthcare, finance, and smart cities.

COURSE CONTENT

ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE) CA:	**40 marks**

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

Introduction to Big Data and Artificial Intelligence

Introduction to Big Data ,Characteristics of Big Data: Volume, Velocity, Variety, Veracity, Value Sources and Types of Big Data ,Challenges in Big Data Analytics, Introduction to Artificial Intelligence ,Role of AI in Big Data Analytics ,AI Techniques used in Big Data ,Applications of AI in Big Data Analytics.

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

Big Data Storage and Processing Frameworks

Big Data Architecture ,Distributed File Systems ,Hadoop Ecosystem: HDFS ,MapReduce,YARN ,Apache Spark Framework, Data Storage Techniques: NoSQL Databases ,MongoDB ,Cassandra ,Real-Time Data Processing

Unit–III:	No. of Lectures: 809 Hours	Marks: 12

Advanced AI Applications and Analytics for Big Data

Distributed Machine Learning using Spark MLlib ,Natural Language Processing for Big Data:
Text Mining ,Sentiment Analysis ,Topic Modeling ,Stream Data Analytics: Batch Processing vs Stream Processing ,Real-Time Analytics using Spark Streaming, Recommendation Systems: Content-Based Filtering ,Collaborative Filtering ,AI for Unstructured Big Data: Text Data ,Image Data Social Media Data

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

Deep Learning and Predictive Analytics for Big Data

Introduction to Deep Learning ,Artificial Neural Networks ,,Deep Neural Networks
Convolutional Neural Networks (CNN),Recurrent Neural Networks (RNN) ,Predictive Analytics using Deep Learning ,Time Series Forecasting for Big Data ,AI-Based Decision Support Systems

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

Applications, Security, and Emerging Trends

AI for Healthcare Big Data ,AI for Financial Analytics ,AI for Smart Cities and IoT ,Fraud Detection and Cybersecurity Analytics ,Ethical Issues in Big Data Analytics ,Privacy and Security in AI-Based Big Data Systems ,Recent Trends:Generative AI for Big Data, Explainable AI ,Edge AI Federated Learning ,Case Studies and Industrial Applications

Text Books:

1. Artificial Intelligence for Big Data", Anand Deshpande and Manish Kumar, Packt Publishing Ltd., 2018.
2. "Big Data Analytics", Seema Acharya and Subhashini Chellappan, Wiley India Pvt. Ltd., 2nd Edition, 2019.

Reference Books:

1. "Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale", Tom White, O'Reilly Media, 4th Edition, 2015. This is one of the most recommended references for Hadoop, HDFS, MapReduce, YARN, Hive, Pig, and Spark.
2. "Designing Data-Intensive Applications", Martin Kleppmann, O'Reilly Media, 2017. Recommended for understanding distributed systems, stream processing, scalability, and fault tolerance in big data environments.
3. "Deep Learning", Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.
"Artificial Intelligence: A Modern Approach", Stuart Russell and Peter Norvig, Pearson Education, 4th Edition, 2020.

NPTEL Links:

1. https://nptel.ac.in/courses/106104189, Big Data Computing, Prof. Rajiv Misra,IIT Patna

ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS LAB (PCC)**	**Short Title:**	**AIBDAL**	**Course Code:**	**CS-615 A**

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

Prerequisite course(s):

Basic knowledge of programming in Python , Understanding of fundamental statistics and probability concepts

COURSE CONTENT

ARTIFICIAL INTELLIGENCE FOR BIG DATA ANALYTICS LAB (PCC)		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Practical:	**02 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. Faculty may use following list of experiment as a reference.

1. Implement a big data environment using Hadoop and Spark and study their architecture and components.
2. Perform data ingestion from multiple structured and unstructured data sources using batch and real-time techniques.
3. Implement distributed storage and file management using HDFS in a Hadoop environment.
4. Perform data preprocessing, cleaning, and transformation on a large dataset using Apache Spark.
5. Implement batch data processing using MapReduce for large-scale analytical tasks.
6. Perform real-time stream data analytics using Apache Kafka and Spark Streaming.
7. Implement machine learning on big data using Spark MLlib for classification or clustering.
8. Implement text mining and natural language processing techniques on unstructured big data.
9. Develop a sentiment analysis model for social media or review data using AI techniques.
10. Build a recommendation system using content-based and collaborative filtering methods.
11. Apply deep learning techniques using TensorFlow or PyTorch for big data analytics applications.
12. Perform predictive analytics on a large-scale dataset using AI models.,

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 practical, paper work and performance in the ESE

Text Books:

1. Artificial Intelligence for Big Data", Anand Deshpande and Manish Kumar, Packt Publishing Ltd., 2018.
2. "Big Data Analytics", Raj Kamal and Preeti Saxena, McGraw Hill Education (India) Pvt. Ltd., 2019. This book covers Hadoop, Spark, NoSQL, stream analytics, and machine learning for big data.

Reference Books:

1. "Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale", Tom White, O'Reilly Media, 4th Edition, 2015. Considered a standard reference for Hadoop, HDFS, MapReduce, YARN, Hive, Pig, and Spark.
2. "Learning Spark: Lightning-Fast Big Data Analysis", Holden Karau, Andy Konwinski, Patrick Wendell, and Matei Zaharia, O'Reilly Media, 2nd Edition, 2020. Recommended for practical Spark programming and distributed analytics

NPTL link:

1. https://nptel.ac.in/courses/106104189, Big Data Computing, Prof. Rajiv Misra,IIT Patna.

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Bachelor of Engineering – Minor
in
Virtual Reality and Augmented Reality
for Third Year Bachelor of Engineering
offered by
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 – V & VI
W.E.F. 2026 – 27

Specialization Minor in "Virtual Reality and Augmented Reality"

Syllabus Structure for Minor in Virtual Reality and Augmented Reality: Additional Credit (Semester – V) (w.e.f. 2026 – 27)

(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 -512B	Augmented Reality	PCC	3			3	40	60			100	3
CS -513B	Augmented Reality Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Minor in Virtual Reality and Augmented Reality**: Additional Credit (Semester – VI) (w.e.f. 2026 – 27)**

(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 -614B	Virtual Reality in Game Development	PCC	3			3	40	60			100	3
CS -615B	Virtual Reality in Game Development Lab	PCC			2	2			25	25 (PR)	50	1

AUGMENTED REALITY(PCC)					
COURSEOUTLINE					
Course Title:	**AUGMENTED REALITY(PCC)**	**Short Title:**	**AR**	**Course Code:**	**CS-512B**
Course description:					

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

Prerequisite course(s):

Course objectives:

1. To introduce the fundamentals and concepts of Augmented Reality.
2. To understand AR hardware, tracking, and display technologies.
3. To study AR software platforms and development tools.
4. To design and develop AR applications using modern frameworks.
5. To explore real-world AR applications and future research trends.

Course outcomes:

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

1. Understand the fundamentals of Augmented Reality systems.
2. Explain AR hardware, displays, and tracking techniques.
3. Use AR development tools and platforms.
4. Develop AR-based applications.
5. Analyze real-world AR applications and future trends.

COURSECONTENT

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

Unit–I:	**No.ofLectures:09 Hours**	**Marks:12**

Introduction to Augmented Reality:
Definition and concept of Augmented Reality ,History and evolution of AR ,Augmented Reality vs Virtual Reality vs Mixed Reality ,Reality-Virtuality Continuum ,Components of AR system
AR architecture and working principle ,Applications of AR in education, healthcare, industry, and gaming

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

AR Hardware and Display Technologies:
AR hardware components ,Display technologies ,Head Mounted Displays (HMD) ,Handheld displays
Projection-based AR ,Sensors and cameras ,Depth sensors and motion tracking ,Visual perception and calibration ,Spatial mapping and environment understanding

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

Tracking and Interaction in AR :
Tracking techniques in AR ,Marker-based tracking ,Markerless tracking ,Computer vision techniques in AR
Sensor fusion ,Registration and alignment ,User interaction in AR ,AR user interface design

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

AR Development Platforms and Tools:
AR software platforms and SDKs ,Unity for AR development ,ARCore and ARKit ,Vuforia SDK 3D modeling and asset integration ,Scene creation and rendering ,Mobile AR application development

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

AR Applications and Future Trends :
AR in healthcare and medical training ,AR in education and learning ,AR in industry and manufacturing
AR in gaming and entertainment ,AR in e-commerce and smart cities ,Challenges in AR systems
Future trends and research directions in AR

TextBooks:

1. Dieter Schmalstieg & Tobias Höllerer , Augmented Reality: Principles and Practice, Addison-Wesley, 2016.
2. Alan B. Craig ,Understanding Augmented Reality: Concepts and Applications, Morgan Kaufmann, 2013.

Reference Books:

1. Jonathan Linowes – *Augmented Reality for Developers*, Packt
2. Tony Parisi – *Learning Virtual Reality*, O'Reilly
3. Gregory Kipper – *Augmented Reality: An Emerging Technologies Guide*
4. Steven LaValle – *Virtual Reality*, Cambridge University Press
5. Dieter Schmalstieg – *Augmented Reality Systems*

NPTELLinks:
https://onlinecourses.nptel.ac.in/noc26_cs03/preview

AUGMENTED REALITY LAB (PCC)					
COURSE OUTLINE					
Course Title:	**AUGMENTED REALITY LAB (PCC)**	**Short Title:**	**ARL**	**Course Code:**	**CS-513B**

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

Prerequisite course(s):

COURSE CONTENT			
Name of the Subject: Machine Learning and Data Science Lab		**Semester:**	**V**
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. Faculty may use following list of experiment as a reference.

List of Experiments

1. Study of AR systems and development platforms
2. Installation of Unity and AR development environment
3. Creation of basic 3D scene in Unity
4. Importing and manipulating 3D objects
5. Marker-based AR application using Vuforia
6. Image tracking AR application
7. Plane detection using ARCore
8. Object placement in AR environment
9. UI interaction in AR application
10. AR animation and lighting effects
11. Face tracking or object tracking application

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

VIRTUAL REALITY IN GAME DEVELOPMENT (PCC)					
COURSE OUTLINE					
Course Title:	**VIRTUAL REALITY IN GAME DEVELOPMENT (PCC)**	**Short Title:**	**VRGD**	**Course Code:**	**CS-614B**

Course description:

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

Prerequisite course(s):

Course objectives:

The objective of this course is to:

Course Objectives

- To understand the fundamentals of Virtual Reality (VR) and immersive technologies
- To explore VR hardware, software, and interaction techniques
- To design and develop VR-based games using modern engines
- To apply VR concepts in real-time game environments
- To evaluate performance, usability, and user experience in VR games

Course outcomes:

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

1. Explain VR concepts, history, and applications
2. Understand VR hardware and rendering techniques
3. Develop VR environments using game engines (Unity/Unreal)
4. Implement interaction and locomotion in VR games
5. Design and evaluate complete VR game prototypes

COURSE CONTENT

VIRTUAL REALITY IN GAME DEVELOPMENT		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

UNIT I:	**No. of Lectures: 09 hours**	**Marks:12**

Introduction to Virtual Reality and Game Development

Definition and evolution of Virtual Reality ,Types of VR: Immersive, Semi-immersive, Non-immersive, VR ecosystem and applications in gaming , Fundamentals of Game Development
Game engines overview (Unity, Unreal Engine) ,VR vs AR vs MR
Components of VR systems ,Challenges and Limitations of VR

UNIT II:	**No. of Lectures:09 hours**	**Marks:12**

VR Hardware and Software Technologies

VR hardware: HMDs, controllers, sensors ,Tracking systems (inside-out, outside-in)
Input devices and haptics ,Display technologies and stereoscopic vision
VR software frameworks and SDKs ,Introduction to Unity for VR
VR project setup and environment configuration ,

UNIT III:	**No. of Lectures: 09 hours**	**Marks:12**

3D Graphics and Rendering in VR

Basics of 3D graphics and coordinate systems ,Rendering pipeline Stereo rendering and depth perception ,Lighting, shading, and textures ,Physics and collision detection ,Optimization techniques for VR (FPS, latency) ,Spatial audio in VR		
UNIT IV:	**No. of Lectures: 09 hours**	**Marks:12**
Interaction and Game Mechanics in VR VR interaction techniques (gaze, gesture, controllers) 'Virtual hands and object interaction Locomotion techniques (teleportation, smooth movement) ,UI/UX design for VR environments Game mechanics and level design in VR ,User experience (presence, immersion, comfort) Motion sickness and mitigation techniques		
UNIT V:	**No. of Lectures: 09 hours**	**Marks:12**
VR Game Development and Deployment VR game architecture and design patterns ,Scene creation and asset integration Scripting (C# in Unity / C++ in Unreal) ,Testing and debugging VR applications Performance optimization and deployment ,Multiplayer and social VR concepts Case studies of VR games		
Text Books:		
1. Tony Parisi, Learning Virtual Reality: Developing Immersive Experiences and Applications, O'Reilly 2. Jonathan Linowes, Unity Virtual Reality Projects, Packt Publishing		
Reference Books: 1. Christopher Coutinho, *Unity Virtual Reality Development with VRTK4*, Apress 2. Jason Jerald, *The VR Book: Human-Centered Design for Virtual Reality* 3. LaViola et al., *3D User Interfaces: Theory and Practice* 4. Srushtika Neelakantam, *Learning Web-based Virtual Reality*, Apress		
NPTELLinks: https://onlinecourses.nptel.ac.in/noc25_cs87/preview		

<table>
<tr><th colspan="8">VIRTUAL REALITY IN GAME DEVELOPMENT LAB(PCC)</th></tr>
<tr><th colspan="8">COURSE OUTLINE</th></tr>
<tr><td colspan="2">Course Title:</td><td colspan="2">VIRTUAL REALITY IN GAME DEVELOPMENT LAB (PCC)</td><td>Short Title:</td><td>VRGDL</td><td>Course Code:</td><td>CS-615B</td></tr>
<tr><td colspan="2"></td><td>Hours/week</td><td>No. of weeks</td><td colspan="2">Total hours</td><td colspan="2">Semester Credits</td></tr>
<tr><td colspan="2">Practical</td><td>2</td><td>15</td><td colspan="2">30</td><td colspan="2">1</td></tr>
<tr><th colspan="8">COURSE CONTENT</th></tr>
<tr><td colspan="3">VIRTUAL REALITY IN GAME DEVELOPMENT LAB</td><td colspan="3">Semester:</td><td colspan="2">VI</td></tr>
<tr><td colspan="3">Teaching Scheme:</td><td colspan="5">Examination scheme</td></tr>
<tr><td colspan="2">Practical:</td><td>2hours/week</td><td colspan="4"></td></tr>
<tr><td colspan="3" rowspan="2"></td><td colspan="4">End semester exam (ESE):UA PR</td><td>25 marks</td></tr>
<tr><td colspan="4">Internal Continuous Assessment (ICA):CA</td><td>25 marks</td></tr>
<tr><td colspan="8">Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

List of Experiments

1. Introduction to Unity/Unreal Interface and VR setup
2. Create a basic 3D environment (scene, lighting, camera)
3. Implement VR camera rig and headset integration
4. Develop object interaction using controllers (pick & drop)
5. Implement locomotion techniques (teleportation & smooth movement)
6. Design VR UI (menus, buttons, spatial UI elements)
7. Add physics, collision detection, and animations</td></tr>
<tr><td colspan="8">Guide lines for ICA:</td></tr>
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</table>

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

Bachelor of Engineering – Minor
in
Cyber Security
for Third Year Bachelor of Engineering
offered by
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 – V & VI
W.E.F. 2026 – 27

Specialization Minor in "Cyber Security"

Syllabus Structure for Specialization Minor in "Cyber Security": Additional Credit (Semester – V) (w.e.f. 2026 – 27)

(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-512C	Steganography and Digital Watermarking	PCC	3			3	40	60			100	3
CS-513C	Steganography and Digital Watermarking Lab	PCC			2	2			25	25 (PR)	50	1

Syllabus Structure for Specialization Minor in "Cyber Security": Additional Credit (Semester – VI) (w.e.f. 2026 – 27)

(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-614C	Security Assessment and Risk Analysis	PCC	3			3	40	60			100	3
CS-615C	Security Assessment and Risk Analysis lab	PCC			2	2			25	25 (PR)	50	1

STEGANOGRAPHY AND DIGITAL WATERMARKING (PCC)					
COURSE OUTLINE					
Course Title:	**STEGANOGRAPHY AND DIGITAL WATERMARKING (PCC)**	**Short Title:**	**SDW**	**Course Code:**	**CS-512C**

Course description:

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

Prerequisite course(s):

Course objectives:

The objective of this course is to:

1. To understand the fundamentals of steganography and digital watermarking
2. To study various techniques for hiding and protecting information
3. To analyze security, robustness, and attacks on hidden data
4. To explore real-world multimedia security applications

Course outcomes:

After completion of the course, students will be able to:

1. Understand principles of steganography and watermarking
2. Apply various data hiding techniques
3. Analyze multimedia security systems
4. Evaluate robustness and security of hidden data
5. Explore advanced trends in information hiding

COURSE CONTENT

STEGANOGRAPHY AND DIGITAL WATERMARKING		**Semester:**	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

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

Introduction to Information Hiding

Overview of Information Security ,Information Hiding vs Cryptography vs Steganography Steganography Principles and Models ,Characteristics: Imperceptibility, Capacity, Robustness Applications of Steganography and Watermarking

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

Image Steganography Techniques

Spatial Domain Techniques (LSB Method) ,Transform Domain Techniques (DCT, DWT) Steganographic Algorithms and Tools ,Image Formats and Their Impact ,Performance Metrics (PSNR, MSE)

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

Audio and Video Steganography

Audio Steganography Techniques ,Video Steganography Methods ,Compression Effects (MP3, MPEG)

Unit–IV:	No. of Lectures:09 Hours	Marks:12
Digital Watermarking Fundamentals of Digital Watermarking ,Types: Visible, Invisible, Robust, Fragile Watermark Embedding and Extraction ,Applications: Copyright Protection, Ownership Verification		
Unit–V:	**No. of Lectures:09 Hours**	**Marks:12**
Security, Attacks, and Advanced Topics Steganalysis Techniques ,Attacks on Steganography and Watermarking Robustness and Security Evaluation ,Legal and Ethical Issues ,Emerging Trends and Research		
Text Books: 1. Digital Image Steganography and Watermarking – Amine Bouchentouf, Digital Image Steganography and Watermarking, Wiley. 2. Information Hiding Techniques for Steganography and Digital Watermarking – Stefan Katzenbeisser& Fabien Petitcolas, Artech House. 3. Digital Watermarking and Steganography – Ingemar Cox et al., Morgan Kaufmann.		
Reference Books: 1. Multimedia Security – Borko Furht& Darko Kirovski, CRC Press. 2. Handbook of Image and Video Processing – Alan Bovik, Academic Press. 3. Network Security Essentials – William Stallings, Pearson.		
NPTELLinks: https://www.google.com/search?q=STEGANOGRAPHY+AND+DIGITAL+WATERMARKING+NPTL+Course+link		

STEGANOGRAPHY AND DIGITAL WATERMARKING LAB (PCC)					
COURSE OUTLINE					
Course Title:	**STEGANOGRAPHY AND DIGITAL WATERMARKING LAB (PCC)**	**Short Title:**	**SDWL**	**Course Code:**	**CS-513C**
Prerequisite course(s):					

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

COURSE CONTENT			
		Semester:	**V**
Teaching Scheme:		**Examination scheme**	
Lectures:	**2hours/week**		
		End Semester Examination (ESE) UA: PR	**25 marks**
		Internal Sessional Exam (ISE) CA:PR	**25marks**

Concerned faculty member should suitably frame at least SIX Laboratory assignments from the syllabus. Faculty may use following list of experiment as a reference.

List of Experiments

1. Implementation of LSB Image Steganography
2. Image Steganography using DCT/DWT
3. Audio Steganography Techniques
4. Video Steganography Demonstration
5. Watermark Embedding and Extraction
6. Performance Evaluation using PSNR/MSE
7. Steganalysis Tools Study
8. Mini Project on Multimedia Security

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 Practical, paper work and performance in the ESE

SECURITY ASSESSMENT AND RISK ANALYSIS(PCC)					
COURSEOUTLINE					
Course Title:	**SECURITY ASSESSMENT AND RISK ANALYSIS(PCC)**	**Short Title:**	**SARA**	**Course Code:**	**CS-614C**
Course description:					

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

Prerequisite course(s):

Course Objectives:

The objective of this course is to:

1. To understand fundamental concepts of security assessment including CIA triad, threats, vulnerabilities, and risk.
2. To learn risk analysis and risk management techniques used in information security.
3. To study various security assessment techniques such as vulnerability assessment, penetration testing, and security auditing.
4. To analyze network and system security assessment methods including intrusion detection and log analysis.
5. To explore advanced security assessment topics such as cloud security, compliance standards, and incident response through real-world case studies.

Course Outcomes:

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

1. Explain basic security concepts, threats, vulnerabilities, and risk assessment principles.
2. Apply risk analysis and risk mitigation strategies in security management.
3. Perform vulnerability assessment, penetration testing, and security auditing using appropriate tools and methodologies.
4. Analyze network and system security issues and implement system hardening and monitoring techniques.
5. Evaluate cloud security, compliance standards, and incident response strategies using real-world case studies.

COURSECONTENT

SECURITY ASSESSMENT AND RISK ANALYSIS		**Semester:**	**VI**
Teaching Scheme:		**Examination scheme**	
Lectures:	**3 hours/week**	**End Semester Examination (ESE) UA:**	**60 marks**
		Duration of Exam:	**03 hours**
		Internal Sessional Exam (ISE)CA:	**40marks**

Unit–I:	**No.ofLectures: 09 hours**	**Marks:12**

Introduction to Security Assessment

Security concepts, CIA triad, threats, vulnerabilities, risk, security policies and standards.

Unit–II:	**No.ofLectures:09 hours**	**Marks:12**

Risk Analysis and Management

Risk assessment process, qualitative and quantitative analysis, risk mitigation strategies.

Unit–III:	No.of Lectures: 09 hours	Marks:12
Security Assessment Techniques Vulnerability assessment, penetration testing, security auditing, tools and methodologies.		
Unit–IV:	**No. of Lectures:09 hours**	**Marks:12**
Network and System Security Assessment Network vulnerabilities, system hardening, intrusion detection, log analysis.		
Unit–V:	**No. of Lectures:09 hours**	**Marks:12**
Advanced Topics and Case Studies Cloud security assessment, compliance standards, incident response, real-world case studies.		
Text Books:		
1. Mike Chapple, James Stewart, Darril Gibson, CISSP Official Study Guide, Wiley. 2. Nina Godbole, Information Systems Security, Wiley.		
Reference Books: 1. Ross Anderson, Security Engineering, Wiley. 2. Charles P. P fleeger, Security in Computing, Prentice Hall. 3. William Stallings, Network Security Essentials, Pearson.		
NPTEL Links: https://onlinecourses.nptel.ac.in/noc22_mg55/preview		

SECURITY ASSESSMENT AND RISK ANALYSIS LAB (PCC)					
COURSE OUTLINE					
Course Title:	**SECURITY ASSESSMENT AND RISK ANALYSIS LAB (PCC)**	**Short Title:**	**SARAL**	**Course Code:**	**CS-615C**
Course description:					

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

Prerequisite course(s):			
Course Objectives:			
COURSECONTENT			
	Semester:	**VI**	
Teaching Scheme:	**Examination scheme**		
Practical **2 hours/week**			
	End Semester Examination (ESE) UA:PR		**25 marks**
	Internal Continuous Assesment (ICA):CA		**25marks**
	No. of Experiments:08	**Marks:12**	

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. Introduction to Information Security Tools
   Study of security concepts: CIA triad, threats, vulnerabilities, Installation of tools (Kali Linux / Virtual Machine setup), Familiarization with tools like Nmap, Wireshark
2. Network Scanning using Nmap
   Perform host discovery, Port scanning techniques (TCP, SYN, UDP), Service and OS detection
3. Packet Analysis using Wireshark
   Capture network traffic, Analyze protocols (HTTP, TCP/IP, DNS) ,Identify suspicious packets
4. Vulnerability Scanning
   Scan systems using vulnerability scanners, identify common vulnerabilities (CVEs), Generate scan reports
5. Password Cracking Techniques
   Dictionary and brute-force attacks ,Password strength evaluation ,Hash cracking basics
6. Web Application Security Testing
   Identify vulnerabilities like SQL Injection, XSS ,Perform basic web penetration testing
7. Risk Assessment and Analysis
   Identify assets, threats, and vulnerabilities ,Risk calculation (qualitative and quantitative methods) ,Risk mitigation strategies