

Progressive Education Society's
Modern College of Arts, Science and Commerce (Autonomous),
Shivajinagar, Pune 5
(An Autonomous College Affiliated to Savitribai Phule Pune University)

Framework of Syllabus

For

B.Sc. (Computer Science)

(Based on NEP 2020 framework)

(To be implemented from 2023-24)

Semester 1 (First Year)

Course Type	Course	SubjectCode	Course/PaperTitle	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (4+2)	Major Paper 1 (Theory) Section1	23CsCmpU1101	Programming in 'C' and Database Concepts	2	4	40	60	100
	Major Paper 1 (Theory) Section2			2				
	Major Paper 2 (Practical)	23CsCmpU1102	Lab Course on 23CsCmpU1101	4	2	20	30	50
Major Electives	–							
Minor	–							
OE(2+2)	Theory	23CsCopU1401	Computer Fundamentals	2	4	40	60	100
		23CpCopU1402	Democracy, Election and Governance	2				
VSC(2)	Major Specific Practical I	23CsEleU1501	Lab Course on Basic Analog & Digital Electronics	4	2	20	30	50
SEC(2)	Skill Paper 1 (Practical)	23CsStaU1601	Lab Course on Statistical analysis using R programming I	4	2	20	30	50
AEC(2)	MIL	23CpCopU1701/ 23CpCopU1702	MIL-I (Hindi) /MIL-I(Marathi)	2	2	20	30	50
VEC(2)	EVS Theory	23CpCopU1801	Environment Science I	2	2	20	30	50
IKS(2)	Generic IKS	23CpCopU1901	Generic IKS	2	2	20	30	50
CC(2)	CC-I Course	23CpCopU1001	Online Course Based on Yoga	2	2	20	30	50
Total				28	22	220	330	550

Semester 2 (First Year)

Course Type	Course	SubjectCode	Course/PaperTitle	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (4+2)	Major Paper 3 (Theory) Section 1	23CsCmpU2101	Advanced 'C' Programming & Advanced Database Concepts	2	4	40	60	100
	Major Paper 3 (Theory) Section 2			2				
	Major Paper 4 (Practical)	23CsCmpU2102	Lab Course on 23CsCmpU2101	4	2	20	30	50
Major Electives	–							
Minor(2)	Minor Paper I (Practical)	23CsMatU2301	Lab Course on Applied Sciences–I (Numerical Methods Using C)	4	2	20	30	50
OE(2+2)	Theory	23CsCopU2401	Digital Marketing	2	4	40	60	100
		23CpCopU2402	Fundamentals of Music	2				
VSC(2)	Major Specific Practical II	23CsCmpU2501	Lab Course on Scripting Languages	4	2	20	30	50
SEC(2)	Skill Paper II (Practical)	23CsStaU2601	Lab Course on Statistical Analysis using R Programming II	4	2	20	30	50
AEC(2)	English Theory	23CpCopU2703	English Communication Skills I	2	2	20	30	50
VEC(2)	EVS Theory	23CpCopU2801	Environment Science II	2	2	20	30	50
IKS(2)	–							
CC(2)	CC-II Course	23CpCopU2001 / 23CpCopU2011 / 23CpCopU2021 / 23CpCopU2031 / 23CpCopU2041 / 23CpCopU2051 / 23CpCopU2061 / 23CpCopU2071	Physical Education / Cultural Activities / NSS / NCC / Fine Arts / Applied Arts / Visual Arts / Performing Arts	2	2	20	30	50
Total				30	22	220	330	550

Semester 3 (Second Year)

Course Type	Course	SubjectCode	Course/PaperTitle	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (2*4)	Major Paper 5 (Theory+Practical)	23CsCmpU3101	Data Structures(T+P)	2	4	40	60	100
				4				
	Major Paper 6 (Theory)	23CsCmpU3102	Computer Networks	2	2	20	30	50
	Major Paper 7 (Theory) (Major Specific IKS)	23CsCopU1901	Vedic Maths and Computer Fundamentals	2	2	20	30	50
Major Electives	–							
Minor(4)	MinorPaperII (Theory+Practical)	23CsMatU3301	Applied Sciences –II (Discrete Mathematics)	2	4	40	60	100
				4				
OE(2)	Theory	23CsCopU3401	Cyber Security	2	2	20	30	50
VSC(2)	Major Specific Practical III	23CsCmpU3501	Lab Course on Python Programming	4	2	20	30	50
SEC(2)	–							
AEC(2)	EnglishTheory	23CpCopU3703	English Communication Skills II	2	2	20	30	50
VEC(2)	–							
IKS(2)	–							
FP/CEP(2)	FP–I	23CsCmpU3002	Field Project I	4	2	20	30	50
CC(2)	CC-III	23CpCopU3001	Fitness	2	2	20	30	50
Total				32	22	220	330	550

Semester 4 (Second Year)

Course Type	Course	SubjectCode	Course/PaperTitle	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (2*4)	Major Paper 7 (Theory+ Practical)	23CsCmpU4101	Operating System Concepts (T+P)	2	4	40	60	100
				4				
	Major Paper 8 (Theory+ Practical)	23CsCmpU4102	Object Oriented Programming using C++ (T+P)	2	4	40	60	100
				4				
Major Electives	-							
Minor(4)	Minor Paper III (Theory+Practical)	23CsEleU4301	Applied Sciences–III(T+P) Electronic Communication and Instrumentation(T+P)	2	4	40	60	100
				4				
OE(2)	Theory	23CsCopU4401	Web Designing	2	2	20	30	50
VSC(2)	–							
SEC(2)	Skill Paper III (Theory)	23CsStaU4601	Data Mining	2	2	20	30	50
AEC(2)	MIL	23CpCopU4701/ 23CpCopU4702	MIL-II (Hindi) /MIL-II (Marathi)	2	2	20	30	50
VEC(2)	–							
IKS(2)	–							
FP/CEP(2)	CEP–I	23CsCmpU4003	Community Engagement Project	4	2	20	30	50
CC(2)	CC-IV Course	23CpCopU4001	Health and Wellness	2	2	20	30	50
Total				30	22	220	330	550

Semester 5 (Third Year)

Course Type	Course	SubjectCode	Course/PaperTitle	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (2*4+2)	Major Paper 9 Section 1 (Theory)	23CsCmpU5101	Web Technology & Programming in Core Java	2	4	40	60	100
	Major Paper 9 Section 2 (Theory)			2				
	Major Paper 10 Section 1 (Theory)	23CsCmpU5102	Object Oriented Software Engineering & Theory of Computer Science	2	4	40	60	100
	Major Paper 10 Section 2 (Theory)			2				
	Major Paper 11 (Practical)	23CsCmpU5103	Lab Course on 23CsCmpU5101	4	2	20	30	50
Major Electives	Elective I (Theory+Practical)	23CsCmpU5201	Android Programming(T+P)	2	4	40	60	100
				4				
	Elective I (Theory+Practical)	23CsMatU5202	Operations Research(T+P)	2	4	40	60	100
				4				
	Elective I (Theory+Practical)	23CsEleU5203	Intel 8051 and AVR Microcontrollers(T+P)	2	4	40	60	100
				4				
Minor(4)	Minor Paper IV (Theory+ Practical)	23CsMatU5301	Applied Sciences–IV(T+P) (Linear Algebra)	2	4	40	60	100
				4				
OE(2)	–							
VSC(2)	Major Specific Practical V	23CsEleU5501	Lab Course on Raspberry Pi Programming & Computer Maintenance	4	2	20	30	50
SEC(2)	–							
AEC(2)	–							
VEC(2)	–							
IKS(2)	–							
FP/CEP(2)	FP–II	23CsCmpU5002	Field Project II	4	2	20	30	50
Total				32	22	220	330	550

Semester 6 (Third Year)

Course Type	Course	SubjectCode	Course/PaperTitle	Hours /Week	Credit	CIA	ESE	Total
Major Mandatory (2*4+2)	Major Paper12 Section 1 (Theory)	23CsCmpU6101	System Programming & Programming in Advanced Java	2	4	40	60	100
	Major Paper12 Section 2 (Theory)			2				
	Major Paper13 Section1 (Theory)	23CsCmpU6102	Software Project Management & Introduction to Data Science	2	4	40	60	100
	Major Paper13 Section 2 (Theory)			2				
	Major Paper 14(Practical)	23CsCmpU6103	Lab Course on 23CsCmpU6101	4	2	20	30	50
Major Electives	Elective II (Theory +Practical)	23CsCmpU6201	Big Data Analytics(T+P)	2	4	40	60	100
				4				
	Elective II (Theory+Practical)	23CsMatU6202	Computational Geometry(T+P)	2	4	40	60	100
				4				
	Elective II (Theory +Practical)	23CsEleU6203	Embedded systems(T+P)	2	4	40	60	100
				4				
Minor(4)	Minor Paper V (Theory+ Practical)	23CsEleU6301	Applied Sciences –V (T + P) Advanced Communication and IoT Based Instrumentation	2	4	40	60	100
				4				
OE(2)	–							
VSC(2)	–							
SEC(2)	–							
AEC(2)	–							
VEC(2)	–							
OJT(4)	OJT	23CsCmpU6004	On Job Training	8	4	40	60	100
FP/CEP(2)	–							
Total				32	22	220	330	550

SEMESTER - V

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU5101
Course Name: Section 1: Web Technology

Teaching Scheme: TH: 2 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Prerequisite Courses:

- One must have knowledge of HTML, CSS very well.

Course Objectives:

- Learn Basics of PHP
- Learn Database Connectivity with PostgreSQL/MySQL etc.
- Learn Web Techniques such as Session, Cookies
- Learn Client Side Scripting Language such as JavaScript, DHTML
- Learn AJAX to make the Web applications more dynamic
- Learn UI/UX Design for web Pages.
- Learn Server side framework such as Nodejs

Course Outcomes:

- Students should be able to design attractive web pages using HTML, CSS & PHP.
- Students should be able to implement Database Connections.
- Students should be able to design dynamic web sites / web apps using JavaScript, Nodejs etc.

CO No	Course Outcomes (Cos)	Blooms Cognitive level
1	Recall and revise the HTML, CSS to design attractive forms	1
2	Understand the basics of Language construct	2
3	Apply the basics and build applications using PHP(Array, string and functions)	3
4	Simplify Database connectivity method	4
5	Compare and analyze Classical web model with AJAX Web model	5
6	Create NodeJs registration and CURD operations	6

Course Contents:

Unit 1	PHP Basics	5 lectures
	1.1 Introduction to PHP 1.2 HTTP basics, Introduction to Web Server and Web Browser 1.3 Defining and Calling function 1.4 Default Parameter 1.5 Variable parameters, Missing parameter 1.6 Anonymous function, Variable function 1.7 Types of Strings in PHP 1.8 Inbuilt String functions 1.9 Perform different operations on Strings 1.10 String Validation 1.11 Regular Expression 1.12 Introduction to Array 1.13 Types of Array	
Unit 2	Database Programming using PHP	3 lectures
	2.1 Database connectivity 2.2 Different operations on database.	
Unit 3	Web Designing Technologies JavaScript, DHTML	5 lectures
	3.1 Overview of JavaScript, DHTML 3.2 Object Orientation and JavaScript 3.3 Basic Syntax (JS data types, JS variables) 3.4 Primitives, Operations and Expressions 3.5 Screen Output and keyboard input (Verification and Validation) 3.6 JS Control statements 3.7 JS Functions 3.8 JavaScript HTML DOM Events (onmouseup, onmousedown, onclick, onload, onmouseover, onmouseout). 3.9 JS Strings. 3.10 JS String methods 3.11 JS popup boxes (alert, confirm, prompt). 3.12 Changing property value of different tags using DHTML (Example: Adding innerhtml for DIV tag, Changing source of image etc.).	
Unit 4	Session and Cookies using PHP	3 lectures
	4.1 HTTP vs HTTPS 4.2 Session Handling 4.3 Cookies Handling 4.4 Difference between Session and Cookies	
Unit 5	PHP using AJAX	3 lectures
	5.1 Introduction of AJAX 5.2 AJAX web application model 5.3 AJAX –PHP framework 5.4 Performing AJAX validation 5.5 Handling XML data using php and AJAX 5.6 Connecting database using php and AJAX	
Unit 6	Introduction to UI/UX	4 lectures

	6.1 Design Fundamentals, User Flows and Navigation 6.2 Identify the project parameters 6.3 User personas, storyboards 6.7 Workflow for designing a site 6.8 UXD Principles 6.9 Visual design, Focal point , Flow and Interaction, Responsive Web Pages	
Unit 7	Node.js introduction	7 lectures
	7.1 Introduction to Node.js 7.2 Node.js modules 7.3 Node.js Events 7.4 Rest API 7.5 NodeJSDatabase connection	

Reference Books:

1. Programming PHP By Rasmus Lerdorf and Kevin Tatroe, O'Reilly publication
2. Beginning PHP 5 ,Wrox publication
3. Mastering PHP , BPB Publication
4. PHP for Beginners, SPD publication
5. Programming the World Wide Web , Robert W Sebesta(3rdEdition)
6. Javascript , The Complete reference.
7. AJAX Black Book Kogent solution
8. www.php.net.in
9. www.wrox.com
10. Learning Node: Moving to Server-side by Shelley Powers, O'Reilly, ISBN-13: 978-1491943120
11. Getting MEAN with Mongo, Express, Angular and Node by Simon Holmes, Manning Publications, ISBN-13: 978-1617292033
12. Programming JavaScript Applications Robust Web Architecture with Node, HTML5 and Modern JS Libraries by Eric Elliot,O'Reilly, ISBN-13: 978-1491950296
13. Don't Make me think, Revisited: A Common sense Approach to Web Usability by Steve Krug, New Riders, ISBN-13: 978-0321965516

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**T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)**

**Course Code: 23CsCmpU5101
Course Name: Section 2: Programming in Core JAVA**

**Teaching Scheme: 2 Lectures/Week
Examination Scheme: CIA : 20 Marks**

**Credits: 2
End-Sem: 30 Marks**

Prerequisite:

Basic knowledge of Object Oriented Programming language.

Course Objectives:

- To understand the fundamentals of object-oriented programming in Java
- To understand the concept and importance of Exception Handling
- To understand basic screen design with Swing
- To understand User Interface Components with Swing
- To understand features of JavaFX

Course Outcomes:

On completion of the course, Students will be able to:

CO No	Course Outcomes(COs)	Blooms Cognitive level
1	Recall and explore the basic syntax of Object Oriented Programming features	1
2	Demonstrate robust application using Core Java features	2
3	Implement basic GUI based application	3
4	Analyze the proficiency in Exception Handling	4
5	Evaluate and develop applications with File handling	5
6	Create interactive applications that leverage user input/output and visual interfaces, combining knowledge of Java and related libraries/frameworks.	6

Course Contents:

Unit 1	An Introduction to Java	4
	1.1 Overview of Java Concepts 1.1.1 What Can Java Do? 1.1.2 Characteristics/Buzzwords of Java 1.1.3 Advantages and Disadvantages of Java 1.2 Comparison of Java and C++ 1.3 Java Environment and IDEs 1.4 Java Tools 1.4.1 jdb (Java Debugger) 1.4.2 javap (Class File Disassembler) 1.4.3 javadoc (Java Documentation Generator) 1.5 Data Types and Variables 1.6 Operators 1.7 Expressions, Statements, and Blocks 1.8 Control Flow Statements 1.9 Wrapper Classes 1.10 Writing a Simple Java Program	
Unit 2	Usage of Input/ Output and File Handling	3
	2.1 Basic I/O 2.1.1 Reading Input 2.1.2 Writing Output 2.2 File Handling	
Unit 3	Objects and Classes	6
	3.1 Defining Your Own Classes 3.2 Access Specifiers (public, protected, private, default) 3.3 Array of Objects 3.4 Constructor, Overloading Constructors and use of 'this' Keyword 3.5 Usage of static block, static fields and static methods 3.6 Inner class, anonymous class 3.7 Garbage Collection	
Unit 4	Inheritance, Abstract class, Interface	4
	4.1 Inheritance Basics 4.1.1 Understanding the 'extends' Keyword 4.1.2 Types of Inheritance 4.2 Usage of final Keyword and Abstract class 4.2.1 final with Methods 4.2.2 final with Classes 4.2.3 Abstract Classes and Abstract Methods 4.3 Interfaces	
Unit 5	Exception Handling	5
	5.1 Dealing with Errors and Exceptions 5.1.1 Understanding Errors vs. Exceptions 5.1.2 Common Causes of Exceptions 5.2 Exception Class and Types of Exceptions 5.2.1 The Exception Class Hierarchy 5.2.2 Checked Exceptions 5.2.3 Unchecked Exceptions 5.3 Exception Handling Blocks	

	5.3.1 try Block 5.3.2 catch Block 5.3.3 throw Keyword 5.3.4 throws Keyword 5.3.5 finally Block 5.4 Creating User-Defined Exceptions 5.4.1 Defining Custom Exception Classes 5.4.2 Throwing Custom Exceptions	
Unit 6	User Interface Components with Swing, Introduction to JavaFX	8
	6.1 Introduction to Swing 6.2 Understanding MVC (Model-View-Controller) Architecture 6.3 Usage of Layout Managers 6.3.1 FlowLayout 6.3.2 BorderLayout 6.3.3 GridLayout 6.4 Swing Components 6.4.1 JButton 6.4.2 JLabel 6.4.3 JTextField 6.4.4 JTextArea 6.4.5 JCheckBox 6.4.6 JRadioButton 6.4.7 JList 6.4.8 JComboBox 6.4.9 JMenu and JMenuItem 6.4.10 JPopupMenu 6.4.11 JCheckBoxMenuItem 6.4.12 JRadioButtonMenuItem 6.5 Event Handling in Swing 6.5.1 Event Sources 6.5.2 Mouse Events 6.5.3 Keyboard Events Event Listeners: ActionListener, MouseListener and MouseMotionListener. KeyListener 6.6. Introduction to JavaFX 6.6.1 What is JavaFX? 6.6.2 Key Features of JavaFX	

Reference books:

1. Java The Complete Reference - Eleventh Edition, Herbert Schildt, Tata Mc Graw Hill, ISBN-13 :978-9390491629
2. Programming with Java | 6th Edition, E Balagurusamy, ISBN-13 : 978-9353162344
3. Core Java: Fundamentals, Volume I, 10th Edition, Cay S. Horstmann, Prentice Hall ISBN-13: 978-0134177304

Reference link:

<https://docs.oracle.com/javase/8/>

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU5102
Course Name: Section 1: Object Oriented Software Engineering

Teaching Scheme: TH: 2 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Prerequisite Courses:

- Knowledge of Software Engineering practices

Course Objectives:

- To get knowledge and understanding of Object Oriented Software Engineering disciplines, practices and pedagogy.
- To learn Analysis, Design principles for Object Oriented Software Project Development.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Understand and describe the basic principles of Software Engineering and Object-Oriented Software Engineering.	1
CO 2	Compare Object-Oriented Software Engineering with traditional software engineering approaches and identify key differences.	2
CO 3	Apply structural UML diagrams (e.g., class diagrams, object diagrams) to model system components and relationships.	3
CO 4	Analyze system behavior using sequence, activity, and state diagrams to evaluate and predict system performance and flow.	4
CO 5	Evaluate system architecture using component and deployment UML diagrams to assess the effectiveness of hardware and software deployment.	5
CO 6	Create UML diagrams from real-world case studies to represent complex systems and their behavior accurately.	6

Course Contents:

Unit 1	Introduction to Object-Oriented Software Engineering	07 lectures
	1.1 Overview of Software Engineering 1.2 Object-Oriented Software Engineering vs. Traditional Software Engineering 1.3 Object-Oriented Concepts: Abstraction, Encapsulation, Inheritance, Polymorphism 1.4 Software Development Life Cycle (SDLC) in Object-Oriented Context 1.5 Introduction to Unified Modeling Language (UML): Concept and advantages	
Unit 2	UML Diagrams – Structural Modeling	07 lectures
	2.1 Classes, attributes, operations, relationships (association, aggregation, composition, dependency, generalization) 2.2 Advanced Classes 2.3 Advanced Relationship 2.4 Interface 2.5 Class Diagram 2.6 Object Diagram – Object instances and their relationships 2.7 Case study of each (Minimum Two)	
Unit 3	UML Diagrams – Behavioral Modeling	10 lectures
	3.1 Sequence Diagram – Interaction between objects over time (lifelines, messages, activation bars) 3.2 Use Case Diagram – Actors, use cases, relationships (include, extend, generalization) 3.3 Interaction Diagram 3.4 Activity Diagram – Workflow representation, decision nodes, swimlanes 3.5 State Diagram – States, transitions, events, initial & final states 3.6 Case study of each (Minimum Two)	
Unit 4	UML Diagrams – Architectural Modeling	06lectures
	4.1 Collaboration Diagram – Object interactions represented as links between objects 4.2 Component Diagram – Software components, dependencies, interfaces 4.3 Deployment Diagram – Hardware and software deployment, nodes, artifacts 4.4 Case study of each (Minimum Two)	

Reference Books:

1. The Unified Modeling Language, User Guide by Grady Booch, James Raumbaugh, Ivar Jacobson, ISBN: 0321267974.
2. Object Oriented Software Engineering by Ivar Jacobson, ISBN: 9780201544350
3. Software Engineering by Roger S. Pressman, ISBN: 9780078022128
4. Applying UML and Patterns by Craig Larman, ISBN-10: 8177589792

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU5102
Course Name: Section 2:Theory of Computer Science

Teaching Scheme: TH: 2 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Prerequisite Courses:

- Sets, Operations on sets, Finite & infinite sets Formal Language
- Relation, Equivalence Relation,(reflexive, transitive and symmetric closures)

Course Objectives:

- To have an understanding of finite state and push down automata.
- To have a knowledge of regular languages and context free languages.
- To know the relation between regular language, context free language and corresponding recognizers.
- To study the Turing machine and classes of problems.

Course Outcomes:

After successful completion of this course students will able to :

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Define basic concepts in formal language theory, grammars, automata theory and computability theory Explain the relationship among language classes and grammars with the help of Chomsky Hierarchy	1
CO 2	Apply mathematical and formal techniques for solving problems in computer science.	2
CO 3	Relate practical problems to languages, automata, computability, and complexity	3
CO 4	Demonstrate abstract models of computing, including deterministic (DFA), non-deterministic (NFA), Push Down Automata (PDA) and Turing (TM) machine models and their power to recognize the languages.	4
CO 5	Apply formal mathematical methods to prove properties of languages, grammars and automata.	5
CO 6	Model various kinds of real-time problems such as designing the compilers.	6

Course Contents

Chapter 1	Introduction	1 lecture
	1.1 Symbol, Alphabet, String 1.2 Prefix & Suffix of Strings 1.3 Formal Language 1.4 Operations on Languages	
Chapter 2	Finite Automata	8 lectures
	2.1 Deterministic finite Automaton – Definition, DFA as language recognizer, 2.2 Nondeterministic finite automaton – Definition and Examples. 2.3 NFA TO DFA : Method 2.4 NFA with ϵ - transitions Definition and Examples. 2.5 NFA with ϵ -Transitions to NFA without ϵ -Transitions & Examples 2.6 Finite automaton with output – Mealy and Moore machine, Definition and Examples. 2.7 Minimization of DFA, Algorithm & Problem using Table Method	
Chapter 3	Regular Languages	4 lectures
	3.1 Regular language-Definition and Examples. 3.2 Conversion of RE To FA-Examples. 3.3 Pumping lemma for regular languages and Applications	
Chapter 4	Context Free Grammar and Languages	10 lectures
	4.1 Grammar - Definition and Examples 4.2 Derivation-Reduction - Definition and Examples 4.3 Chomsky Hierarchy. 4.4 CFG: Definition & Examples. LMD, RMD, Parse Tree 4.5 Ambiguous Grammar: Concept & Examples. 4.6 Simplification of CFG: 4.6.1 Removing Useless Symbols 4.6.2 Removing unit productions 4.6.3 Removing ϵ productions & Nullable symbols 4.7 Normal Forms : 4.7.1 Chomsky Normal Form (CNF) Method & Problem 4.7.2 Greibach Normal form (GNF) Method & Problem	
Chapter 5	PushdownAutomaton	4lectures
	5.1 Definition of PDA and examples 5.2 Construction of PDA using empty stack and final State method : Examples using stack method 5.3 Definition DPDA & NPDA, their correlation and Examples ofNPDA	
Chapter 6	Turing Machine	3 lectures
	6.1 The Turing Machine Model and	

	Definition of TM 6.2 Design of Turing Machines 6.3 Problems on language recognizers. 6.4 Language accepted by TM	
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References:

1. John E. Hopcraft, Rajeev Motwani, Jeffery D. Ullman, "Introduction to Automata Theory, Languages & Computations", ISBN: 978-0321455369, Pearson publication, Third edition
2. K. L. P. Mishra, N. Chandrasekaran, "Theory of Computer Science", ISBN: 9788120329683, Published by Prentice-Hall of India Pvt.Ltd , Third edition.
3. Daniel A. Cohen, "Introduction to Computer Theory", ISBN: 978-0471137726, John Wiley & Sons; 2nd Revised edition edition.

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU5103
Course Name: Lab Course on 23CsCmpU5101

Teaching Scheme: PR: 4 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Course Objective:

- To understand the process of designing and implementing applications with Core Java features.
- Revise and implement different technologies used at client Side Scripting Language such as HTML, CSS, Javascript

Sr. No.	Assignment Name
1	PHP Database Programming
2	JavaScript Programming
3	Session and Cookies using PHP
4	Ajax with PHP
5	Login and Registration form using Node.js
6	Node.js different operations on database.
7	Simple Java programs and File handling
8	Objects and Classes
9	Inheritance
10	Exception Handling
11	Usage of Swing components
12	Simple Java programs and File handling
13	Objects and Classes

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU5201
Course Name: Elective 1:Android Programming

Teaching Scheme: TH: 2 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Prerequisite Courses:

- Knowledge of Java
- Basic knowledge of XML

Course Objectives:

- Understand the Android platform, architecture, and components.
- Design interactive user interfaces using XML and Android UI components.
- To learn to create Android Applications.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Bloom's Cognitive Level
CO 1	Recall the fundamental concepts of Android programming, including components, Android architecture.	1
CO 2	Illustrate basic Android applications with various UI components and features like buttons, text fields, and images and event handling.	2
CO 3	Applying programming concepts in creating Android applications using event handling ,activities, fragments and intents, services, broadcast receivers, threads.	3
CO 4	Analyze and troubleshoot Android applications to identify issues. Examine the life cycles of Activities and fragments.	4
CO 5	Determine use of Google Maps,SMSand multimedia in Android application	5
CO 6	Design and implement mobile applications involving data storage in SQLite database	6

Course Contents:

Unit 1	Introduction to Android OS	No of lectures
	1.1 What is Android 1.2 Features of Android 1.3 History and Versions 1.4 Android Architecture 1.5 Dalvik VM 1.6 Core Building Blocks	2
Unit 2	Creating Android Application	No of lectures
	2.1 Creating Android project 2.3 Project Structure 2.4 AndroidManifest.XML 2.5 Android Virtual Devices(AVDs) 2.6 Emulators	2
Unit 3	Activities, Fragments and Intents	No of lectures
	3.1 Introduction to Activities 3.2 Activity Lifecycle 3.3 Introduction to Intents and types 3.4 Linking Activities using Intents 3.5 Broadcast receivers 3.6 Using Intents to broadcast events 3.7 Introduction to Fragments 3.8 Lifecycle of Fragment 3.9 Threads and Services 3.10 Toast	10
Unit 4	Building User Interfaces	No of lectures
	4.1 Fundamentals of UI design - Views, View Groups, fragments, activities 4.2 Layout manager - LinearLayout - RelativeLayout - ConstraintLayout - FrameLayout: - GridLayout: - TableLayout - ScrollView 4.3 Designing your user interface with views - TextView - Button, - ImageButton, - EditText - CheckBox - ToggleButton, - RadioButton, and RadioGroup Views - ProgressBar - AutoCompleteTextView - List View - Spinner	10

	• ImageView • Menus • TimePicker and DatePicker View • Dialogs	
Unit 5	Databases – SQLite, Messaging, Location-Based Services and Multimedia	No of lectures
	5.1 Introducing ANDROID databases: SQLite Databases and content providers 5.2 Introduction to SQLite 5.3 Working with SQLite • Building and executing queries 5.4 SMS telephony 5.5 Google Maps • Display Google Maps • Getting Location Data • Navigating to specific location 5.6 Multimedia • Play Audio and Video 5.7 Android App project ideas	6

Reference Books:

1. Head First Android Development, 3rd Edition by Dawn Griffiths, David Griffiths, O'Reilly Media, ISBN: 9781492076476
2. Android Programming for Beginners - Second Edition by John Horton, Packt Publishing , ISBN 978-1789538502
3. Android by Prasanna Kumar Dixit, Vikas Publishing House, ISBN 9789325977884

Websites:

1. The official site for Android developers - <https://developer.android.com>
2. <https://abhiandroid.com/>
3. <https://www.tpointtech.com/android-tutorial>

MOOC Course link:

<https://nptel.ac.in/courses/106106147>

<https://www.digimat.in/nptel/courses/video/106106147/L07.html>(and next lessons)

Progressive Education Society's
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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU5201
Course Name: Elective 1: Lab Course on Android Programming

Teaching Scheme: PR: 4 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisite Courses:

- Knowledge of programming in Java
- Knowledge of XML
- Understanding of core Android components

Course Objectives:

- Learn how to set up Android Studio and use its features for efficient Android app development.
- Practice using Android Studio's tools like the emulator, and the UI designer.
- Create interactive user interfaces with UI components such as buttons, text fields, images etc. and perform event handling.
- Implement navigation using Activities and Fragments.
- Design and implement mobile applications involving data storage in SQLite database
- Use location-based services, multimedia in developing applications

Course Contents:

Sr.No	List of practical
1	Android Installation and Introduction to Android Studio
2	Running Simple Hello World
3	Applying different Layouts
4	Activity and Intent
5	User Interface and Event Handling
6	ImageSwitcher
7	Spinner
8	Custom Toast
9	TimePicker, DatePicker,
10	Alert Dialog
11	Menus
12	Multimedia: Play audio, video
13	Location-Based Services and Google Maps
14	Databases – Sqlite

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsMatU5202
Course Name: Elective 1: Operations Research

Teaching Scheme: TH: 2 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Prerequisites: Matrices, Graphs, Linear Inequations.

Course Objectives: To study

- Linear Programming Problems.
- Assignment Models.
- Transportation Models.

Course Outcomes:

On completion of the course, student will be able to:-

- Find optimum solution to Linear Programming Problem
- Find IBFS of Transportation Problem
- Find optimum solution of Transportation Problem
- Find optimum solution of Assignment Problem

Course Contents:

Chapter 1	Linear Programming Problem I • Theory of Linear Programming, Slack and surplus variables • Standard form of LPP, Some important definitions, • Assumptions in LPP, Limitations of Linear programming, Applications of Linear programming, Advantages of Linear programming Techniques. • Simplex method, Big-M-method.	8 Hours
Chapter 2	Linear Programming Problem II • Special cases of LPP: Alternative solution, Unbounded solution, Infeasible solution. • Duality in Linear Programming, Primal to dual conversion, Examples.	6 Hours
Chapter 3	Transportation Models • Introduction, Tabular representation. • Methods of IBFS: North-West rule, Matrix-minima, Vogel's Approximation), Algorithms. • The Optimality Test of Transportation Model: Modified Distribution method	10 Hours
Chapter 4	Assignment Models • Assignment Model - Introduction. • Hungarian method for Assignment problem.	6 Hours
Total No. of Hours		30

Reference Books:

- 1) Operation Research (12th Edition), by S. D. Sharma.
- 2) Operations Research: An Introduction, by Hamdy A. Taha, Pearson (9th Edition), 2014.
- 3) Operations Research by Gupta and Hira, S. Chand, 2015.
- 4) Operation Research: Theory and Applications, by J. K. Sharma, 4th Edition, 2017.

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsMatU5202

Course Name: Elective 1: Lab Course on Operations Research

Teaching Scheme: PR: 4 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisites: Matrices, Graphs, Linear Inequations.

Course Objectives: To study

- Linear Programming Problems.
- Assignment Models.
- Transportation Models.

Course Outcomes:

On completion of the course, student will be able to:-

- Find optimum solution to Linear Programming Problem
- Find IBFS of Transportation Problem
- Find optimum solution of Transportation Problem

Find optimum solution of Assignment Problem

Course Contents:

	List of Practical	60 Hours
Practical 1	Standard and Canonical forms of LPP	
Practical 2	Simplex Method	
Practical 3	Big-M Method	
Practical 4	Special Cases of LPP	
Practical 5	Duality in LPP	
Practical 6	Drawing Feasible region of LPP (Using Python)	
Practical 7	Solution of Linear Programming Problem (Using Python)	
Practical 8	North West Corner Method	
Practical 9	Matrix Minima Method	
Practical 10	Vogel's Approximation Method	
Practical 11	Modified Distribution Method	
Practical 12	Solution of Transportation Problem (Using Python)	
Practical 13	Assignment Problem – I	
Practical 14	Assignment Problem – II (Special Cases)	
Practical 15	Solution of Assignment Problem (Using Python)	

Note: For every batch there will be 4 hours for each practical session per week.

Reference Books:

- 1) Operation Research (12th Edition), by S. D. Sharma.
- 2) Operations Research: An Introduction, by Hamdy A. Taha, Pearson (9th Edition), 2014.
- 3) Operations Research by Gupta and Hira, S. Chand, 2015.
- 4) Operation Research: Theory and Applications, by J. K. Sharma, 4th Edition, 2017.

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsMatU5203

Course Name: Elective 1 Intel 8051 and AVR Microcontroller

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisites: Basic knowledge of Digital Electronics and C programming

Course Outcomes:

- Understand the architecture and operation of the 8051
- Understand the architecture and operation of the AVR microcontrollers.
- Develop assembly programming skills for these microcontrollers.
- Capable to write embedded C programming for these microcontrollers.
- Develop interfacing skills for peripherals such as LCD, Keypad, ADC, DAC, motors, and sensors.
 - Implement 8bit embedded system applications using 8051 and AVR.

Course Contents

Chapter 1	Introduction to Microcontrollers	8 Hrs
	Microprocessors vs. Microcontrollers, Classification and applications of microcontrollers, Comparison of different microcontroller families (8051, AVR, PIC, ARM) Architecture & Features Intel 8051 architecture, Internal memory organization (RAM, ROM), Special function registers (SFRs), I/O ports and pin configuration, Timers and Counters, Interrupts.	
Chapter 2	Instruction Set, Interfacing and Programming	10 Hrs
	Assembly language programming:- Addressing modes, Instruction set, assembler directives(ORG,DB, END),Delay generation using loops and timers Peripheral Interfacing:- LED, Seven-Segment Display, LCD and Keypad, Serial Communication (UART),Timer-based delay generation.	
Chapter 3	AVR Microcontroller Architecture & Features	4 Hrs
	AVR family overview (ATmega series), Harvard architecture and RISC features, Memory organization (Flash, EEPROM, SRAM), GPIO structure and pin configurations	
Chapter 4	Programming & Development	8 Hrs

	Introduction to AVR Studio & Atmel Studio, Embedded C programming for AVR:- I/O operations and delays, Timers and interrupts Peripheral Interfacing: ADC and DAC, PWM generation, Serial communication (USART, SPI, I2C), DC motor and stepper motor interfacing, Real-time clock (RTC) interfacing.	
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Text/ Reference Books:

1. **"The 8051 Microcontroller and Embedded Systems"** – Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin McKinlay, Pearson publisher, 2nd edition.
2. **"AVR Microcontroller and Embedded Systems"** – Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Pearson publisher, 2nd edition.
3. **"Microcontroller Theory and Applications with the PIC18F"** – M. Rafiquzzaman, John Willey publisher, 1st edition.
4. **Datasheets and Application Notes from Intel (8051) and Atmel (AVR)**

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsMatU5203

Course Name: Elective 1: Lab Course Intel 8051 and AVR microcontroller

Teaching Scheme: PR: 4 Hours/Week

Examination Scheme: CIA: 20 Marks

Credit: 02

End-Sem: 30 Marks

Prerequisites: Basic knowledge of Digital Electronics and C programming

Course Outcomes:

- Understand the architecture and operation of the 8051 and AVR microcontrollers.
- Learn assembly and embedded C programming for these microcontrollers.
- Develop interfacing skills for peripherals such as LCD, Keypad, ADC, DAC, motors, and sensors.
- Implement embedded system applications using 8051 and AVR.

List of Practical

1. Basics of assembly program: basic arithmetic and logical instruction handling Code conversion, Equal length array addition, Array sorting.
2. Study of LED interfacing to 8051 and programme for LED blinking using 8051
3. Study of SSD interfacing and programming using 8051 as rolling display.
4. Study of Interfacing thumb wheel switch and SSD and programming of 8051
5. Study of LCD interfacing and its programming using 8051
6. Create a simple serial communication program to send characters between the 8051 and PC.
7. Study of waveform generations using DAC 8051.
8. Basics of AVR programming (I/O, Arithmetic and Logic).
9. Program to convert Packed BCD number into ASCII and ASCII to BCD using instruction Set of AVR.
10. Study for PWM Generation for speed control of DC motor using AVR.
11. Study of ADC interfacing and sensor reading using AVR.
12. Study the I2C EEPROM interfacing with AVR.
13. Study of SPI based RTC interfacing to AVR.
14. Study to interface of IR modules as object detector using AVR.
15. Building a mini project (e.g., temperature monitoring system) 8051/AVR (weightage of 3 practical).

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsMatU5301
Course Name: Applied Sciences -IV (Linear Algebra)

Teaching Scheme: TH: 2 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Prerequisites: Vectors, Functions, Polynomials, Matrices, Determinant.

Course Objectives: To study

- System of linear equations
- Vector spaces
- Linear transformations
- Eigenvalues and Eigenvectors.

Course Outcomes: On completion of the course, student will be able to:-

- Identify whether a given set of objects is a vector space or not.
- Solve system of linear equations
- Check whether given set of vectors is linearly independent or not
- Find eigenvalues and eigenvectors of a square matrix.
- Find a matrix of general linear transformation.
- Apply concepts learnt in this course to solve some real world problems arising out as an application of linear algebra.

Course Contents:

Chapter 1	System of linear equations	06 hours
	• Row reduction and echelon form of a matrix • The matrix equation $Ax=b$ • Solution sets of Linear systems (Gauss elimination method, Gauss –Jordan elimination method)	
Chapter 2	Euclidean Vector Spaces	10 hours
	• Real Vector Spaces. $(R, R^2, R^3, \dots, R^n)$ • Subspaces. • Linear Independence. • Basis and Dimension. • Row Space, Column Space and Null space. • Rank and Nullity.	
chapter 3	Linear Transformations	06 hours
	• General Linear Transformations. • Kernel and Range (Rank Nullity Theorem). • Matrix of general Linear Transformations.	
Chapter 4	Eigenvalues and Eigenvectors	08 hours
	• Eigenvalues and Eigenvectors. • Diagonalization. • Quadratic Forms.	
Total No. of Hours		30

Reference Books:

- 1) Elementary Linear Algebra (Applications Version) by Howard Anton, Chriss Rorres, John Wiley and Sons Inc.(Ninth edition), 2010 .
- 2) Linear Algebra and Its Applications by David Lay, Steven Lay and Judi McDonald, Pearson, Fifth edition.
- 3) Introduction to Linear Algebra, S. Lang, Springer-Verlag (Second edition), 1986.
- 4) Linear Algebra by K. Hoffmann and R. Kunze, Prentice Hall of India (Second edition), 1998.

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsMatU5301

Course Name: Lab course on Raspberry Pi and Computer maintenance

Teaching Teaching Scheme: PR: 4 hrs / Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisites: Basic knowledge of Digital Electronics and C programming

Course Objectives: This course will enable the students to:

1. Learn basic python programming.
2. Learn interfacing with Raspberry Pi.
3. Learn general input and Output connection.
4. Understand and apply Python syntax and semantics in program development.

Course Outcomes: At the end of the course the student should be able to:

1. Understand the architecture and operation of the Raspberry PI.
2. Develop interfacing skills for peripherals such as LCD, Keypad, ADC, DAC, motors, and sensors.
3. Implement embedded system applications using Raspberry PI.
4. Utilize Python & built-in data structures such as lists, tuples, sets, and dictionaries effectively.
5. Setting up the development environment.

Course Contents:(Any 12)

1. Program the Raspberry Pi to control light emitting diodes (LEDs) and to get feedback from a switch connected to the GPIO pins.
2. Program the Raspberry Pi to get the temperature from a sensor connected to the GPIO pins.
3. Program the Raspberry Pi to control light emitting diodes (LEDs) attached to the GPIO pins.
4. Program the Raspberry Pi to detect room light from a photocell sensor connected to the GPIO pins.
5. Program the Raspberry Pi for Motion detection using Raspberry pi.
6. Program the Raspberry Pi for interfacing the Camera to grab the image.
7. Program the Raspberry Pi for water level monitor.
8. To Interface LED/Buzzer with Raspberry PI
9. To interface Push Button / Digital Sensor (IR/LDR) with Raspberry PI
10. To interface DHT11 sensor with Raspberry PI
11. To interface DC motor using relay with Raspberry PI
12. To interface Bluetooth module with Raspberry pi.
13. Program the Raspberry Pi for interfacing the DHT11 sensor.
14. Program the Raspberry Pi for interfacing the Ultrasonic sensor.
15. Program the Raspberry Pi for interfacing PIR sensor.

SEMESTER - VI

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU6101
Course Name: Section 1: System Programming

Teaching Scheme: TH: 2 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Prerequisite Courses:

- Students should have basic knowledge of C Programming and Basic and Advanced Data structures

Course Objectives:

- To understand the design and implementation challenges of system programs essential for program development.
- To explore various elements of the programming environment.
- To comprehend and design the structure of an assembler.
- To understand the structure and functionality of a macro preprocessor.
- To learn the fundamental working principles of linkers and loaders.
- To analyze the complexity of an operating system as a software system.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Differentiate between system programs and application programs.	1
CO 2	Explain various system programs, including Editors, Simulators, Assemblers, Macro Assemblers, Loaders, and Linkers.	2
CO 3	Design and implement system programs such as Editors, Simulators, Assemblers, Macro Assemblers, and DFA drivers.	3
CO 4	Analyze the structure and working of Assemblers and Macro Processors.	4
CO 5	Evaluate the role of linkers and loaders in program execution.	5
CO 6	Demonstrate an understanding of the complexity of operating systems as software.	6

Course Contents:

Unit 1	Introduction	8 lectures
	1.1 Types of program – System program and Application program. 1.2 Elements of Programming environment - Editor, Preprocessor, Assembler, Compiler, Interpreter, Linker and Loader, Debugger, Device drivers, Operating System. 1.3 Need/purpose of editor, Types of editor, Structure of editor 1.4 Simulation of simple computer smac0 (hypothetical computer) -Memory, Registers, Condition Codes, Instruction format, Instruction Set, smac0 programs.	
Unit 2	Assembler	12 lectures
	2.1 Definition 2.2 Features of assembly language, advantages 2.3 Statement format, types of statements – Imperative, Declarative, Assembler Directive. 2.4 Constants and Literals. 2.5 Design of assembler – Analysis Phase and Synthesis Phase. 2.6 Overview of assembling process 2.7 Pass Structure of Assembler – One pass, Two pass assembler. 2.8 Problems of 1-pass assembler - forward reference, efficiency, Table of Incomplete Instructions. 2.9 Design of 2-pass Assembler – Pass-I and Pass-II 2.10 Advanced assembler directives (LTORG, ORIGIN, EQU), 2.11 Data structure of 2-pass assembler. 2.12 Intermediate Code – Need, Forms-variant I and Variant II	
Unit 3	Macros and Macro Processors	4 lectures
	3.1 Definition 3.2 Macro definition and call 3.3 Macro expansion – positional and keyword parameters 3.4 Nested macro calls 3.5 Advanced macro facilities – alteration of flow of control during expansion, expansion time variable, conditional expansion, expansion time loops. (with examples)	
Unit 4	Compilers and Interpreters	3 lectures

	4.1 Definition, Aspects of compilation 4.2 The structure of Compiler Phases of Compiler – Lexical Analysis, Syntax Analysis, Semantic Analysis, Intermediate Code generation, code optimization, code generation 4.3 Interpreter - Use of interpreter, definition, Comparison with compiler, Overview of interpretation, 4.4 Pure and impure interpreter. P-code compiler	
Unit 5	Linker and Loader	3 lectures
	5.1 Introduction 5.2 Concept of bindings, static and dynamic binding, translated, linked and load time addresses. 5.3 Relocation and linking concept – program relocation, public and external references, linking, Relocatability - non relocatable, relocatable, and self-relocating programs , Linking for Overlays.	

Reference Books:

1. Systems Programming and Operating Systems by D.M.Dhamdhare (Second Revised Edition).
2. System Software - An introduction to Systems Programming - Leland L. Beck (Pearson Education)
3. Compilers: Principles, Techniques and Tools – Aho, Lam, Sethi, Ullman (Second Edition) Pearson Education
4. Linkers and Loaders – John R. Levine, Elsevier Morgan Kaufmann

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU6101

Course Name: Section 2: Programming in Advanced JAVA

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisites: Knowledge of Core Java

Course Objectives:

- To learn database programming using Java
- To study web development concept using Servlet and JSP
- To learn socket programming for developing Client-Server applications

Course Outcomes:

On completion of the course, Students will be able to:

CO No	Course Outcomes(COs)	Blooms Cognitive level
1	Recall and define advanced Java concepts such as multithreading, networking, Java database connectivity (JDBC)	1
2	Illustrate the use of multithreading, concurrency, and synchronization mechanisms in Java applications.	2
3	Apply JDBC to connect to a database and perform CRUD operations (Create, Read, Update, Delete).	3
4	Break down software requirements and determine how to implement solutions using design patterns, advanced Java features, and frameworks.	4
5	Evaluate database design decisions and recommend improvements in the context of performance, maintainability, and scalability.	5
6	Design and implement advanced Java applications that integrate multiple technologies (e.g., multi-threading, database, networking, and GUI).	6

Course Contents

Unit 1	Collections	6
	1.1 Introduction to the Collection Framework 1.1.1 Overview of Collections in Java 1.1.2 Benefits of Using Collections 1.1.3 Collection Framework Hierarchy 1.2 List Interface 1.2.1 ArrayList 1.2.2 LinkedList 1.2.3 Vector 1.2.4 Stack 1.2.5 Queue 1.3 Set Interface 1.3.1 HashSet 1.3.2 TreeSet 1.3.3 LinkedHashSet 1.4 Important Interfaces in Collections 1.4.1 Comparator Interface 1.4.2 Iterator Interface 1.4.3 ListIterator Interface 1.4.4 Enumeration Interface	
Unit 2	Database Programming	6
	2.1 Introduction to JDBC and Architecture 2.1.1 What is JDBC? 2.1.2 Features of JDBC 2.1.3 JDBC Architecture and Components 2.1.4 Types of JDBC Drivers 2.2 Processing SQL Statements with JDBC 2.2.1 Establishing a Connection 2.2.2 Executing SQL Queries (Statement, PreparedStatement, CallableStatement) 2.2.3 Handling ResultSet and Retrieving Data 2.2.4 Updating and Deleting Records Using JDBC	
Unit 3	Servlet	6
	3.1 Introduction to Servlet 3.2 Servlet life cycle 3.3 Handling of Request and Response 3.4 Session tracking 3.4.1 User Authorization 3.4.2 URL Rewriting 3.4.3 Hidden form fields 3.4.4 Cookies	
Unit 4	Java Server Pages	6
	4.1 Introduction to JSP 4.1.1 What is JSP?	

	4.1.2 Features and Advantages of JSP 4.1.3 Difference Between JSP and Servlets 4.1.4 JSP Lifecycle 4.1.5 Implicit Objects 4.2 Scripting Elements 4.2.1 Declarations (<%! %>) 4.2.2 Expressions (<%= %>) 4.2.3 Scriptlets (<% %>) 4.2.4 Comments (<%-- --%>) 4.3 JSP Directives 4.3.1 Page Directive (<%@ page %>) 4.3.2 Include Directive (<%@ include %>) 4.4 Simple JSP Program	
Unit 5	Multithreading	3
	5.1 What are threads? 5.2 Thread Lifecycle 5.3 Usage of Thread class / Runnable Interface 5.4 Thread Priorities	
Unit 6	Introduction to Frameworks	3
	6.1 Spring Framework 6.1.1 Introduction to Spring Framework and Beans 6.1.2 Understanding Dependency Injection 6.1.3 Spring Applications and Configuration 6.1.4 Overview of Spring MVC Framework 6.2 Introduction to Components of Hibernate 6.2.1 What is Hibernate? 6.2.2 Hibernate Architecture and Components 6.2.3 Hibernate ORM and Persistence 6.3 Introduction to Struts Framework 6.3.1 Overview of Struts Framework 6.3.2 Features and Advantages of Struts 6.3.3 Struts MVC Architecture 6.4 Introduction to Maven Framework 6.4.1 What is Maven? 6.4.2 Maven Project Structure and Build Lifecycle 6.4.3 Understanding MOJO (Maven Plain Old Java Object) 6.4.4 Understanding POJO (Plain Old Java Object)	

References Books:

1. Java The Complete Reference - Eleventh Edition, Herbert Schildt, Tata Mc Graw Hill, ISBN-13 :978-9390491629
2. Programming with Java 6th Edition, E Balagurusamy, ISBN-13 : 978-9353162344
3. Core Java, Volume II—Advanced Features, Tenth Edition, Pearson publication, ISBN-13 :978-0134177298
4. Getting started with Spring Framework: covers Spring 5 by J Sharma and Ashish Sarin, ISBN-13 : 978-1979962780
5. Spring 4 for Developing Enterprise Applications: An End-to-End Approach by Henry H.Liu, ISBN-13 : 978-0615639451

Reference link:

<https://docs.oracle.com/javase/8/>

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU6102
Course Name: Section 1:Software Project Management

Teaching Scheme: TH: 2 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisite Courses:

- Introduction to Object Oriented Software Engineering

Course Outcomes:

1. Demonstrate an understanding of software project management principles, tools, and techniques.
2. Apply project management methodologies to plan, execute, and close a software project.
3. Analyze and select appropriate software development methodologies for various project scenarios.
4. Manage resources, team dynamics, and communication in a software project.

Course Objectives:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Understand the Fundamentals of Software Project Management	Level 2
CO 2	Master Software Development Methodologies	Level 4
CO 3	Plan and Organize Software Projects	Level 3
CO 4	Master Software Development Methodologies	Level 4
CO 5	Resource and Team Management	Level 2
CO 6	Monitor and Control Software Projects	Level 5

Course Contents:

Unit 1	Introduction to Software Project Management	5 lectures
	1.1 Definition of software project management 1.2 Importance of project management in software development 1.3 Types of software projects 1.4 Project lifecycle: Initiation, planning, execution, monitoring, and closure 1.5 Triple constraint: Scope, time, and cost	

	1.6 Key roles in a software project (Project Manager, Developers, 1.7 Stakeholders) 1.8 Waterfall model 1.9 Agile methodologies (Scrum, Kanban)	
Unit 2	Project Evaluation and Programme Management	4 lectures
	2.1 Project Portfolio Management and Evaluation 2.2 Cost-Benefit Evaluation Techniques 2.3 Risk Evaluation 2.4 Programme Management and Resource Allocation	
Unit 3	Software Estimation	4 lectures
	3.1 Basics of Software Estimation – Bottom -Up, top-Down 3.2 Function Point Analysis, COCOMO 3.3 Cost Estimation	
Unit 4	Activity Planning	6 lectures
	4.1 Planning, Scheduling of Project 4.2 Network Planning Models 4.3 Forward Pass, Backward Pass, Critical Path 4.4 Activity on Arrow Network	
Unit 5	Resource Allocation	5lectures
	5.1Identifying Resource Requirement, 5.2 Scheduling, 5.3 Planning Cost Schedule 5.4 Scheduling Sequence	
Unit 6	Monitoring and Control	6 lectures
	6.1 Creating Framework, 6.2 Project termination Review, 6.3 Cost Monitoring, 6.4 Change Control 6.5 Software Configuration Management (SCM)	

Reference Books:

1. "Software Engineering: A Practitioner's Approach"

Author: Roger S. Pressman, Bruce R. Maxim

Edition: 9th Edition**Publisher:** McGraw-Hill Education ISBN: 978-9355325044

2. Information Technology Project Management by Kathy Schwalbe Edition: 13 ISBN :978-1337101356

Online resources:

1. **Website:** <https://www.pmi.org/>

2. **Website:** <https://www.coursera.org/specializations/software-project-management>

3. **Website:** <https://github.com/>

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU6102
Course Name: Section 2:Introduction to Data Science

Teaching Scheme: TH: 2 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30Marks

Prerequisite Courses:

- Basic knowledge of mathematics, statistics, and programming (preferably Python or R)

Course Objectives:

- Introduce students to the fundamental concepts and techniques used in data science.
- Develop an understanding of data preprocessing, analysis, and visualization techniques.
- Introduce students to the basics of machine learning and data modelling.
- Equip students with the ability to handle real-world data and derive insights from it.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Outcomes (COs)	Blooms Cognitive level
CO 1	Understand the fundamental concepts of Data Science.	1
CO 2	Analyze and describe data types, data collection methods, and data cleaning techniques.	2
CO 3	Apply data preprocessing techniques such as normalization, scaling, and outlier detection.	3
CO 4	Analyze and visualize data using statistical and graphical techniques.	4
CO 5	Evaluate and interpret results from machine learning models, including classification and regression.	5
CO 6	Create data science solutions and communicate findings through reports and presentations.	6

Course Contents:

Unit 1	Introduction	04 lectures
	1.1 Definition and importance of Data Science 1.2 Role of a Data Scientist, Data Analyst, Data Engineer, Data Architect 1.3 Key areas of Data Science: Data Collection, Cleaning, Analysis and Visualization 1.4 Overview of tools and technologies (Python, R, Power BI, Weka)	
Unit 2	Data Collection and Data Types	04 lectures
	2.1 Types of Data: Quantitative vs. Qualitative 2.2 Data Collection Methods: Structured and Unstructured Data 2.3 Data Sources: APIs, Web Scraping, Databases, CSV 2.4 Data Formats and Storage	
Unit 3	Data Preprocessing and Visualization	04 lectures
	3.1 Data Transformation: Normalization, Scaling, Encoding 3.2 Outlier Detection and Treatment 3.3 Importance of Data Visualization in Data Science 3.4 Tools and Libraries: Matplotlib, Seaborn, Plotly (for Python) 3.5 Basic Visualizations: Histograms, Bar Charts, Line Graphs, Pie Charts 3.6 Advanced Visualizations: Heatmaps, Scatter Plots, Box Plots	
Unit 4	Machine Learning Algorithms	06 lectures
	4.1 Supervised Learning: Support Vector Machine, Gradient Boosting Machines, Random Forest 4.2 Unsupervised Learning: Principal Component Analysis technique 4.3 Deep Learning: Convolutional Neural Networks, Recurrent Neural Networks	
Unit 5	Exploratory Data Analysis (EDA)	06 lectures
	5.1 Data Distribution, Outlier Treatment, Measuring Symmetry, Continuous Distribution, Kernel Density, Estimation: Sample and Estimated Mean, Variance and Standard Scores, Covariance, and Pearson's and Spearman's Rank Correlation 5.2 Distributions: Normal Distribution, Binomial Distribution 5.3 Hypothesis Testing and p-values	
Unit 6	Social Network Analysis	06 lectures
	6.1 Social Networks as Graphs, Varieties of Social Networks, Graphs With Several Node Types, Clustering of Social-Network 6.2 Graphs: Distance Measures for Social-Network Graphs,	

	Applying Standard Clustering Methods, Betweenness, The Girvan-Newman Algorithm, Using Betweenness to Find Communities	
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Reference Books:

1. **"Data Science for Business"** by Foster Provost and Tom Fawcett
ISBN: 9781449361327
2. **"Python for Data Analysis"** by Wes McKinney
ISBN-13: 978-1491957660
3. **"Introduction to Machine Learning with Python"** by Andreas C. Müller and Sarah Guido
ISBN: 9789352134571
4. **"Practical Statistics for Data Scientists"** by Peter Bruce and Andrew Bruce
ISBN: 9781491952962
5. **Online Resources:**DataCamp, Coursera, and edX for hands-on tutorials and courses

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU6103
Course Name: Lab Course on 23CsCmpU6101

Teaching Scheme: PR: 4 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Course Objective :

- To learn database programming using Java
- To study web development concept using Servlet and JSP
- Understand the fundamental concepts and functionality of simulators in computing systems.
- Understand the role of an assembler in translating assembly language to machine language
- Develop skills in creating DFA drivers that simulate the execution of DFA models for practical language recognition tasks

Sr. No.	Assignment Name
1.	Collections
2.	Java Database Connectivity
3.	Servlets
4.	Java Server Pages
5.	Multithreading
6.	Simulator
7.	Line Editor
8.	Assembler
9.	DFA Driver

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU6201
Course Name: Elective 2: Big Data Analytics

Teaching Scheme: TH: 2 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Prerequisite Courses:

- Basic Programming (in Python, C, or Java)
- Database Management and SQL

Course Objectives:

- Prepare and present detailed reports on data analysis findings, communicating complex results to non-technical stakeholders in a concise and understandable way.
- Work collaboratively in groups on projects and case studies, improving communication and teamwork skills.

Course Outcomes:

After successful completion of this course students will able to:

CO No	Course Objectives (COs)	Blooms Cognitive level
CO 1	Introduce students to the fundamental concepts, characteristics, and significance of Big Data in modern industries.	1
CO 2	Learn different about NoSQL databases tools, their architectures, and techniques for Big Data Analytics.	2
CO 3	Provide hands-on experience in executing HDFS commands and managing distributed file systems for data storage processing frameworks like Hadoop	3
CO 4	Perform / examine different distributed computing paradigms and their applications in large-scale data processing for basic data analysis	4
CO 5	Apply & develop students' ability to evaluate and optimize MapReduce & Pig scripts for large-scale data processing on Big Data.	5
CO 6	Create and implement interactive dashboards and custom visualization techniques for Big Data analytics.	6

Course Contents:

Unit 1	Introduction	5 lectures
	1.1 Introduction to Big Data 1.2 Big data characteristics 1.3 Types of Big Data 1.4 Traditional Vs. Big data approach 1.5 Big Data Challenges 1.6 Infrastructure for Big Data, 1.7 Uses Cases of Big Data Analytics, 1.8 Applications of Big Data	
Unit 2	Big Data Technologies	5 lectures
	2.1 Overview of Big data Frameworks 2.2 History and Evolution of Hadoop 2.3 Introduction to Hadoop ecosystem 2.4 Hadoop Vs. Traditional Databases 2.5 NoSQL Databases 2.6 Types of NoSQL Databases 2.7 Comparison of SQL vs. NoSQL	
Unit 3	Hadoop Framework& HDFS	5 lectures
	3.1 Components of Hadoop Framework 3.2 Hadoop Distributed File System (HDFS) 3.3 HDFS Architecture 3.4 Hadoop – Command	
Unit 4	MapReduce Programming	5lectures
	4.1 Introduction to MapReduce 4.2 MapReduce Architecture (Mapper, Reducer, Shuffle and Sort) 4.3 MapReduce Execution Flow 4.4 MapReduce types - input formats, output format 4.5 Writing and Running a Word Count Program in MapReduce (Java / Python)	
Unit 5	Introduction To Hadoop Features	5 lectures
	5.1 New Big Data Architecture 5.2. Apache Pig and Extract, Transform & Load Operations on Hadoop 5.3 Introducing to Apache Hive 5.4 Introduction to ApacheHBase	
Unit 6	Data Analytics and Visualization	5lectures
	6.1 Data Pre Processing and cleaning 6.2 Exploratory Data Analysis 6.3 Data Visualization tools(Power BI, Tableau)	

Reference Books:

- 1.DT Editorial Services,"Big Data, Black Book-Covers Hadoop2, MapReduce, Hive, YARN, Pig, R and Data Visualization" DreamtechPress,(2015).
2. Book Title: "Hadoop: The Definitive Guide" Author: Tom White Edition: 4th Edition (or the latest available edition) Publisher: O'Reilly Media
3. Hands-On Exploratory Data Analysis with Python" by Suresh Kumar Mukhiya
4. Applied Big Data Analytics by Kiran Chaudhary and Pradeep Kumar

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsCmpU6201

Course Name: Elective 2:Lab Course on Big Data Analytics

Teaching Scheme: PR: 4 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisite Courses:

- Java Programming Skills(optional Python)
- Fundamentals Database Knowledge
- Basic descriptive statistics

Course Objectives:

- Provide hands-on experience and practical skills in working with Big Data technologies
- To introduce students to the fundamental concepts, and approaches of data visualization tools. (Power BI & Tableau)

Course Contents:

Sr.No	List of practical
1	Assignment on: Install and Configure HDFS in Hadoop Objective: Set up Hadoop and configure HDFS on a single-node cluster. • Download and install Hadoop on your system • Configure core-site.xml and hdfs-site.xml for HDFS • Format the HDFS namenode using hdfsnamenode -format • Start Hadoop services (start-dfs.sh) and verify • Check HDFS status using hdfsdfsadmin -report
2	Assignment on: Creating and Managing Files in HDFS Objective: Perform file operations in HDFS. • Start the Hadoop services if not already running • Create a new directory in HDFS using hdfsdfs -mkdir • Upload a file from the local system to HDFS (hdfsdfs -put) • List files in HDFS using hdfsdfs -ls • Display the contents of an HDFS file using hdfsdfs -cat
3	Assignment on: Retrieving and Deleting Data in HDFS Objective: Learn how to read and remove data from HDFS. • List all files and directories in HDFS (hdfsdfs -ls /) • Retrieve a file from HDFS to the local file system (hdfsdfs -get) • Check the file content using hdfsdfs -cat or tail • Remove a specific file from HDFS (hdfsdfs -rm) • Remove an empty directory from HDFS (hdfsdfs -rmdir)
4	Assignment on: Word Count using MapReduce Objective:Write a MapReduce program (Java/Python) to count the number of occurrences of each word in a given input text file.
5	Assignment on: Finding the Most Frequent Word using MapReduce Objective:Write a MapReduce program (Java/Python) to find the most frequently

	occurring word in a text file.
6	Assignment on: Calculating Average Temperature using MapReduce Objective: Write a MapReduce program (Java/Python) to calculate the average temperature for each year. Input File (weather_data.txt): File - weather_data.txt: <pre>2023 35 2023 40 2022 32 2022 38</pre>
7	Assignment on: Loading and Displaying Data using Pig Objective: Write a Pig script to load a CSV file containing customer details (CustomerID, Name, Age, City), display the schema, and show the first 10 records. • Load the CSV file • Display schema • Display first 10 records • Use proper delimiters and field types
8	Assignment on: Computing Total Sales per Customer using Pig Objective: Write a Pig script to compute the total sales amount for each customer. • Load datasets correctly • Apply grouping and aggregation () • Display results • Use correct schema
9	Assignment on: Storage Processing Data using Pig Question: Write a Pig script to load customer data, filter adults, and store the results in HDFS. • Marks Distribution: • Load data correctly • Filter adults • Store results in HDFS • Use correct format
10	Assignment on: Introduction and Installation of Power BI Desktop Objective: Install and set up Power BI Desktop. • Download Power BI Desktop from the official Microsoft website • Install Power BI Desktop on your system • Open Power BI and explore the interface • Set up basic preferences such as theme and auto-recovery options
11	Assignment on: Establishing a Connection in Power BI and Extracting Data Objective: Connect Power BI to a data source and extract data. • Open Power BI and navigate to "Get Data" • Select an appropriate data source (Excel, SQL Server, etc.) • Load the dataset into Power BI • Verify the data extraction by checking the "Data View" tab • Save the Power BI file(.pbix)
12	Assignment on: Creating a Simple Table Visualization in PowerBI Objective: Visualize data in a table. • Open the "Report" tab • Insert a table visualization • Select appropriate fields for the table • Format the table (colors, alignment, etc.) • Save the report

13	Assignment on: Installing Tableau on your system and set up a workspace. Objective: Install and set up your Tableau interface. • Download & install Tableau • Open Tableau & explore interface • Take & submit a screenshot
14	Assignment on: Loading, extracting data from Excel to Tableau Objective: Connect Tableau to an Excel dataset and extract the data for further analysis. • Open Tableau & choose Excel connection • Load dataset & verify • Extract and save data
15	Assignment 4: Creating a Simple Table Visualization in Tableau Objective: Create a bar chart, line chart, pie chart, scatter plot, and area chart using a sample dataset in Tableau. • Load dataset • Create bar, line, pie, scatter, and area charts • Customize with labels, colors

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsMatU6202
Course Name: Elective 2: Computational Geometry

Teaching Scheme: PR: 4 Hours/Week
Examination Scheme: CIA: 20 Marks

Credit: 02
End-Sem: 30 Marks

Prerequisites: Euclidean Geometry, Trigonometry, Matrices, Algebra of Equations.

Course Objectives: To study

- Mathematical techniques required for Computer graphic applications, especially principles of geometry and transformations.
- Parametric representation and generation of Conic sections and Space curves.

Course Outcomes:

On completion of the course, student will be able to:-

- Apply various transformations to the object (which can be created using computer graphics software) in order to manipulate (render) the object.
- Analytically represent and generate two dimensional curves (Conic sections).
- Apply Curve fitting technique for given data points.

Course Contents:

Chapter 1	Two Dimensional Transformations	12 Hours
	● Introduction. ● Representation of points. ● Transformation and Matrices. ● Transformation of Points. ● Transformation of Straight Lines. ● Midpoint Transformation. ● Transformation of Parallel Lines. ● Transformation of Intersecting Lines. ● Transformations: Rotations, Reflections, Scaling, Shearing. ● Combined Transformations. ● Transformation of the Unit Square. ● Solid Body Transformations. ● Translations and Homogeneous Coordinates. ● Rotation about an Arbitrary Point. ● Reflection through an Arbitrary Line. ● Projection – A Geometric Interpretation of Homogeneous	

	Coordinates. • Overall Scaling. • Points at Infinity.	
Chapter 2	Three Dimensional Transformations	10 Hours
	• Introduction. • Three Dimensional – Scaling, Shearing, Rotation, Reflection, Translation. • Multiple Transformations. • Rotation about an Axis Parallel to a Coordinate Axis. • Rotation about an Arbitrary Axis in Space. • Reflection through an Arbitrary Plane. • Affine and Perspective Geometry. • Orthographic Projections. • Axonometric Projections. • Oblique Projections. • Single Point Perspective Transformations.	
Chapter 3	Plane Curves	04 Hours
	• Introduction. • Curve Representation. • Nonparametric Curves. • Parametric Curves. • Parametric Representation of a Circle and Generation of Circle. • Parametric Representation of an Ellipse and Generation of Ellipse.	
Chapter 4	Space Curves	04 Hours
	• Introduction. • Representation of Space Curves. • Bézier Curves – Introduction, Definition, Properties, Curve fitting (upto $n = 3$), Equation of the Curve in Matrix form (upto $n = 3$).	
Total No. of Hours		30

Reference Books:

- 1) Mathematical Elements for Computer Graphics by D. F. Rogers and J. A. Adams, Tata McGraw Hill (Second edition), 2002.
- 2) Schaum's Outlines, Computer Graphics, Tata McGraw Hill Publisher (Second edition), 2015.
- 3) Applied Geometry for Computer Graphics and CAD by Duncan Marsh, Springer (Second edition), 2005.
- 4) Computer Graphics with OpenGL, Donald Hearn, M. Pauline Baker, Warren Carithers, Pearson (4th Edition).

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsMatU6202

Course Name: Elective 2: Lab on Computational Geometry

Teaching Scheme: PR: 4 Hours/Week

Credit: 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisites: Euclidean Geometry, Trigonometry, Matrices, Algebra of Equations.

Course Objectives: To study

- Mathematical techniques required for Computer graphic applications, especially principles of geometry and transformations.
- Parametric representation and generation of Conic sections and Space curves.

Course Outcomes:

On completion of the course, student will be able to:-

- Apply various transformations to the object (which can be created using computer graphics software) in order to manipulate (render) the object.
- Analytically represent and generate two dimensional curves (Conic sections).
- Apply Curve fitting technique for given data points.

Course Contents:

	List of Practicals	60 Hours
Practical 1	Two dimensional Transformations I (scaling, shearing, reflection, rotation)	
Practical 2	Combined Transformations	
Practical 3	Two dimensional Transformations II (translation, rotation about arbitrary point, reflection through arbitrary line)	
Practical 4	Two dimensional transformations (using Python)	
Practical 5	Three dimensional Transformations I (scaling, shearing, reflection, rotation)	
Practical 6	Combined Transformations	
Practical 7	Three dimensional Transformations II (translation, rotation about arbitrary line, reflection through plane parallel to coordinate plane)	
Practical 8	Three dimensional transformations (using Python)	
Practical 9	Projections (orthographic, axonometric, oblique)	
Practical 10	Projections (using Python)	
Practical 11	Generation of Circle	
Practical 12	Generation of Ellipse	
Practical 13	Generation of Plane Curves (using Python)	
Practical 14	Bezier Curve (for control points 2 and 3)	

Practical 15	Bezier Curve (using Python)	
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Reference Books:

- 1) Mathematical Elements for Computer Graphics by D. F. Rogers and J. A. Adams, Tata McGraw Hill (Second edition), 2002.
- 2) Schaum's Outlines, Computer Graphics, Tata McGraw Hill Publisher (Second edition), 2015.
- 3) Applied Geometry for Computer Graphics and CAD by Duncan Marsh, Springer (Second edition), 2005.
- 4) Computer Graphics with OpenGL, Donald Hearn, M. Pauline Baker, Warren Carithers, Pearson (4th Edition).

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsEleU6203
Course Name: Elective 2: Embedded System

Teaching Scheme: TH: 2 hrs / Week

Credit : 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisites: Basic knowledge of Microcontroller, Digital Electronics, and C Programming.

Course Objectives: This course will enable the students to:

1. To understand the architecture 8-bit microcontroller
2. To understand registers and modules of PIC controller.
3. To understand basics of interfacing concepts.
4. To learn software techniques to embed codes into the systems.
5. To interface different peripherals to PIC controller.
6. To learn communication standards and protocols

Course Outcomes

- Understand the architecture and components of embedded systems.
- Understand the **architecture and operation** of PIC microcontrollers.
- **C programming** for PIC.
- Design and develop embedded system applications using hardware and software tools.
- Interface peripherals such as sensors, actuators, and communication devices with PIC.
- Develop **real-time embedded applications**.
- Gain exposure to **PIC development tools** and simulation software.

Chapter 1	Introduction to Embedded Systems & PIC Microcontrollers	8 hrs
	Definition and characteristics of embedded systems, Applications of embedded systems, Differences between general-purpose and embedded systems, Embedded system design process, Introduction to PIC microcontrollers , PIC microcontroller families & selection criteria, Applications of PIC-based systems .	

Chapter 2	PIC Microcontroller Architecture	16 hrs
	Internal architecture of PIC microcontrollers:- CPU, Memory (Flash, RAM, EEPROM), I/O Ports and Pin configuration, Clock and Reset circuits, Power-saving modes. Interrupt handling & Priorities	
Chapter 3	PIC Programming Fundamentals	8Hrs
	Assembly vs. Embedded C Programming Overview of MPLAB X IDE and XC8 Compiler Writing, compiling, and debugging programs, Interfacing LEDs, switches, and buzzers, Introduction to Timers & Delays, Timers and Counters (PWM generation), Serial Communication (UART, SPI, I2C)	
Chapter 4	Sensor Interfacing & Data Acquisition	6Hrs
	Analog-to-Digital Converter (ADC), Digital-to-Analog Conversion (DAC) ,Interfacing Temperature Sensors (LM35, DHT11, etc.) IR Sensors, Ultrasonic Sensors, Accelerometer & Gyroscope Interfacing Data acquisition and real-time applications	

Text/ Reference Books:

1. "PIC Microcontroller and Embedded Systems" – Muhammad Ali Mazidi, Pearson publisher, 2nd edition.
2. "Programming PIC Microcontrollers in C" – Lucio Di Jasio, Elsevier, 3rd edition.
3. "Embedded C Programming & the Microchip PIC" – Richard H. Barnett, Elsevier Science, 1st edition.
4. Microchip Official Website & Documentation
5. MPLAB X IDE & XC8 Compiler User Guides, Apress publisher, 1st edition.

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T.Y. B.Sc. (Computer Science)
(2023 Course under NEP)

Course Code: 23CsEleU6203
Course Name: Elective 2: Lab Course on Embedded system

Teaching Scheme: PR: 4 hrs / Week

Credit : 02

Examination Scheme: CIA: 20 Marks

End-Sem: 30 Marks

Prerequisites: Basic knowledge of Digital Electronics and C programming

Course Outcomes:

- Understand the architecture and components of embedded systems.
- Understand the architecture and operation of PIC microcontrollers.
- Develop basic C programming for PIC microcontroller.
- Design and develop embedded system applications using hardware and software tools.
- Understand to Interface peripherals such as sensors, actuators, and communication devices with PIC.
- Develop soft real-time embedded applications.
- Gain exposure to PIC development tools and simulation software.

List of Practical

1. Getting Started with MPLAB X IDE & XC8 Compiler.
2. Arithmetic operations of PIC using MPLAB X software.
3. Basic I/O operations of PIC with Switch Interfacing: Single key interface result on LED.
4. Study of LED bank interfacing and programming to PIC microcontroller.
5. To study for Generating Delays using Timers and SSD Interfacing to PIC microcontroller.
6. Study of waveform generations using DAC and PIC.
7. Study for PWM Generation for speed control of DC motor using PIC.
8. Study of External interrupt as input switch press, output at relay.
9. Study to interface ADC for reading of sensor values using PIC.
10. Programming for UART Communication of PIC with PC.
11. To study the I2C Interfacing with external EEPROM.
12. To study programming for LCD Interface (16x2 & Graphical LCD).
13. Study to interface Stepper Motor to PIC.
14. Study Wireless communication using Bluetooth module and PIC.
15. Mini project Embedded system based on PIC microcontroller.