5th Semester Syllabi

Software Project Management

Course Code	22CS51	**Course type**	HSMS	**Credits L-T-P**	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To provide **understanding** of basic project management principles, including project planning, risk management, and team collaboration.
2.	To **apply** comprehensive project plans, incorporating project scheduling, resource allocation, and risk management techniques to guide students in meeting specified learning objectives.
3.	To **analyze s**ecurity risk assessments and propose mitigation strategies based on security engineering principles to ensure students understand software system survivability
4.	To **evaluate** various software testing methodologies such as boundary value analysis and equivalence class testing, and design effective test cases to ensure students understand software quality and reliability.

Pre-requisites: Software Engineering, Engineering mathematics

Unit – I	**Contact Hours = 8 Hours**
Project management: Introduction, Risk management, Risk management process, Risk analysis, Risk planning, Risk monitoring**,** Risk indicators**,** managing people, motivating people, Teamwork: selecting group members.	

Unit – II	**Contact Hours = 8 Hours**
Project Planning: Software pricing, Plan-driven Development: Project Plans, Planning process, Project scheduling: Schedule Representation, Agile Planning, Estimation techniques: Algorithmic Cost Modeling, Introduction to The COCOMO II Model. Tools used: Atlassian Jira	

Unit – III	**Contact Hours = 8 Hours**
Security engineering: Introduction, Security risk management, Life cycle risk analysis, Operational risk assessment, Design of security, System survivability, stages in System survivability**.**	

Unit – IV	**Contact Hours = 8 Hours**
Software Testing: A perspective on Testing, Basic definitions, Test cases, Insights from Venn diagram, Identifying Test Cases, Error and fault taxonomy, Levels of Testing. Examples: Generalized pseudocode, The Triangle problem, The Next Date function, The Commission Problem, The SATM (Simple Automatic Teller Machine) system, Saturn Windshield Wiper Controller.	

Unit – V	Contact Hours = 8 Hours
Boundary Value Testing: Boundary Value Analysis, Robustness Testing, Worst Case Testing, Special Value Testing, Examples Equivalence Class Testing: Equivalence classes, Weak Normal Equivalence Class Test, Strong Normal Equivalence Class Test, Weak Robust testing, strong robust testing, Equivalence Class Test Cases examples: Triangle Problem, Next Date Function, Guidelines and Observations.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	1

Unit No.	Self-Study Topics
I	Personality types
II	Atlasian Jira tool
III	Stages in System survivability
IV	The currency convertor
V	Guidelines and Observations.

Books	
	Text Books:
1.	Ian Sommerville: Software Engineering, Pearson Education, 9th Edition onwards.
2.	Paul C. Jorgensen: Software Testing, ACraftsman's approach, 3rd Edition, Auerbach Publications, 2008.
	Reference Books:
1.	Aditya P. Mathur: Foundations of Software Testing, Pearson Education, 2008.
2.	Srinivasan Desikan, Gopalaswamy Ramesh, : Software Testing Principles and Practices, 2nd Edition, Pearson Education, 2007.
	E-resources (NPTEL/SWAYAM.. Any Other)-
1.	https://onlinecourses.nptel.ac.in/noc22_cs61/preview
2.	https://onlinecourses.nptel.ac.in/noc24_mg01/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Assignment (OA)/ Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	4.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - **Apply**; An - **Analysis**; Ev - **Evaluate**; Cr **- Create**		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Demonstrate **understanding** of project management, including project planning, risk management, and teamwork.	Un	1,6,8,9,11	2
2.	**Apply** project planning techniques to create effective project plans with clear objectives, schedules, and resource allocation.	Ap	2, 3, 4, 5,6, 8,9	1,2
3.	**Analyze** security risks and propose mitigation strategies to ensure system survivability.	An	2,4, 6, 8,12	1,2
4.	**Evaluate** software testing methodologies, such as boundary value analysis and equivalence class testing, to design effective test cases for quality assurance.	Ev	2,3,4	2
5	**Demonstrate** effective team collaboration and communication skills to complete project-related tasks.	Ap	8, 9,10,11,12	3

Scheme of Continuous Internal Evaluation (CIE):

Components	**Addition of two IA tests**	**Two Assignments – (Open /Industry/Certification etc)**	**Course project (CP)/ Case study etc**	**Total Marks**
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓					✓		✓	✓		✓			✓	
2		✓	✓	✓	✓	✓		✓	✓				✓	✓	
3		✓		✓		✓		✓				✓	✓	✓	
4		✓	✓	✓					✓					✓	
5								✓	✓	✓	✓	✓			✓
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Software Design	IT Sector, Banking, Finance, Health Care	Software Engineers
2	Software Project Management Tools		Project Manager
3	Software Testing Tools		Quality Assurance Engineer

Formal Languages Automata Theory

Course Code	**22CS52**	**Course type**	IPCC	**Credits L-T-P**	3 - 0 - 1
Hours/week: L - T- P	3 - 0 – 2			**Total credits**	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To study abstract computing machines, Language representation techniques and finite state machines to realize formal language.
2.	To Employ regular expressions and properties to solve problems in computing.
3.	To Design Grammars and Recognizers for different formal languages
4.	To Understand Push Down Automata and Turing theory and its significance.
5.	To Demonstrate Lex and YACC tools.

Prerequisite: Basic knowledge of problem solving and Discrete mathematics

Unit – I	**Contact Hours = 8 Hours**
Introduction to Finite Automata: Introduction to Finite Automata, Structural Representation. The central concepts of Automata theory – Alphabet, Strings & Languages. Deterministic Finite Automata (DFA), Non -Deterministic and Equivalence of NFA and DFA, FA with Epsilon (ε) transitions.	

Unit – II	**Contact Hours = 8 Hours**
Regular Expressions and languages: Regular Expressions, Finite Automata and Regular Expressions, Properties of Regular Languages (RL): Proving Languages not to be Regular. Equivalence and Minimization of Automata. Applications of Regular Expressions.	

Unit – III	**Contact Hours = 8 Hours**
Context -Free Grammars (CFG) and Languages (CFL): Context - Free Grammars, Parse Trees, Applications of Context - Free Grammars, Ambiguity in Grammars and Languages. Normal forms for Context Free Grammar.	

Unit – IV	**Contact Hours = 8 Hours**
Pushdown Automata (PDA): Definition of Pushdown Automata, The languages of a PDA: Acceptance by Final state & Empty stack. Introduction to Turing Machines (TM): Turing Machine model: Definition of Turing Machine, Transition Function, Instantaneous Description & Moves, Programming a Turing Machine, Language recognition by Turing Machine.	

Unit – V	Contact Hours = 8 Hours
LEX and YACC Tools: The Simplest Lex Program, Recognizing Words with Lex. Grammars: Parser-Lexer communication, A Yacc Parser, Rules section. Running Lex and Yacc and examples. Using Lex: Regular Expressions and examples. Using Yacc: Shift reduce parsing, Arithmetic Expressions Validity and Evaluation.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
I.	-	
II.	3	Programs on regular expressions using Lex tool
III.	3	Programs on Context Free Grammars using YACC tool
V.	2	Programs to check validity and evaluation of arithmetic expression using YACC tool

Unit No.	Self-Study Topics
I.	Applications of Automata Theory.
II.	Properties of Regular Languages
III.	Normal form of Context Free Grammars (GNF)
IV.	Lexical and Syntax Analysis phases of Compiler Design

Books	
	Text Books:
1.	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, “Introduction to Automata Theory, Languages and Computation”, Pearson Education, 3/E, 2013
2.	John R. Levine and Tony Mason and Doug Brown, Lex and Yacc, “UNIX programming tools”, 2/E, 1992.
3.	S. P. Euguene Xavier “Theory of Automata, Formal Languages and Computation “, 5/ E 2008.
	Reference Books:
1.	Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, “Compilers Principles, Techniques and Tools”, Pearson Education, 2 / E,2008.
2.	Peter Linz, “An Introduction to Formal Languages and Automata”,Narosa Publishing House, 5/E, 2011.
	E-resources (NPTEL/SWAYAM/ Any Other)
1.	https://nptel.ac.in/courses/106105196

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Assignment (OA)/ Lab Project/ Industry assignment/Certification/ Course project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)				
Learning Levels: Re **- Remember**; Un - **Understand;** Ap - **Apply**; An - **Analysis**; Ev - **Evaluate**; Cr - **Create**				
At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Acquire fundamental understanding of the core concepts in automata theory , regular expressions, CFG, PDA, Turing machines .	Un	1,2	1,3
2.	Design Finite state machines and Regular Expressions for the given pattern.	Ap	1,2,3,12	1,3
3.	Design Grammars for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free)	Ap	1,2,3,12	1,3
4.	Design and Analysis of PDA, Turing Machine for the given problem description.	An	1,2,3,12	1,3
5.	Design programs to implement lexical analyzer & parsers using LEX and YACC tools.	Ap	1,2,3,5,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test (COMPULSORY) will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)		**LAB (40 marks)**		**Total**
IA test 1	**IA test 2**	**Conduction**	**Lab test**	
30 marks	30 marks	10 marks	30 marks	100 marks

IA Test:
1. No objective part in IA question paper
2. All questions descriptive

-Certification earned by passing the standard Online MOOCs course (of at least 8 hours defined by BOS) can be considered as a Course activity/Assignment and awarded maximum of 10 marks.

Conduct of Lab:
1. Conducting the experiment and journal: 5 marks
2. Calculations, results, graph, conclusion and Outcome: 5 marks

Lab test: (Batch wise with 15 students/batch)
1. Test will be conducted at the end of the semester
2. Time table, Batch details and examiners will be declared by Exam section
3. Conducting the experiment and writing report: 5 marks
4. Calculations, results, graph and conclusion: 15 marks
5. Viva voce: 10 marks

Eligibility for SEE:
1. 40% and above (24 marks and above) in theory component (No change)
2. Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Total.
3. Lab test is COMPULSORY
4. Not eligible in any one of the two components will make the student Not Eligible for SEE

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	Minimum marks required in SEE to pass: Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts A, B and C. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (planned)													CO-PSO Mapping (planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓											✓		✓
2	✓	✓	✓									✓	✓		✓
3	✓	✓	✓									✓	✓		✓
4	✓	✓	✓									✓	✓		✓
5	✓	✓	✓		✓							✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Compiler Design phases	Core Companies, Networking companies	Software Designer

Microcontrollers and Embedded Systems

Course Code	22CS53	**Course type**	PCC	**Credits L-T-P**	**4 – 0 - 0**
Hours/week: L - T- P	**4 – 0 – 0**			**Total credits**	**4**
Total Contact Hours	**L = 50 Hrs; T = 0 Hrs; P = 0 Hrs** **Total = 50 Hrs**			**CIE Marks**	**100**
Flipped Classes content	**10 Hours**			**SEE Marks**	**100**

Course learning objectives	
1.	To equip students with a thorough understanding of microcontrollers, including their architecture, functionalities, and various applications in embedded systems.
2.	To guide students in mastering programming microcontrollers using Embedded ‘C’, ensuring they can write efficient and effective code for various applications.
3.	To teach students how to connect microcontrollers with a wide range of peripheral devices such as sensors, actuators, displays, and communication modules, enhancing their practical skills in system integration.
4.	To enable students to design and deploy embedded systems by instructing them on selecting appropriate hardware components and integrating them into functional and optimized systems.

Pre-requisites : Digital Electronics, ‘C’ Programming.

Unit – I	Contact Hours = 10 Hours
The 8051 Microcontrollers: Microcontrollers and Embedded Processors, A brief history of the 8051, Block Diagram of 8051 Microcontroller. 8051 Programming in ‘C’: Data Types and Time Delay in 8051 ‘C’, I/O Programming in ‘C’, Logic operations in 8051 ‘C’.	

Unit – II	Contact Hours = 10 Hours
8051 Programming in ‘C’: Data conversion programs in 8051 ‘C’, Accessing code ROM space in 8051 ‘C’, Data Serialization using 8051 ‘C’. 8051 Timer Programming in ‘C’: Programming Timers in Mode1 and Mode 2.	

Unit – III	Contact Hours = 10 Hours
8051 Counter Programming in ‘C’: Programming Counters in Mode1 and Mode 2. Serial Communication: Basics of Serial Communication, Serial Port Programming in ‘C’.	

Unit – IV	Contact Hours = 10 Hours
Interrupts Programming in ‘C’: 8051 interrupts, Interrupt Programming in ‘C’. Peripheral interfacing: Sensor, Actuator, LCD, ADC and DAC interfacing with 8051 Microcontroller.	

Unit – V	Contact Hours = 10 Hours
Embedded Computing: Introduction, Complex systems and microprocessors, embedding computers, Characteristics of embedded computing applications, why use microprocessors, Challenges in embedded computing system design, Performance of embedded computing systems. The Embedded System Design Process: Requirements, Specification, Architecture design, Designing hardware and software components, System integration.	

Flipped Classroom Details

Unit No.	**I**	**II**	**III**	**IV**	**V**
No. for Flipped Classroom Sessions	2	2	2	2	2

Unit No.	**Self-Study Topics**
I	A brief history of the 8051
II	Data Serialization using 8051 'C'
III	Basics of Serial Communication
IV	8051 interrupts
V	Performance of embedded computing systems

Books	
	Text Books:
1.	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson, Second Edition onwards.
2.	Marilyn Wolf, Computers as Components Principles of Embedded Computing System Design, Morghan Kaufmann Elsevier, Third Edition onwards.
	Reference Books:
1.	David Calcutt, Frederick Cowan, and Hassan Parchizadeh, 8051 Microcontroller: An Applications Based Introduction
2.	Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://onlinecourses.nptel.ac.in/noc20_ee42/preview
2.	https://onlinecourses.nptel.ac.in/noc20_ee98/preview

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Assignment (OA)/ Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	4.	Semester End Examination

Course Outcome (COs) At the end of the course, the student will be able to (Highlight the action verb representing the learning level.)				
Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Explain the essential concepts governing microcontrollers and the architectural framework of embedded systems.	Un	1,2	1
2.	Apply programming concepts to effectively program microcontrollers using Embedded 'C'.	Ap	1,2,3,5	1,2
3.	Analyze various peripheral devices and determine suitable interfacing methods with microcontrollers.	An	1,2,3,5	1,2
4.	Develop embedded systems solutions by selecting appropriate hardware components and designing circuits.	Ap	1,2,3,5	1,2
5.	Analyze the requirements for a real world problem or a specification and develop a course project as the solution.	An	1,2,3,5, 9,10,11,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	**Addition of two IA tests**	**Open Assignments (OA)**	**Course project (CP)**	**Total Marks**
Marks	30 + 30 = 60 marks	10 + 10 = 20 marks	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	Minimum marks required in SEE to pass: Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts A,B and C. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓											✓		
2	✓	✓	✓		✓								✓	✓	
3	✓	✓	✓		✓								✓	✓	
4	✓	✓	✓		✓								✓	✓	
5	✓	✓	✓		✓				✓	✓	✓	✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	**Skill & competence enhanced after undergoing the course**	**Applicable Industry Sectors & domains**	**Job roles students can take up after undergoing the course**
1	Programming Proficiency	Embedded System and IoT Application.	Embedded Engineers
2	Peripheral Interfacing		Embedded- IoT- Firmware Design Engineer
3	Hardware Design and Selection		

Data Visualization

Course Code	22CS541	Course type	PLC	Credits L-T-P	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To gain a deeper understanding of how to effectively communicate data insights using visualizations.
2.	To create interactive visualizations which can be used to create dashboards and reports, which can be shared with stakeholders.
3.	To have hands-on experience working with real-world data sets and to practice creating visualizations and improve their skills.
4.	To gain the basic understanding of julia language for data visualization

Pre-requisites : Basics of Python programming and Data Structure

Unit – I:	Contact Hours = 8 Hours

Introduction to Python: Python Programming Language, History of Python, Python Enhancement, Proposals, Applications of Python, Installing Python on Various Platforms, installing on a Windows Computer, Installing on Ubuntu and Debian Derivatives, Python Modes, Interactive Mode
Script Mode
Exploring Jupyter Notebook : Overview of Jupyter Notebook, Setting up Jupyter Notebook , Running Code in Jupyter Notebook

Unit – II:	Contact Hours = 8 Hours

Data Visualization with Leather
Running OS Commands in Jupyter Notebook, Introduction to Leather, More Types of Visualizations, Scales, Styling. Scientific Python Ecosystem and NumPy: Scientific Python Ecosystem, NumPy and Ndarrays, More Than One Dimension, Ndarray Properties, NumPy Constants

Unit – III:	**Contact Hours = 8 Hours**

Data Visualization with NumPy and Matplotlib: Matplotlib, Visualization with NumPy and Matplotlib, Single Line Plots, Multiline Plots, Grid, Axes, and Labels, Colors, Styles, and Markers
Visualizing Images and 3D Shapes: Visualizing the Images, Operations on Images, 3D Visualizations
Getting Started with Pandas: Introduction to Pandas, Series in Pandas, Basic Operations on Series, Dataframes in Pandas, Reading Data Stored in CSV Format, Visualizing with Pandas

Unit – IV: Visualizing Graphs and Networks & Story Telling	**Contact Hours = 8 Hours**

Visualizing Graphs and Networks: Graphs and Networks, Graphs in Python 3, Visualizing Graphs in Python, More Types of Graphs, Assigning Custom Labels to Nodes
Introduction to Storytelling: The importance of context, choosing an effective visual, clutter is your enemy!, focus your audience's attention, think like a designer

Unit – V: Introduction to Julia and Data visualization	Contact Hours = 8 Hours
Data manipulation: Creating new dataframes, Indexing and summarizing data, Basic mathematical operations, General operations, Grouping data, Dealing with missing data. Importing and exporting data as CSV and excel files. Data visualization: Line plot, Attributes of a plot, Scatter plot, Heatmap, Histogram, Pie chart, Plotting mathematical functions, Saving plots, Animated plots, Various packages for plotting in Julia.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Books	
	Text Books:
1.	Ashwin Pajankar, Practical Python Data Visualization: A Fast Track Approach To Learning Data Visualization With Python, Apress.
2.	Cole Nussbaumer Knaflic, Storytelling with data, Wiley, John Wiley & Sons, Inc., Hoboken, New Jersey.
	Reference Books:
1.	Igor Milovanović), Python Data Visualization Cookbook, Packt Publishing, November 2013
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://www.udemy.com/course/complete-data-visualization-in-python/w
2.	https://blog.quantinsti.com/data-manipulation-visualization-using-julia/

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Tests (OBT)
3.	Flipped Classes	3.	Course Seminar
4.	Online classes	4.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels**: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr – Create**		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Describe** effectively the data insights using visualizations.	Un	1,2,3,5	1,2
2.	**Demonstrate** interactive visualizations using dashboards and reports	Ap	1,2,3,4,5,12	1,2,3
3.	**Use** real-world data sets to practice creating visualizations and improve the skills.	Ap	1,2,3,5,6,9	1,2,3
4.	**Discuss** the methodologies of storytelling with data	AP	1,2,4,5,10	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Addition of two OAs	Course project	Total Marks
Marks	30 + 30 = 60 marks	10 + 10 = 20 marks	20 marks (with report & presentation)	100

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be ≥ 35%, however overall score of CIE + SEE should be ≥ 40%.
3.	Question paper contains 3 parts - A,B & C, wherein students have to answer any 5 out of 7 questions in part A, 5 out of 10 questions choosing 1 question from each unit in part B & 1 out of 2 questions in part C.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓	✓		✓								✓	✓	
2	✓	✓	✓	✓	✓							✓	✓	✓	✓
3	✓	✓	✓		✓	✓			✓				✓	✓	✓
4	✓	✓		✓	✓					✓			✓	✓	✓
5															
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Data visualization techniques using Python and Julia	Finance, Health care, banking etc	Data Scientist, Data science Engineer, Visualization Specialist

Object Oriented Modeling and Design

Course Code	22CS542	Course type	PEC	Credits L-T-P	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			Total credits	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To Bring out the importance of object oriented software development
2.	To study and understand the UML notations as applicable to different stages of software development.
3.	To model given real world problem using object oriented concepts and notations.

Pre-requisites : Basics of object oriented programming and Software Engineering	
Unit – I	**Contact Hours = 8 Hours**
Introduction, Modeling Concepts, Class Modeling: Introduction to Object Orientated (OO) development. OO themes; OO modeling history. Modeling as Design Technique: Modeling; abstraction; The three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and Inheritance.	

Unit – II	Contact Hours = 8 Hours
State Modeling, Advanced State Modeling: State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior; Advanced State Modeling: Nested state diagrams; Nested states.	

Unit – III	Contact Hours = 8 Hours
Interaction Modeling, Advanced interaction Modeling Interaction Modeling Use case models; Sequence models; Activity models. Use case relationships; Procedural sequence models; Special constructs for activity models.	

Unit – IV	Contact Hours = 8 Hours
Domain Analysis: Overview of domain analysis; Domain class model; Domain state model; Domain interaction model; Iterating the analysis.	

Unit – V	Contact Hours = 8 Hours
Application Analysis: Application interaction model; Application class model; Overview of class design	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

Unit No.	Self-Study Topics
1	Application of Object Oriented Design and Modeling
2	Build a model based on a case study.
5	Introduction to Design Patterns

Books	
	Text Books:
1.	Michael Blaha, James Rumbaugh: Object-Oriented Modeling and Design with UML, Pearson Education, 2nd Edition and onwards.
2.	Grady Booch, James Rumbaugh, Ivar Jacobson, "Unified Modeling Language User Guide", Publisher: Addison Wesley.
	Reference Books:
1.	Grady Booch et al: Object-Oriented Analysis and Design with Applications, 3rd Edition, Pearson Education, 2007 and onwards.
2.	Brahma Dathan, Sarnath Ramnath: Object-Oriented Analysis, Design, and Implementation, Universities Press, 2009 and onwards.
3.	Grady Booch, James Rumbaugh, Ivar Jacobson, "Unified Modeling Language Reference Manual", Publisher: Addison Wesley.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	Object-Oriented Design Course by University of Alberta | Coursera

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Book Tests (OBT)
3.	Flipped Classes	3.	Course Seminar
4.	Online classes	4.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels**: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr – Create**		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Identify** and **explain** different UML notations for a given problem statement	**Un**	1,2	1
2.	**Apply** UML notations to model real world problems at different stages of software development.	**Ap**	2,3,5	1,2
3.	**Perform** domain and application Analysis for a given real world problems.	**Ap**	2,3,11	1,2,3
4.	**Analyze** the requirements for a real world problem or a specification and develop a course project as the solution using OOP language	**An**	1,2,3,5,9,10,11,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Open Assignments (OA)	Course project (CP)	Total Marks
Marks	30 + 30 = 60 marks	10 + 10 = 20 marks	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓											✓		
2		✓	✓		✓								✓	✓	
3		✓	✓								✓		✓	✓	✓
4	✓	✓	✓										✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	After undergoing an object-oriented modeling course, individuals can enhance their skills and competencies applicable across various industries, sectors, and domains.	Object-oriented modeling is foundational to software engineering, making it applicable in industries such as: Information Technology, Services, Software Development Companies .	Software Engineer/Developer Systems Analyst Database Administrator Product Designer/Engineer Designing and Systems Engineer Business Analyst Project Manager Quality Assurance Engineer Data Scientist Healthcare IT Specialist
2	Students have a basic idea to develop the Software		

Advanced Java

Course Code	**22CS543**	Course type	**PEC**	**Credits L-T-P**	2-0-1
Hours/week: L - T- P	2 - 0 –2			**Total credits**	3
Total Contact Hours	L = 30 Hrs; T = 0 Hrs; P = 10 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To introduce the fundamental concept of Java Collections for efficient data organization and manipulation.
2.	To implement advanced Java concepts such as multithreading.
3.	**To design the Graphical User Interface (GUI) through Java Swing.**
4.	To Develop web applications using Java EE technologies like Servlets

Required Knowledge of : Basics of Java Programming

Unit – I	**Contact Hours = 8 Hours**
Collections: Overview, Collection Interfaces, Collection classes, storing user defined classes in collections, working with Maps, Comparators, the collections algorithms.	

Unit – II	**Contact Hours = 8 Hours**
Multithreading: The Java thread model, the main thread, creating a thread, multiple threads, isAlive() and join(), thread priorities, synchronization, inter thread communication, suspending, resuming and stopping threads. The Stream API: Stream Basics, Stream Interfaces, Methods, How to Obtain a Stream, A Simple Stream Example, Reduction Operations.	

Unit – III	**Contact Hours = 8 Hours**
Introducing Lambda Expressions: Block Lambda Expressions, Generic Functional Interfaces, Passing Lambda Expressions as Arguments, Lambda Expressions and Exceptions, Lambda Expressions and Variable Capture, Method References.	

Unit – IV	**Contact Hours = 8 Hours**
Introducing Swing: The Origins of Swing, Key Swing Features, Components and Containers, The Swing Packages, A Simple Swing Application, Event Handling, Create a Swing Applet, JLabel and ImageIcon, JTextField.	

Unit – V	**Contact Hours = 8 Hours**
Servlets: Background; The Life Cycle of a Servlet; Using Tomcat for Servlet Development; A simple Servlet; The Servlet API; The Javax.servlet Package; Reading Servlet Parameter; The Javax.servlet. http package	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
1	2	Collections and collection class
2	2	Multithreading
3	1	lambda expression
4	3	Simple Swing GUI
5	1	Servlets Program

Books	
	Text Books:
1.	Herbert Schildt, Java The Complete Reference, TataMcGraw Hill, Ninth edition onwards
2.	H.M.Deitel, P. J. Deitel , Advanced Java 2 Platform HOW TO PROGRAM", Prentice Hall, Ninth edition onwards.
	Reference Books:
1.	Rod Johnson, J2EE Design and Development" , Wrox publishers, July 2004 and onwards.
	E-resources (NPTEL/SWAYAM. Any Other)- mention links
1.	https://www.shiksha.com/online-courses/programming-in-java-by-nptel-course-nptel22
2.	https://onlinecourses.nptel.ac.in/noc22_cs47

Course delivery methods		**Assessment methods**	
1.	Chalk and Talk	1.	IA tests- Theory & Lab based
2.	PPT and Videos	2.	Project phase 1 & 2
3.	Flipped Classes	3.	SEE- Project evaluation
4.	Practice session/Demonstrations in Labs	4.	SEE- Solving an Open ended problem
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re - **Remember**; Un - Understand; Ap - **Apply**; An - **Analysis**; Ev - **Evaluate**; Cr – **Create**

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Make use of the collection framework to store and manipulate data efficiently	Ap	1,2	1,2
2.	Explore and understand use of Java Server Programming	Ap	1	1
3.	Create and Design GUIs using Java Swing.	An	1,2,3	1
4.	Develop advanced skills for programming in Java	Ap	1,2,12,5,3,9,10,11	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test **(COMPULSORY)** will be part of the CIE. **No SEE for Lab**.

THEORY (40 marks)		**PROJECT (60 marks)**			**Total**
IA test (Theory)	**IA test (Lab)**	**Project Phase 1**	**Project Phase 2**	**Project report**	
25 marks	15 marks	25 marks	25 marks	10 marks	100 marks
-Theory IA test should be of one-hour duration. -Lab IA test should be of two/three-hour duration. -Project batch will ideally consist of 2 students (maximum of 3). -Project Phase 1 presentation will be conducted after 6 weeks and Project Phase 2 presentation will be conducted after 13 weeks from the start of the semester. -Submission of Project report is compulsory.					
Eligibility for SEE: 1. 40% and above (16 marks and above) in theory component 2. 40% and above (24 marks and above) in project component 3. Not eligible in any one of the two components will make the student **Not Eligible** for SEE					

Semester End Examination (SEE):

1.	It will be conducted for 100 marks having 3 hours duration.		
2.	Lab Open ended program/problem/experiment Write-up & execution (1 open ended expt)- (20 marks write-up + 20 marks algorithm/flowchart + 10 marks execution)	50 marks	100 marks
	Project evaluation a. Initial write up stating the objectives, methodology and the outcome b. Hardware project: Exhibiting and demonstration of working of project. Software project: Demonstration of the programming capabilities by writing flowchart, algorithm and codes related to a section of the project. c. Viva-voce	10 marks 30 marks 10 marks	
3.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.		
4.	SEE will be conducted in project batches by **Internal & External examiners** together.		

CO-PO Mapping (planned)													CO-PSO Mapping (planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓	✓									✓	✓		
2		✓	✓									✓	✓		
3		✓										✓	✓		
4	✓											✓	✓		
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Developed and enhanced dynamic applications using SWINGS.	Healthcare Sector	Front-End Developer
2	Developed high-quality, scalable code for various modules in the complex software development	e-commerce, Logistics	Junior Developer. Java Web Developer.
3	Developer is responsible for designing, developing, and maintaining Java-based programs.	Banking and finance	Architect. Java EE developer.

Robotic Process Automation

Course Code	**22CS544**	**Course type**	PEC	**Credits L-T-P**	2-0-1
Hours/week: L - T- P	2 - 0 – 2			**Total credits**	3
Total Contact Hours	L = 20 Hrs; T = 0 Hrs; P = 20 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To Describe Robotic Process Automation (RPA) and its benefits
2.	To understand and use sequences / flowcharts to build automation
3.	To Explain and apply data manipulation
4.	To utilize the concept of selectors, descriptors to build ui automation
5.	To Describe version control system and orchestrator functionalities.

Required Knowledge of : Basics of logical reasoning and programming

Unit – I	**Contact Hours = 8 Hours**
Introduction to Robotic Process Automation (RPA) concepts, tools and fundamentals of implementation: Robotic Process Automation (RPA) and its benefits, UiPath Business Automation Platform, the UiPath core RPA components (Studio, Orchestrator and Robot with Assistant), two types of UiPath robots—attended and unattended, the key components of the UiPath Studio user interface, modern vs classic design, variables in an automation project , common data types used in UiPath Studio and conversion methods, arguments in an automation project, Invoke Workflow File Activity to chain workflow execution and pass data through arguments, Automation best practices, global constants and global variables in your automation projects	

Unit – II	**Contact Hours = 8 Hours**
Control flow, common RPA implementations, Exception handling and Debugging : Sequences and Flowcharts, control flow statements for decisions and iterations, Excel and Workbook activities, different types of exceptions, best practices for error and exception handling , file and folder activities - selecting, creating, deleting, moving and renaming files and folders, UiPath Studio integration capabilities - Gmail account, retrieve, work with emails, Microsoft Office 365 activities, working with PDF files, debugging actions	

Unit – III	**Contact Hours = 8 Hours**
Data Manipulation: Explain and apply data manipulation: VB.NET methods to manipulate string variables, RegEx builder in UiPath Studio, string activities in Studio, Lists and data manipulation on Lists, Invoke and String Conversion methods, Arrays and Lists, dictionary variables and data manipulation, Working with Datatable variable in Studio, comparison of worksheet and a data table	

Unit – IV	**Contact Hours = 8 Hours**
UI Automation, Descriptors and Selectors Synchronizing activities in automation workflows, Check App State activity and Verify Execution feature, Pick Branch activity, Targeting methods used in UI automation and characteristics ,Validate target	

elements, Fine-tune descriptors using the 'Dynamic Text Target' option, wildcards, variables, and making adjustments to enhance image accuracy, the structure and type of selectors in the context of web development, the functionality and purpose of the Property Explorer tool during editing selectors

Unit – V	**Contact Hours = 8 Hours**
Version Control System, Orchestrator resources and Project organization: Orchestrator capabilities and entities, tenant context and the folder context, Orchestrators resources, Benefits and challenges of using version control systems, basic GIT features for version control, project layout for an automation process, split complex automation project into functional workflows that can be developed separately, benefits of utilizing best practices for project organization	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
I	4	Basic automation Example
II	3	Web automation and Conditional Statements
III	2	Data Table and Data manipulation
IV	2	Screen Scraping , Data Scraping and PDF automation
V	1	Email Automation & Exception Handling

Unit No.	Self-Study Topics
I	Programming fundamentals
III	Practical exercises on conditional statements and loops
V	Exercises on exception handling

Books	
	Text Books:
1.	Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018ISBN: 9781788470940
	Reference Books:
1.	Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation.
2.	Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant
3	Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation
	E-resources (NPTEL/SWAYAM. Any Other)- mention links
1.	https://www.uipath.com/rpa/robotic-process-automation

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests- Theory & Lab based
2.	PPT and Videos	2.	Project phase 1 & 2
3.	Flipped Classes	3.	SEE- Project evaluation
4.	Practice session/Demonstrations in Labs	4.	SEE- Solving an Open ended problem
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re **- Remember**; Un - **Understand**; Ap - **Apply**; An - **Analysis**; Ev - **Evaluate**; Cr - **Create**

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Explain and utilize the fundamentals of Robotic Process Automation	Un	1	1
2.	Develop familiarity and deep understanding of UiPath tools	Ap	3	1
3.	Develop the ability to independently design and create robots for business processes	Ap	3	1
4	Prepare for UiPath Certified Professional Automation Developer Associate exam by further learning	Ap	1,2,3,5,9,10,11,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test (COMPULSORY) will be part of the CIE. **No SEE for Lab.**

THEORY (40 marks)		PROJECT (60 marks)			Total
IA test (Theory)	IA test (Lab)	Project Phase 1	Project Phase 2	Project report	
25 marks	15 marks	25 marks	25 marks	10 marks	100 marks

-Theory IA test should be of one-hour duration.
-Lab IA test should be of two/three-hour duration.
-Project batch will ideally consist of 2 students (maximum of 3).
-Project Phase 1 presentation will be conducted after 6 weeks and Project Phase 2 presentation will be conducted after 13 weeks from the start of the semester.
-Submission of Project report is compulsory.

Eligibility for SEE:
1. 40% and above (16 marks and above) in theory component
2. 40% and above (24 marks and above) in project component
3. Not eligible in any one of the two components will make the student Not Eligible for SEE

Semester End Examination (SEE):

1.	It will be conducted for 100 marks having 3 hours duration.		
2.	Lab Open ended program/problem/experiment Write-up & execution (1 open ended expt)- (20 marks write-up + 20 marks algorithm/flowchart + 10 marks execution)	50 marks	100 marks
	Project evaluation a. Initial write up stating the objectives, methodology and the outcome	10 marks	

	b. Hardware project: Exhibiting and demonstration of working of project. Software project: Demonstration of the programming capabilities by writing flowchart, algorithm and codes related to a section of the project. c. Viva-voce	30 marks 10 marks	
3.	Minimum marks required in SEE to pass: Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.		
4.	SEE will be conducted in project batches by Internal & External examiners together.		

CO-PO Mapping (planned)													CO-PSO Mapping (planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓		✓										✓		
2	✓												✓		
3	✓												✓		
4	✓	✓	✓		✓				✓	✓	✓	✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Robotic Process Automation with UiPath	HealthCare, Finance, Banking, Education etc	RPA solution architect, RPA developer, RPA Evangelist, RPA Subject Matter Expert etc

Data Warehousing and Data Mining

Course Code	**22CS545**	**Course type**	PEC	**Credits L-T-P**	3 – 0 - 0
Hours/week: L - T- P	3 – 0 – 0			**Total credits**	3
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 0 Hrs Total = 40 Hrs			**CIE Marks**	100
Flipped Classes content	10 Hours			**SEE Marks**	100

Course learning objectives	
1.	To introduce the basic concepts and techniques of data mining and data warehousing.
2.	To understand the different architectures and mining techniques.
3.	To inculcate the skills using recent data mining software for solving practical problems.
4.	To assess the strengths and weaknesses of various data mining methods and algorithms.

Pre-requisites: Database Management System, Design and Analysis of Algorithms.

Unit – I	Contact Hours = 8 Hours
Introduction and Data Pre-processing: Why data mining, what is data mining, What kinds of data can be mined, what kinds of patterns can be mined, Which Technologies Are used, which kinds of Applications are targeted, Major issues in data mining. Data Pre-processing: An overview, Data cleaning, Data integration, Data reduction, Data transformation and data discretization.	

Unit – II	Contact Hours = 8 Hours
What is a Data Warehouse? Differences between Operational Database Systems and Data Warehouses, Data Warehouse Architecture, Data Warehouse Modelling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, From Data warehousing to Data Mining.	

Unit – III	Contact Hours = 8 Hours
Classification and Prediction: Issues regarding Classification and Prediction, classification by Decision tree induction, Bayesian classification, Rule Based classification, Classification Based on the concepts from association rule mining. Other classification methods, prediction.	

Unit – IV	Contact Hours = 8 Hours
Cluster Analysis: What is Cluster Analysis? Types of data in cluster Analysis: a Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical methods, Density Based Methods, Model Based Clustering Methods: Statistical Approach, Neural Network Approach Outliner Analysis.	

Unit – V	Contact Hours = 8 Hours
Application and Trends in Data Mining: Data mining application, Data mining system Products and research Prototypes, Additional Themes on Data Mining, Data Mining and Intelligent Query Answering, Trends in Data Mining.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	2	2	1	1

Unit No.	Self-Study Topics
I	Introduction to Data Lakes
II.	Efficient Processing of OLAP Queries
III.	Metrics for Evaluating Classifier Performance
IV.	Evaluation of Clustering
V.	Privacy, Security, and Social Impacts of Data Mining

Books	
	Text Books:
1.	Jiawei Han, Micheline Kamber , Jian Pei: Data Mining - Concepts and Techniques , 3rd Edition, Morgan Kaufmann Publishers, 2011 and above.
	Reference Books:
1.	Pang Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Addison Wesley, 2007.
2.	G. K. Gupta: Introduction to Data Mining with Case Studies, 3rd Edition, PHI, New Delhi, 2014.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	https://nptel.ac.in/courses/106105174
2.	https://onlinecourses.swayam2.ac.in/cec20_cs12/preview

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Assignment (OA)/ Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	4.	Semester End Examination

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - **Remembe**r; Un - **Understand**; Ap - **Apply**; An - **Analysis**; Ev - **Evaluate**; Cr – **Create**		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Apply** KDD process for finding interesting patterns from warehouse.	Ap	1,2,3	1
2.	**Understand** warehousing architectures and tools for systematically organizing large database and use their data to make strategic decisions.	Un	2,3,4	1,2
3.	**Design and apply** appropriate classification techniques.	An	2,3,4,5	1,2,3
4.	**Apply** clustering the high dimensional data for better organization of the data.	Ap	2,3,4,5	1,2,3

5.	Apply the learnings inculcated throughout the course and develop a course project or present a course seminar.	Ap	1,2,3,4,5,9,10 ,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Open Assignments (OA)	Course project (CP)	Total Marks
Marks	30+30 = 60 marks	10 + 10 = 20 marks	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓	✓										✓		
2		✓	✓	✓									✓	✓	
3		✓	✓	✓	✓								✓	✓	✓
4		✓	✓	✓	✓								✓	✓	✓
5	✓	✓	✓	✓	✓				✓	✓		✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Students can apply appropriate techniques/methods to store and extract the useful information from large data sets.	IT Industry	Software Developer Data Mining Engineer Database Administrator

Research Methodology and IPR

Course Code	22AECCS56	Course type	AEC	Credits L-T-P	2-0-0
Hours/week: L-T-P	2-0-0			Total credits	2
Total Contact Hours	L = 30 Hrs; Total = 30 Hrs			CIE Marks	100
Flipped Classes content	05 Hours			SEE Marks	100

Course learning objectives	
1.	Understand the basic concepts of research and its methodologies
2.	Identify and select the appropriate research.
3.	Understand the basic concepts & types of hypothesis.
4.	Create the awareness about Intellectual Property Rights for the protection of inventions.

Required Knowledge of : --

Unit – I	Contact Hours = 5 Hours
Research Methodology: Introduction Meaning, Objectives, types, Research Approaches. Significance of Research, Research Methods versus Methodology, Research and scientific method, research Process, Criteria of good research, Problems encountered by researchers.	

Unit – II	Contact Hours = 6 Hours
Research Problem: Defining a research problem, selecting a research problem, necessity and techniques involved in defining the research problem. **Data Collection Methods:** Collection of Primary Data, Observation Method, Interview Method, Questionnaires, Schedules, Collection of Secondary Data, Case study method.	

Unit – III	Contact Hours = 9 Hours
Processing and Analysis of Data: Processing operations, Elements/ types of analysis, Statistics in research- measures of central tendency or statistical averages, measures of dispersion, measures of asymmetry (skewness), measures of relationship. **Testing of hypothesis 1:** Definition, basic concepts, procedure, flow diagram, measuring the power of hypothesis tests, tests of hypothesis. **Chi-square test:** Chi-square as a test for comparing variance, steps involved in applying chi-square test.	

Unit – IV	Contact Hours = 5 Hours
Intellectual Property Rights – IPR- Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs)- A brief summary of: Patents, Copyrights, Trademarks, Industrial Designs-Integrated Circuits-Geographical Indications-Establishment of WIPO-Application and Procedures. Research ethics, Plagiarism, Prior art search.	

Unit – V	Contact Hours = 5 Hours
Interpretation and Report Writing: Meaning of interpretation, Why interpretation, Technique of interpretation, Precaution in interpretation, Significance of report writing, Different steps in writing report, Layout of the research report, Types of reports, Mechanics of writing research report.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	01	01	01	01	01

Unit No.	Self-Study Topics [Mention if applicable else NIL]
I	Significance of Research Methodology.
II	Limitations of test of hypothesis.
III	Other measures-Index numbers, Time series analysis.

Books	
	Text Books:
1.	C R. Kothari, **"Research Methodology"**, New Age International Publishers, 2nd edition, 2007.
2.	Dr. B.L. Wadhera, **"Intellectual Property Rights"**, Universal Law Publishing Co. Ltd. 2002
	Reference Books:
1.	Panneer Selvam, **"Research Methodology"**, PHI Learning Pvt. Ltd., 2007.
	E-resources (NPTEL/SWAYAM. Any Other)-
1.	https://onlinecourses.swayam2.ac.in/cec20_ge37

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Assignments (OA)
3.	Flipped Classes	3.	Case studies
4.		4.	Semester End Examination

Course Outcome (COs)

Learning Levels**:** Re **- Remember;** Un **- Understand;** Ap **- Apply;** An **- Analysis;** Ev **- Evaluate;** Cr **- Create**

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Identify and select an appropriate methodology for research.	Un	1,2,9,10	1
2.	Analyze and interpret data collected	Ap	1,2,9,10	1
3.	Analyze the significance of hypothesis testing	An	1,2,9,10	1
4.	Discuss the significance of Intellectual Property Rights & report writing	Ap	1,2,3,9,10,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A,B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓							✓	✓			✓		
2	✓	✓							✓	✓			✓		
3	✓	✓							✓	✓			✓		
4	✓	✓	✓						✓	✓		✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Environmental Studies

Course Code	22CS58A	Course type	HSMS	Credits L-T-P	2-0-0
Hours/week: L-T-P	2-0-0			Total credits	2
Total Contact Hours	L = 30 Hrs; Total = 30 Hrs			CIE Marks	100
Flipped Classes content	5 Hours			SEE Marks	100

Course learning objectives	
1.	To understand the scope of Environmental Engineering.
2.	Identify the Environmental impact due to Human activities.
3.	Identify the renewable and non-renewable sources of energy.
4.	To understand the concept of Disaster Management.
5.	Identify the various Legal aspects in Environmental Protection.

Required Knowledge of : Nil

Unit – I	Contact Hours = 6 Hours
Definition of Environment, Ecology and Ecosystem, Structure and functions of ecosystem, balanced ecosystem, Introduction to Environmental Impact Assessment Natural Resources: Material Cycles – Oxygen, Carbon, Nitrogen and Hydrological cycle. Importance of water quality, Water borne diseases, Water induced diseases, Significance of Fluoride in drinking water.	

Unit – II	Contact Hours = 6 Hours
Energy – Different types of energy, Conventional and Non – Conventional sources – Advantages and Limitations of Wind Mills, Hydro Electric, Fossil fuel, Nuclear, Solar, Biomass and Biogas, Geothermal energy.	

Unit – III	Contact Hours = 6 Hours
Disasters – Natural Disasters: Meaning and nature of natural disasters, their types and effects (Floods, drought, cyclone, earthquakes, Tsunami). Man Made Disasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution and marine pollution.	

Unit – IV	Contact Hours = 6 Hours
Disaster Management: International strategy for disaster reduction. Concept of disaster management and national disaster management framework.	

Unit – V	Contact Hours = 6 Hours
Environmental Protection: Role of Government, Legal aspects, Initiatives by Non – Governmental Organizations (NGO), Environmental Education, Women Education. E-waste and solid waste management rules.	

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	1	1	1	1	1

Unit No.	Self-Study Topics [Mention if applicable else NIL]

Books	
	Text Books:
1.	Benny Joseph, **"Environmental Studies"**, Tata McGraw – Hill Publishing Company Limited (2005).
2.	Sanjay K. Sharma, **"Environment Engineering and Disaster Management"**, USP (2011).
3.	Harsh K. Gupta, **"Disaster Management"**, Universities Press (India) Pvt. Ltd (2003).
4.	Ranjit Daniels R.J. and Jagdish Krishnaswamy, **"Environmental Studies"**, Wiley India Private Ltd., New Delhi (2009).
	Reference Books:
1.	Meenakshi P., **"Elements of Environmental Science and Engineering"**, Prentice Hall of India Private Limited, New Delhi (2006).
2.	Tyler Miller Jr. G., **"Environmental Science – Working with the Earth"**, Tenth Edition, Thomson Brooks/Cole (2004).
	E-resources (NPTEL/SWAYAM. Any Other)-

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Assignment- Open/Industry/Certification
3.	Flipped Classes	3.	Course Project
4.	Online classes	4.	Semester End Examination

Course Outcome (COs)

Learning Levels: Re **- Remember;** Un **- Understand;** Ap **- Apply;** An **- Analysis;** Ev **- Evaluate;** Cr **- Create**

At the end of the course, the student will be able to		Learning Level	PO (s)	PSO(s)
1.	Understand the importance of the Environment and different sources of energy and energy crises.	Un	6,7	1
2.	Understand various environmental disasters and its management.	Ap	6,7	1
3.	Understand the various Legislations related to Environment.	Un	6,7	1

Scheme of Continuous Internal Evaluation (CIE):

Components	Addition of two IA tests	Two Assignments – (Open /Industry/Certification etc)	Course project (CP)/ Case study etc	Total Marks
Marks	30+30 = 60	10 + 10 = 20	20 marks (with report & presentation)	100

-Certification earned by passing the standard Online MOOCs course (1 course of atleast 8 hours defined by BOS) can be considered as a Course activity and awarded maximum of 10 marks.
-Student should score minimum 40% of 60 marks (i.e. 24 marks) in IA tests.
-Lack of minimum score in IA test will make the student Not Eligible for SEE
-Minimum score in CIE to be eligible for SEE: 40 OUT OF 100.

Scheme of Semester End Examination (SEE):	
1.	It will be conducted for 100 marks of 3 hours duration.
2.	**Minimum marks required in SEE to pass:** Score should be $\geq$ 35%, however overall score of CIE + SEE should be $\geq$ 40%.
3.	Question paper contains three parts **A, B and C**. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

CO-PO Mapping (Planned)													**CO-PSO Mapping (Planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
1						✓	✓						✓		
2						✓	✓						✓		
3						✓	✓						✓		
Tick mark the CO, PO and PSO mapping															

Employability Skills I

Course Code	22AECCS58A	Course type	AEC	Credits L-T-P	1– 0 - 0
Hours/week: L - T- P	1 – 0 – 0			Total credits	1
Total Contact Hours	L = 30 Hrs; T = 0 Hrs; P = 0 Hrs Total = 30 Hrs			CIE Marks	100

Course learning objectives	
1.	Skill development is/are personal attributes that influence how well an individual works or interacts with others.
2.	Skill development is/are personal attributes that influence how well an individual works or interacts with others.
3.	In essence, they are essential for individual success in the workplace, their company's success, and their personal life also

Pre-requisites :----

Unit – I	Contact Hours = 6 Hours
***Quantitative Aptitude*:** Number System (2 Hours), HCF, LCM and Decimal Fractions (1 Hour), Simplification (1 Hour) ***Logical Reasoning*:** Blood Relations (1 Hour), Direction Sense Test (1 Hour)	

Unit – II	Contact Hours = 6 Hours
Quantitative Aptitude*:** Percentages (2 Hours), Profit, Loss and Discounts (2 Hours) ***Verbal Ability: Change of Speech and Voice (2 Hours)	

Unit – III	Contact Hours = 6 Hours
Quantitative Aptitude*:** Simple and Compound Interest (2 Hours) ***Logical Reasoning*:** Number and Letter Series (2 Hours) ***Verbal Ability: Sentence Correction (2 Hours)	

Unit – IV	Contact Hours = 6 Hours
***Quantitative Aptitude*:** Averages (2 Hours) ***Logical Reasoning*:** Coding and Decoding (1 Hour), Analogy (1 Hour) ***Soft Skills*:** Body Language (1 Hour), Grooming and Etiquette (1 Hour)	

Unit – V	Contact Hours = 6 Hours
Quantitative Aptitude: Alligations and Mixtures (2 Hours) ***Verbal Ability*:** Sentence Completion (2 Hours) ***Soft Skills*:** Group Discussion and Mock GDs (2 Hours)	

Books	
	Text Books:
1.	The Aptitude Triad , BIZOTIC
2.	How to prepare for Quantitative Aptitude for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 4th Edition, 2018.
3.	How to prepare for Logical Reasoning for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 8th Edition, 2018.
4.	How to prepare for Verbal Ability and Reading Comprehension for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 8th Edition, 2018.
5.	How to prepare for Data Interpretation for CAT & other Management Examinations, Arun Sharma, McGraw Hill Education(India) Private Limited, 5th Edition, 2018.

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Online Quizzes
		3.	Assignments
		4.	Seminar

Course Outcome (COs)

At the end of the course, the student will be able to (Highlight the **action verb** representing the learning level.)

Learning Levels: Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr – Create		**Learning Level**	**PO(s)**	**PSO(s)**
1.	Clear the Aptitude round of recruiters during placements	L2	10, 12	
2.	Perform confidently during the GD and Interview process	L2	10, 12	
3.	Develop behaviors that are appropriate for a professional	L2	10, 12	

Scheme of Continuous Internal Evaluation (CIE):

Components	**Addition of two IA tests**	**Online Quiz**	**Addition of two Assignments**	**Total Marks**
Marks	30+30 = 60	20	10+10 =20	100

- Writing 2 IA tests are compulsory

-Student should score minimum 40% of 100 marks to pass the course.

CO-PO Mapping (Planned)													CO-PSO Mapping (Planned)		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1										✓		✓			
2										✓		✓			
3										✓		✓			
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Logical Thinking	IT Industry	Software Engineer
2	Problem Solving	Automotive	Developer
3	Communication Skills	Education Sector	Project Manager

Micro-Controllers and Embedded Systems Laboratory

Course Code	22CSL59	Course type	PCCL	Credits L-T-P	0 - 0 - 1
Hours/week: L - T- P	0 - 0 - 2			Total credits	1
Total Contact Hours	L = 0 Hrs; T = 0 Hrs; P = 20 Hrs Total = 20 Hrs			CIE Marks	50
Flipped Classes content	--			SEE Marks	50

Course learning objectives	
1.	To guide students in mastering the programming of microcontrollers using Embedded 'C', ensuring they can develop robust and efficient code for embedded applications.
2.	To instruct students on how to interface microcontrollers with a variety of peripheral devices, including sensors, actuators, displays, and communication modules, enhancing their practical skills and system integration capabilities.
3.	To facilitate students' understanding of hardware components by designing and conducting experiments that explore the functionalities of embedded systems, fostering hands-on learning and practical problem-solving skills.

Required Knowledge of : Digital Electronics, 'C' Programming.

List of Experiments

Lab Experiment – I	Contact Hours = 2 Hours
8051 I/O Programming.	
Lab Experiment – 2	**Contact Hours = 2 Hours**
Led Interfacing.	
Lab Experiment – 3	**Contact Hours = 2 Hours**
Timer Programming.	
Lab Experiment – 4	**Contact Hours = 2 Hours**
Counter Programming.	
Lab Experiment – 5	**Contact Hours = 2 Hours**
Liquid Crystal Display Interfacing.	
Lab Experiment – 6	**Contact Hours = 2 Hours**
Digital to Analog Converter (DAC) Interfacing.	
Lab Experiment – 7	**Contact Hours = 2 Hours**
Stepper Motor Interfacing.	
Lab Experiment – 8	**Contact Hours = 2 Hours**
Serial Port Programming.	
Lab Experiment – 9	**Contact Hours = 2 Hours**

Interrupt Programming.	
Lab Experiment – 10	**Contact Hours = 2 Hours**
Sensor and Actuator Interfacing.	

Books	
	Text Books:
1.	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson, Second Edition onwards.
2.	Marilyn Wolf, Computers as Components Principles of Embedded Computing System Design, Morghan Kaufmann Elsevier, Third Edition onwards.
	Reference Books:
1.	David Calcutt, Frederick Cowan, and Hassan Parchizadeh, 8051 Microcontroller: An Applications Based Introduction
2.	Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition.
	E-resources (NPTEL/SWAYAM.. Any Other)- mention links
1.	**https://onlinecourses.nptel.ac.in/noc20_ee42/preview**
2.	https://onlinecourses.nptel.ac.in/noc20_ee98/preview

Course delivery methods		**Assessment methods**	
1.	Practice session/Demonstrations in Labs	1.	Conduction of Experiments
2.	Virtual Labs (if present)	2.	Journal writing
3.	Chalk and Talk	3.	Lab project/ Open ended experiment
4.		4.	Lab Test
5.		8.	Semester End Examination

Course Outcome (COs)

Learning Levels:

Re - Remember; Un - Understand; Ap - Apply; An - Analysis; Ev - Evaluate; Cr - Create

At the end of the course, the student will be able to		**Learning Level**	**PO(s)**	**PSO(s)**
1.	**Apply** programming concepts to effectively code microcontrollers using Embedded 'C'.	**Ap**	1,2	1
2.	**Analyze** the specifications of various peripheral devices and determine suitable interfacing methods with microcontrollers based on their functionalities.	**An**	1,2,3,5	1,2
3.	**Apply** knowledge of embedded systems hardware to design circuits and select appropriate components for specific applications.	**Ap**	1,2,3,5	1,2
4.	**Analyze** the requirements for a real world problem or a specification and develop a course project as the solution	**An**	1,2,3,5, 9,10,11,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

Conduction of experiments & viva-voce	Journal	Lab project/ Open ended expt	Lab Test	Total
20 marks	5 marks	10 marks	15	50 marks

Conduct of Lab:

1. Conduction of the experiment: 15 marks + Viva voce: 5 marks
2. Calculations, results, graph, conclusion and Outcome recorded in Journal: 5 marks
3. Lab project/ Open ended expt: 10 marks
4. Lab Test: 15 marks

Eligibility for SEE:

1. 40% and above (20 marks and above)
2. **Lab test is COMPULSORY**

Scheme of Semester End Examination (SEE):			
1.	It will be conducted for 50 marks of 2/3 hours duration.		
2.	**Minimum marks required in SEE to pass:** Score should be ≥35% , however overall score of CIE+SEE should be ≥40%.		
2.	One or Two experiments to be conducted.		
3.	Minimum marks required in SEE to pass: 20 out of 50		
4.	Initial write up	10 marks	50 marks
	Conduct of experiments, results and conclusion	20 marks	
	One mark question	10 marks	
	Viva- voce	10 marks	
5.	Viva-voce shall be conducted for individual student and not in a group.		

CO-PO Mapping (planned)													**CO-PSO Mapping (planned)**		
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	✓	✓											✓	✓	
2	✓	✓	✓		✓								✓	✓	
3	✓	✓	✓		✓								✓	✓	
4	✓	✓	✓		✓				✓	✓	✓	✓	✓	✓	✓
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Programming Proficiency	Embedded System and IoT Application.	Embedded Engineers
2	Peripheral Interfacing	Embedded System and IoT Application.	Embedded- IoT- Firmware Design Engineer
3	Hardware Design and Selection	Embedded System and IoT Application.	Embedded- IoT- Firmware Design Engineer