GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CM/IT**
PROGRAMME CODE	**06/07**
COURSE TITLE	**PYTHON PROGRAMMING**
COURSE CODE	**CM41202**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CM41202	PYTHON PROGRAMMING	SEC	2	-	4	2	8	4	2	15	35*#	50	20	50	20	25#	10			125

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

1. **FA-TH** represents an average of two class tests of 30 marks each conducted during the semester.
2. a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
3. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
4. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
5. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Python is a powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. Python code is simple, short, readable, intuitive and powerful and thus it is effective for introducing computing and problem-solving for beginners. Its elegant syntax and dynamic typing together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Develop Python programs using control flow statements.
CO2: Perform operations on various data structures.
CO3: Use packages to solve real-time problems
CO4: Apply an object-oriented approach to problem-solving
CO5: Write code for File and Exception Handling.
CO6: Develop Python applications using database connectivity

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		SECTION -I		
		UNIT-I INTRODUCTION TO PYTHON AND CONTROL FLOW STATEMENTS (CL-5 Hrs, Marks- 5)		
1	**TLO 1.1** Explain the given feature of Python. **TLO 1.2** Write a Python program to perform basic input-output operations. **TLO 1.3** Write a Python program to solve a given expression. **TLO 1.4** Implement given decision-making statements and looping statements in the Python program. **TLO 1.5:** Write a Python program using control statements.	**1.1** Introduction: Features, History and Applications of Python, Python IDE's **1.2** Pythn on building blocks: Indentation, Identifiers, Variable, Comments, Keywords **1.3** Basic input output operations: input(),print() **1.4** Operators: Arithmetic, Relational, Assignment, Logical, Bitwise, Membership and Identity operator **1.5** Control flow statements: Conditional statements (if, if-else, if-elif-else, nested if), Loops in Python (while, for, nested loops), Loop manipulation statements (continue, pass, break, else)	Hands-on Demonstration Presentations	**CO1**
		UNIT-II DATA STRUCTURES IN PYTHON (CL -6 Hrs , Marks-7)		
2	**TLO 2.1** Write a Python program to manipulate lists. **TLO 2.2** Write a Python program to manipulate tuples. **TLO 2.3** Write a Python program to manipulate sets. **TLO 2.4** Write a Python program to manipulate dictionaries.	**2.1** Lists: Defining Lists, Accessing values in lists, deleting values from lists, updating lists. Basic List Operations, Built-in List Functions. **2.2** Tuples: Accessing values in Tuples, deleting values from Tuples and updating Tuples. Basic Tuple operations, Built-in Tuple Functions. **2.3** Sets: Accessing values in Set, deleting values from Set and updating Sets. Basic Set operations, Built-in Set Functions. **2.4** Dictionaries: Accessing values in Dictionary, deleting values from Dictionary and updating Dictionary. Basic Dictionary operations and built-in Dictionary Functions.	Hands-on Demonstration Presentations	**CO2**
		UNIT-III PYTHON FUNCTIONS, MODULES AND PACKAGES (CL-5 Hrs , Marks- 5)		

3	**TLO 3.1** Write relevant user-defined functions for the given problem. **TLO 3.2** Write a relevant user-defined module for the given problem. **TLO 3.3** Write packages for the given problem	**3.1** Use of Python built-in functions (Eg. type/data conversion functions, math functions etc.). **3.2** User-defined functions: Function definition, Function call, function arguments and parameter passing, return statement, scope of variable: Global variable and Local variable. **3.3** Modules: Writing modules, importing modules, importing objects from modules, Python built-in modules, (Eg. Numerical and mathematical module, Functional programming module, statistic module), Namespace and Scoping. **3.4** Python Packages: Introduction, Writing Python Packages, using standard (Eg.math, scipy, Numpy, matplotlib, pandas, pandas series etc.) and user-defined Packages.	Hands-on Demonstration Presentations	**CO3**
SECTION II				
UNIT- IV OBJECT ORIENTED PROGRAMMING IN PYTHON (CL-4 Hrs , Marks-6)				
4	**TLO 4.1** Write a Python program using classes and objects to solve a given problem. **TLO 4.2** Implement Python program using different types of constructors. **TLO 4.3** Write a program to demonstrate polymorphism. **TLO 4.4** Write Python code using data abstraction for a given problem. **TLO 4.5** Apply inheritance for the given problem.	**4.1** Object-oriented Concepts: Creating class, Creating object **4.2** Constructors in Python (Parameterized & Non-Parameterized), the self parameter **4.3** Polymorphism: Method Overloading and Overriding **4.4** Data Hiding / Abstraction **4.5** Inheritance: Single Inheritance, Multiple Inheritance, Multilevel Inheritance	Hands-on Demonstration Presentations	**CO4**
UNIT –V FILE HANDLING AND EXCEPTION HANDLING (CL-4 Hrs , Marks-4)				
5	**TLO 5.1** Write Python code for the given reading values from the keyboard. **TLO 5.2** Read data from the given file. **TLO 5.3.1** Write the given data to a file. **TLO 5.3.2** Handle the given exceptions through the Python program.	**5.1** I/O operations: Reading keyboard input, printing to screen. **5.2** File Handling: Opening files in different modes, accessing file contents using standard library functions, reading and writing files, closing files renaming and deleting files. **5.3** Exception Handling: Introduction, 'try: except:' statement, 'raise' statement, user-defined exceptions.	Hands-on Demonstration Presentations	**CO5**

UNIT -VI BUILT-IN GUI PACKAGES AND DATABASE CONNECTIVITY (CL-6 Hrs , Marks-8)				
	TLO 6.1 Create a GUI application using the Tkinter package for the given problem. **TLO 6.2** Create a Python application to connect with the database.	**6.1** Creating GUI using Tkinter: Introduction to Tkinter, Widgets (Entry, Label, Button, RadioButton, Checkbutton), Creating a simple GUI application **6.2** Connecting to Database using MySQL: Installing mysql-connector, cursor() object, execute() method, fetchall() method, Creating simple program to connect database	Hands-on Demonstration Presentations	**CO6**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO1.1** Install the given Python IDE.	*Install the given Python IDE.	2	CO1
2	**LLO2.1** Write a Python program for performing basic input and output operations in a given problem.	*1. Write a Python program that displays a welcome message on the screen. 2. Implement the Python program to read data from the user and display data on the screen.	2	CO1
3	**LLO3.1** Write a Python program to solve a given expression.	*Implement a Python program using the following operators: 1. Arithmetic 2. Relational & Logical 3. Assignment 4. Bitwise 5. Membership 6. Identity	2	CO1
4	**LLO4.1** a. Write a Python program for solving a given problem using various If statements b. Write a Python program for solving a given problem using various Looping statements.	*1.Implement a Python program to demonstrate the use of the following conditional statements: a. Simple IF b. IF..ELSE c. IF..ELIF..ELSE d. nested IF 2. Implement a Python program to demonstrate the use of the following looping statements: a. while loop b. for loop c. nested loop	4	CO1
5	**LLO5.1** Use loop control statements in Python to solve a given problem.	Implement a Python program to demonstrate the use of loop control statements. [continue, pass, break, else]	2	CO1
6	**LLO6.1** Write a Python program to perform operations on a list.	*Create an account on wikipedia.Implement a Python program to perform the following operations on the List: 1. Create a List 2. Access List 3. Update List 4. Delete List	2	CO2
7	**LLO7.1** Write a Python program to use built-in functions on the list. Implement Python program to demonstrate the use of built-in functions/methods on List (Any Eight Functions/methods)	Implement Python program to demonstrate the use of built-in functions/methods on List (Any Eight Functions/methods) Implement Python program to demonstrate the use of built-in functions/methods on List (Any Eight Functions/methods)	2	CO2

	Implement Python program to demonstrate the use of built-in functions/methods on List (Any Eight Functions/methods)			
8	**LLO 8.1** Write a Python program to perform operations on a tuple.	*Implement a Python program to perform the following operations on the Tuple: 1. Create a Tuple 2. Access Tuple 3. Print Tuple 4. Delete Tuple 5. Convert the tuple into a list and vice-versa	2	CO2
9	**LLO 9.1** Write a Python program to manipulate the set.	*Implement a Python program to perform the following operations on the Set: 1. Create a Set 2. Access Set 3. Update Set 4. Delete Set	2	CO2
10	**LLO 10.1** Use built-in functions/methods on sets in Python for solving given problems.	*Implement a Python program to perform the following functions on Set: 1. Union 2. Intersection 3. Difference 4. Symmetric Difference	2	CO2
11	**LLO 11.1** Write a Python program to perform operations on a dictionary.	*Implement a Python program to perform the following operations on the Dictionary: 1. Create Dictionary 2. Access Dictionary 3. Update Dictionary 4. Delete Dictionary 5. Looping through Dictionary 6. Create a Dictionary from a list	2	CO2
12	**LLO 12.1** Write a function to solve a given problem.	*Write a user-defined function to implement the following features: 1. Function without argument 2. Function with argument 3. Function returning value 4. Function positional/required argument 5. Function with keyword argument 6. Function with default argument 7. Function with a variable length argument	2	CO3
13	**LLO 13.1** Write a Python program using an anonymous function. LLO 13.2 Write a Python program to use the function in the argument.	*Write a Python program to demonstrate the use of the following advanced functions: 1. Lambda 2. Map 3. Reduce	2	CO3
14	**LLO 14.1** Write user user-defined module to solve a given problem.	Write a Python program to create and use a user-defined module for a given problem.	2	CO3
15	**LLO 15.1** Select the appropriate module to solve the given problem. **LLO 15.2** Use the given module to solve the problem.	*Write a Python program to demonstrate the use of the following module: 1. math module 2. random module 3. os module 4. static module	2	CO3
16	**LLO 16.1** Write a user-defined package to solve a given problem	*Write a Python program to create and use a user-defined package for a given problem.	2	CO3
17	**LLO 17.1** Write a Python program using classes and objects to solve a given problem.	*Develop a Python program to perform the following operations: 1. Creating a Class with the method 2. Creating Objects of class	2	CO4

		3. Accessing method using object		
18	**LLO18.1** Write a Python program to initialize objects of class using various types of constructors.	*Write a Python program to demonstrate the use of constructors: 1. Default 2. Parameterized 3. Constructor Overloading	2	CO4
19	**LLO19.1** Write a Python program to implement polymorphism.	*Implement a Python program to demonstrate 1. Method Overloading 2. Method Overriding	2	CO4
20	**LLO20.1** Write a Python program that uses data-hiding concepts in Python.	Write a Python program to demonstrate data hiding.	2	CO4
21	**LLO 21.1** Select the appropriate type of inheritance to solve a given problem. **LLO 21.2** Write a Python program using inheritance to solve a given problem.	*Write a Python program to implement 1. Single inheritance 2. Multiple Inheritance 3. Multilevel inheritance	2	CO4
22	**LLO 22.1** Write a Python program using file handling to solve a given problem. **LLO22.2** Write a Python program to implement exceptions.	***Write a Python Program to demonstrate File Handling through: 1. Opening files in different modes 2. Accessing file Reading and Writing file 3. Closing file 4. Renaming and Deleting file	2	CO5
23	**LLO23.1** Write a Python program to implement exceptions.	Implement Python program to demonstrate 1. user-defined exception	2	CO5
24	**LLO24.1** Use appropriate packages in a Python program to create GUI applications.	*1. Write a Python GUI program to import the Tkinter package create a window and set its title. 2. Write a Python GUI program that adds labels and buttons to the Tkinter window.	4	CO6
25	**LLO25.1** Write a Python program to connect the database.	*Write a program to create a connection between the database and Python.	4	CO6
26	**LLO26.1** Write a Python program to display the content from the database.	*Implement a Python program to select records from the database table and display the result.	4	CO6

Note: Out of the above suggestive LLOs –

1. '*' Marked Practicals (LLOs) Are mandatory.
2. A judicial mix of LLOs is to be performed to achieve the desired outcomes

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Self Learning: Yes

Suggestive list of case studies for self learning:

1. Manage small online book store and create a program to manage inventory. Implement a system where store information about each book, such as its title, author, genre, and price. Additionally, Perform

operations such as adding new books, removing books, updating book information, and searching for books by title or author.

2. Develop a program to store information about students in a class. Each student has a unique ID, name, age, and grade. create a system to manage this information efficiently.
3. Developing a project where students need to store unique employee IDs. Each employee has a unique ID assigned to them, and ensure that there are no duplicate IDs in your system.
4. Create a simple dice rolling game where a player rolls two dice, and the sum of the numbers rolled determines their score. The player can continue rolling until they decide to stop, at which point their total score is calculated.
5. Develop an application that calculates the area of different geometric shapes such as rectangles, squares, circles, and triangles.
6. Develop an application that analyzes the frequency of words in a text file and provides basic statistics about the text.
7. Dataset containing information about students' grades in different subjects, and perform various data analysis tasks such as calculating averages, finding the highest and lowest scores, and filtering data based on specific criteria.
8. A Text file containing a list of student names and their corresponding scores. Read this data, calculate the average score for each student, and write the results to another file**.**
9. Develop an application to detects whether a given phrase or sentence is a palindrome, ignoring spaces, punctuation, and capitalization.
10. Develop a graphical user interface (GUI) application for managing a to-do list. The application should allow users to add tasks, view tasks, mark tasks as completed, and remove tasks from the list.
11. Create a graphical user interface (GUI) calculator application that performs basic arithmetic operations such as addition, subtraction, multiplication, and division.
12. Develop a graphical user interface (GUI) weather application that allows users to enter a city name and get the current weather conditions for that city.
13. Build application that acts as an alarm clock. Allow users to set alarms with specific times and optional messages.
14. Develop an application that generates a random strong password based on user-defined criteria (length, inclusion of numbers/symbols).
15. Develop a basic chatbot that can engage in simple conversations, answer questions, and provide information on specific topics.
16. Create a Hangman Game. where the computer selects a word and the player has to guess it letter by letter.Display the progress of the word and the number of guesses remaining.
17. Create a command-line version of the Tic-Tac-Toe game where two players can play against each other.
18. Develop a command-line tool that fetches weather data from an API (like Open Weather Map) based on user input (city name).
19. Create a simple quiz game with multiple-choice questions. Keep track of scores and provide feedback on answers.
20. Develop a contact management system that allows users to add contacts with details like name, phone number, and email address. Implement basic CRUD operations (Create, Read, Update, Delete).
21. Develop a application to generate home automation dash board.

22. Build a COVID-19 tracker that fetches data from a COVID-19 API (such as the one provided bykaggle).Display statistics such as total cases, deaths, and recoveries globally or for a specific country.
23. Build a stock price checker that retrieves real-time stock prices and information from a financial data API (e.g., Alpha Vantage or Yahoo Finance).Display stock prices, historical data, and trends for specified stocks.
24. Develop a recipe management system that stores recipes (name, ingredients, instructions) in a database. Users can add new recipes, search for recipes by name or ingredients, and update existing recipes.
25. Build an expense tracking application that stores expense records (date, category, amount) in a database. Users can add new expenses, categorize them, and view expense summaries.

Activities

- Students are encouraged to use online tools to improve their learning, such as the e-Kumbh from AICTE and the virtual Labs from IIT.
- Students should be encouraged to participate in various coding competitions, such as hackathons, and online coding contests on websites like Hackerrank, Codechef etc.
- At the department level, encourage students to start a coding club
- Students are encouraged to register themselves in various MOOCs such as Infosys Springboard, Swayam etc. to further enhance their learning.

Note:

1. The above is suggestive list of case studies for SLA
2. The faculty must allocate any 2 case studies to individual student. Considering the students technical skills.

Assignment

Prepare a journal of practicals performed in the laboratory.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer System with all necessary Peripherals and Internet connectivity (Any General Purpose Computer available in the Institute)	ALL
2	Any open-source tool (SPYDER / Eclipse IDE), Python Interpreter	
3	Any database software	25,26

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
SECTION-I								
1	I	Introduction to Python and control flow statement	CO1	5	2	3	0	5
2	II	Data Structures in Python	CO2	6	2	2	3	s7
3	III	Python Functions, Modules and Packages	CO3	5	0	2	3	5
		Grand Total		**16**	**4**	**7**	**6**	**17**

SECTION-II								
4	IV	Object Oriented Programming in Python	CO4	4	0	2	4	6
5	V	File Handling and Exception Handling	CO5	4	0	2	2	4
6	VI	Built-in GUI packages and Database connectivity	CO6	6	2	2	4	8
Grand Total				**14**	**2**	**6**	**10**	**18**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	**Summative Assessment (Assessment of Learning)**
Lab performance, Assignment, Self-learning and Seminar/Presentation	Lab. Performance, viva voce

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (Cos)	**Programme Outcomes(POs)**							**Programme Specific Outcomes *(PSOs)**	
	PO-1 Basic and Discipline-Specific Knowledge	**PO-2 Problem Analysis**	**PO-3 Design/ Development of Solutions**	**PO-4 Engineering Tools**	**PO-5 Engineering Practices for Society, Sustainability and Environment**	**PO-6 Project Management**	**PO-7 Life Long Learning**	**PSO-1**	**PSO-2**
CO1	2	1	1	1	-	-	1	-	2
CO2	2	1	1	1	-	-	1	-	2
CO3	3	3	3	2	2	-	2	-	3
CO4	2	2	3	2	-	-	1	-	3
CO5	2	2	2	2	-	-	1	-	2
CO6	3	2	3	3	2	2	2	-	3

Legends:- High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	**Author**	**Title**	**Publisher**
1	K. Nageswara Rao, Shaikh Akbar	Python Programming	Scitech Publications (India) Pvt.Ltd ISBN:9789385983450
2	Mark Lutz	Learning Python	O'Reilly Publication, 5th Edition ISBN13:9781449355739
3	Paul, Barry	Head First Python	O'Reilly Publication, 2nd Edition ISBN: 1491919531
4	David Amos, Dan Bader, Joanna,Jablonski, Fletcher Heisler	Python Basics	Real Python ISBN-13: 9781775093329

XI. LEARNING WEBSITES & PORTALS

1 https://ekumbh.aicte-india.org/allbook.php Python Programming
2 https://Python-iitk.vlabs.ac.in/ Python Programming Lab
3 https://spoken-tutorial.org/watch/Python+3.4.3/Input-output/English/
Introduction to Python and control flow statements, Data Structures in Python, Function and module
4 https://onlinecourses.nptel.ac.in/noc19_cs41/preview Python Programming Course
5https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094439793500160259 2_shared/overview Python for Beginners
6 https://wiki.Python.org/moin/BeginnersGuide Basics of Python
7 https://www.geeksforgeeks.org/Python-gui-tkinter/ Python GUI Programming
8https://www.w3schools.com/Python/Python_mysql_getstarted.asp Python MySQL Database Connectivity
9 https://www.tutorialspoint.com/Python_pandas/index.htm Python pandas package

Name & Signature: **Smt. S. A. Ade** Lecturer in Computer Engineering	 **Smt. H. S. Pawar** Lecturer in Computer Engineering **(Course Experts)**	 **Smt.K.S.Gaikwad** Lecturer in Information Technology
Name & Signature: **Smt.J.R.Hange** (Programme Head)	Name & Signature: **Shri. S.B. Kulkarni** (CDC In-charge)	

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CE/EE/ET/ME/MT/CM/IT/DDGM**
PROGRAMME CODE	**01/02/03/04/05/06/07/08**
COURSE TITLE	**SOCIAL AND LIFE SKILLS**
COURSE CODE	**HU21204**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
HU21204	**SOCIAL AND LIFE SKILLS**	**VEC**	**1**	**--**	**2**	**1**	**4**	**2**	**--**	**--**	**--**	**--**	**--**	**25**	**10**	**--**	**--**	**25**	**10**	**50**

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

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Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
1. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
3. **1 credit** is equivalent to **30 Notional hours**.
4. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

The introduction of a social and life skills course for diploma engineers is indeed a significant step forward in shaping well-rounded professionals. By integrating soft skills training with technical education, this curriculum addresses the growing need for engineers who are not only experts in their field but also adept in interpersonal communication, collaboration, and leadership. Such skills are crucial for success in the modern workforce, where the ability to navigate complex social dynamics can be just as important as technical know-how. Moreover, the emphasis on ethical decision-making prepares engineers to approach their work with integrity and responsibility. As these professionals progress in their careers, the benefits of this comprehensive education will manifest in their ability to innovate, lead, and contribute positively to their communities and the broader society. This forward-thinking approach ensures that the engineers of tomorrow are equipped not just with the tools to excel in their careers, but also with the vision to drive societal progress.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Achieve shared goals through effective teamwork in executing sustainable community development projects.
CO2: Improve cooperation and understanding through refined communication skills.
CO3: Encourage ethical choices and compassionate behaviour by nurturing moral values.
CO4: Foster ethical judgment, honesty, and societal accountability to shape principled and conscientious professionals.
CO5: Equip students with practical financial literacy skills for efficient financial management.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Sr. No	TheoryLearning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
UNIT-I ENGAGEMENTS WITHIN UNNAT MAHARASHTRA ABHIYAN (UMA) (CL Hrs-03, Marks-NIL)				
1.	**TLO1.1:** Recognize the importance of addressing societal needs and involving relevant stakeholders in problem-solving efforts. **TLO1.2:** Integrate academia, society, and technology to devise comprehensive solutions for complex societal issues. **TLO1.3:**Enhance communication and negotiation skills to effectively engage stakeholders, ensuring diverse perspectives and productive collaboration in problem-solving. **TLO1.4:** Utilize critical data sources such as economic surveys, and environmental data to guide decision-making and solution development in problem-solving endeavours. **TLO1.5:** Identify key stakeholders and delineate their roles and interests in addressing societal challenges. **TLO1.6:** Identify essential attributes for measurement in the problem-solving process. **TLO1.7:** Explore diverse	**1.1 Identifying Regional Societal Challenges:** Recognizing Community Needs Requiring Engineering Solutions. **1.2Integrating Multidisciplinary Approaches:** Linking Academia, Society, and Technology **1.3 Involving Diverse Stakeholders:** Engaging Various Actors in the Problem-Solving Process **1.4Accessing Secondary Data Sources:** Utilizing Resources like Census and Economic Surveys **1.5Mapping Problems and Stakeholders:** Understanding Activities' Relevance to System Components and Key Stakeholders **1.6Defining Measurement Metrics:** Identifying Essential Attributes for Evaluation **1.7 Employing Data Collection Tools:** Exploring Surveys and Measurement Equipment **1.8Establishing Measurement Standards:** Developing Survey Forms and Piloting Processes **1.9Conducting Field Surveys:** Quantifying Local Systems such as Agriculture and Transportation **1.10Analyzing Data and Creating**	Considering the unit design, it's vital to consider the following factors during the implementation of the unit: i) Organize students into smaller groups of 5-6 members to carry out fieldwork within the larger cohort. ii) Allocate multiple student groups evenly among all faculty members involved in the course. iii) A team of course faculty will visit local governing bodies like Municipal Corporations, Villages, Panchayats, Zilla Parishads, and Panchayat Samitis to assess small-scale technological or engineering needs within their jurisdiction. iv) The team of course instructors will conduct initial field visits to explore various	**CO1**

	tools and templates for data collection, including surveys and measurement equipment. **TLO1.8:** Establish a structured framework for measuring identified attributes, including the development of survey forms and piloting the measurement process. **TLO1.9:** Gain practical experience in conducting fieldwork to gather primary data, such as agricultural output, rainfall, and transportation networks. **TLO1.10:** Develop proficiency in data analysis to draw meaningful conclusions, informing decision-making and solution development processes.	**Reports:** Summarizing Data and Reflections in Reports, Utilizing Various Formats like Tables and Graphs	scenarios and options for student-led fieldwork to assess and quantify different parameters and characteristics. **a) Session I** will introduce the development approach, fieldwork methodology, and the utilization of case studies as instructional tools. **b) Sessions II** - VII will cover topics such as societal dynamics, stakeholder engagement, value creation, establishing metrics, basic analysis, and preliminary reporting. **c) Session VIII** will wrap up the program with feedback collection and assessment. **d) Field Work:** **1. Pilot Visit** - Testing the survey instrument **2. Survey Visit 1** - Gathering data/information Survey. **3**. **Visit 2-** Further data collection. **4.SummaryVisit-** Concluding activities post-analysis.	
UNIT - II NATIONAL SERVICE SCHEME (NSS) (CL Hrs-03, Marks- NIL)				
2	**TLO2.1:** Enhance communication and leadership abilities to effectively interact with local leaders. **TLO2.2:** Develop proficiency in conducting socio-economic surveys using appropriate data collection techniques and analysis methods to understand community needs. **TLO2.3:** Identify suitable villages and devise activity	2.1 Engaging with Village/Area 2.2 Conducting initial socio-economic surveys in nearby villages. 2.3 Selecting villages for adoption and initiating project activities. 2.4 Conducting thorough socio-economic surveys in the adopted village or area. 2.5 Identifying key issues and challenges within the community. 2.6 Raising awareness about advancements in agriculture, watershed management, wasteland reclamation, renewable energy,	Considering the unit design, it's vital to consider the following factors during the implementation of the unit: i) Organize students into smaller groups of 5-6 members to carry out fieldwork within the larger cohort. ii) Allocate multiple student groups evenly among all faculty members involved in the	**CO2**

	plans based on community needs and available resources. **TLO2.4:** Analyze survey findings to discern socio-economic patterns, obstacles, and potential avenues for progress. **TLO2.5:**Prioritize community issues according to their significance and impact on community welfare. **TLO2.6:** Communicate information on agriculture, watershed management, renewable energy, housing, sanitation, nutrition, and hygiene effectively. **TLO2.7:** Cultivate networking and advocacy skills to foster collaboration among government agencies, development organizations, and the community.	affordable housing, sanitation, nutrition, and personal hygiene. Also, informing about skill enhancement programs, income generation opportunities, government initiatives, legal aid, consumer rights, and related topics. 2.7 Facilitating collaboration between the government and development agencies to implement various schemes in the adopted village or slum.	course. iii) Before selecting a village or slum for NSS activities, it's advisable for teachers to conduct an initial visit. iv)The selected area should have a dense population. iv)Community members should exhibit a willingness to improve their living conditions and actively engage in projects initiated by the NSS for their benefit. vi) NSS units should avoid areas with a history of political conflicts. vii) The chosen area should be conveniently accessible for NSS volunteers to conduct regular visits to the slums.	
UNIT - III UNIVERSAL HUMAN VALUES (CL Hrs-03, Marks- NIL)				
3	**TL03.1:** Apply love and compassion to promote harmony and well-being. **TL03.2:** Demonstrate honesty and transparency to build trust and authenticity. **TL03.3:** Utilize non-violent approaches to resolve conflicts and enhance empathy. **TL03.4:** Align actions with moral principles to promote justice and fairness. **TL03.5:** Employ peace-building strategies for harmony and reconciliation. **TL03.6:** Engage in acts of service to cultivate empathy and social responsibility. **TL03.7:** Prioritize others' needs to foster altruism and	**4.1 Exploring Love and Compassion (Prem and Karuna):** Learning about and embodying the principles of love and compassion in daily life. **4.2 Embracing Truth (Satya):** Understanding the significance of truthfulness and integrating it into one's actions and interactions. **4.3 Embracing Non-Violence (Ahimsa):** Understanding the importance of non-violence and applying it in personal and societal contexts. **4.4 Upholding Righteousness (Dharma):** Exploring the concept of righteousness and practising it through ethical conduct and moral values. **4.5 Cultivating Peace (Shanti):** Reflecting on the	Proposed Learning Approaches for: i) Lecture Delivery ii) Demonstrations iii) Case Studies iv)Role-playing exercises v)Observational Learning vi)Portfolio Development vii) Simulations viii) Inspirational Talks from Industry Professionals ix) On-site Visits to sites or Industries	**CO3**

	generosity. **TL03.8:** Exhibit behaviours that uphold gender equality and respect for diversity to create an inclusive	essence of peace and cultivating inner tranquillity while promoting harmony in relationships and communities. **4.6 Embracing Service (Seva):** Understanding the value of selfless service and actively engaging in acts of kindness and support for others. **4.7 Embracing Renunciation (Sacrifice) Tyaga**: Understanding the concept of renunciation and willingly **letting go of self-interest for the greater good. and attitudes.** **4.8 Promoting Gender Equality and Sensitivity:** Recognizing the importance of gender equality and fostering an environment of inclusivity and respect for all genders through actions and attitudes.		
UNIT - IV VALUE EDUCATION (UNNATI FOUNDATION) (CL Hrs-03, Marks- NIL)				
4	**TLO4.1:** Display comprehension of one's own identity, values, and beliefs. **TLO4.2**: Recognize and express personal strengths and weaknesses effectively. **TLO4.3:**Demonstrate adeptness in active listening by providing feedback and demonstrating empathy. **TLO4.4:**Acquire strategies for handling conflicts constructively and respectfully. **TLO4.5:** Assess and reflect on moral values and principles that influence personal actions and choices. **TLO4.6:** Analyze and assess the moral values and principles guiding individual actions and decisions.	**4.1. Self-awareness and Personal Development** Self-understanding, Identification of strengths and weaknesses, Setting goals and devising plans, Building self-esteem and confidence **4.2.Interpersonal Skills and Effective Communication** Engaging in active listening, Resolving conflicts, Cultivating healthy relationships **4.3. Ethics and Morality** Grasping ethical concepts, Upholding moral values and principles, Making ethical decisions, Demonstrating integrity and honesty **4.4. Social Values and Responsibility** Being punctual and initiating conversation, Managing emotions effectively, Introducing oneself and others, Maintaining a positive attitude Valuing family bonds, Creating	i)Video Demonstrations ii)Flipped Learning Environment iii) Case Studies iv)Role-playing Activities v)Group-based Learning vi)Team-based Learning vii)Utilization of Chalkboard	**CO4**

		favourable impressions, Communicating effectively, Emphasizing cleanliness, hygiene, and organization, Expressing preferences, Fostering confidence Enhancing listening skills, Demonstrating appropriate greetings, Promoting gender equality and sensitivity, Exercising responsibility, Integrating visual and verbal learning, Establishing and pursuing goals, Observing social media etiquette, Efficiently managing time and daily routines		
UNIT - V FINANCIAL LITERACY(CL Hrs-03, Marks- NIL)				
5	**TLO5.1:**Comprehending Savings and Investment Practices. **TLO5.2:**Cultivating Proficiency in Financial Planning. **TLO 5.3:**Developing Competence in Transaction Handling. **TLO5.4:**Achieving Proficiency in Income, Spending, and Budget Management. **TLO 5.5:**Attaining Understanding of Inflation Concepts. **TLO 5.6:** Fostering Competence in Loan Administration. **TLO5.7: A**cknowledging the Significance of Insurance.	**5.1. Fundamentals of Finances:** Grasping concepts of income, expenses, and savings, Employing budgeting techniques, Understanding assets and liabilities, and Recognizing the significance of emergency funds. **5.2. Banking Essentials** Initiating and managing bank accounts, Familiarizing oneself with various account types (savings, checking, etc.), Comprehending interest rates, and Safely utilizing ATMs. **5.3. Management of Credit and Debt** Interpreting credit scores and reports, Identifying different credit types (credit cards, loans, etc.), Responsible debt management, and Preventing involvement in predatory lending. **5.4. Foundations of Investment** Understanding investment types (stocks, bonds, mutual funds, etc.), Assessing risk and return, Implementing diversification strategies, and Formulating investment approaches. **5.5. Financial Planning and Goal Establishment** Establishing financial objectives, Crafting a personalized financial blueprint, Continuously monitoring and adjusting financial goals, and	i) Video Demonstrations ii) Presentations iii) Case Studies iv) Chalkboard Utilization v) Collaborative Learning	**CO5**

		Engaging in long-term financial strategizing. **5.6. Consumer Rights and Duties** Familiarizing oneself with consumer entitlements, Safeguarding against financial scams and fraudulent activities Exercising responsible borrowing and spending practices, Upholding financial privacy and security measures. **5.7. Essentials of Insurance** Exploring different insurance categories (health, life, auto, home, etc.), Understanding insurance policy specifics, Recognizing the importance of insurance coverage, and Navigating the insurance claims process. **5.8. Economic Literacy** Grasping fundamental economic principles, Understanding the concepts of inflation and deflation, Analyzing market trends, and Interpreting economic indicators.		

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	**LLOI.1.1:** Communicating and interacting with residents or children with compassion and empathy, demonstrating an understanding of their needs and emotions.	1.1 Encouraging empathy and kindness through volunteer work at: i) a nearby nursing home ii)a care centre for children from disadvantaged families or similar types of facilities.	2	CO3
2	**LLO 2.1** Enhance goal-setting abilities by engaging in collaborative planning, analyzing obstacles, and reflecting on personal aspirations to align them with broader academic or career goals.	2.1 Pathway to Success: Goal-Setting Exercise	2	CO4
3	**LLO3.1:** Develop effective communication skills by demonstrating compassion, empathy, and understanding towards residents or children, while acknowledging and addressing their needs and emotions.	3.1 Exploring Your Inner World: Self-Reflection Activity	2	CO4

4	**LLO4.1:** Laboratory Learning Outcome: Cultivate structured self-reflection skills to assess personal strengths and weaknesses.	4.1 Strengths and Weaknesses Identification and Analysis Exercise	2	CO4
5	**LLO 5.1:** Display proficiency in time management through the creation and adherence to structured timelines for task coordination.	5.1 Time Management Simulation for Coordinating Industrial Visits	2	CO4
6	**LLO 6.1**: Demonstrate competency in social media etiquette through engaging in activities and adhering to established norms and guidelines.	6.1 Activity on Social Media Etiquette	2	CO4
7	**LLO 7.1:** Develop skills in mapping and analyzing family income and expenses through structured exercises.	7.1. Exercise on Mapping and Analyzing Family Income and Expenses	2	CO5
8	**LLO 8.1**: Apply their knowledge of interest rate calculation to real-world financial situations, improving decision-making skills.	8.1 Exploring Simple and Compound Interest: A Hands-On Exercise on Interest Rate Calculation and Its Impact on Savings and Loans.	2	CO5
9	**LLO9.1:** Enhance comprehension of interest rates and their impact on financial dealings, encompassing savings accounts, Fixed Deposits (FDs), and loans.	9.1 Interest Rate Comparison Exercise: Analyzing Rates for Savings, Fixed Deposits, and Loans.	2	CO5
10	**LLO10.1:** Mastering and implementing safety protocols for ensuring secure ATM transactions.	10.1 Safety Precautions for ATM Usage: Exploring Tips for Secure Transactions	2	CO5

Note: Out of the above suggestive LLOs –

1. A judicial mix of LLOs is to be performed to achieve the desired outcomes

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

SELF-LEARNING - MICRO PROJECT/ASSIGNMENT/ACTIVITIES (ANYONE)

The following list provides examples of activities that can be pursued under the program. Each group has the flexibility to choose from these options or undertake any other activity deemed suitable based on local requirements. The group focuses on the holistic development of the selected area, whether it is a village or a slum.

a) Community clean-up drives

Group tasks for community clean-up drives are,

1. Site Survey and Planning: Identify areas needing attention and plan tasks.
2. Logistics Management: Coordinate supply distribution to volunteers.

3. Volunteer Coordination: Welcome, register, and assign tasks to volunteers.
4. Trash Collection and Segregation: Collect and sort waste into categories.
5. Street Sweeping and Cleaning: Sweep and clean streets, sidewalks, and public areas.
6. Beautification and Landscaping: Enhance aesthetics by planting and trimming.
7. Safety and First Aid: Ensure volunteer safety and manage emergencies.
8. Documentation and Reporting: Capture progress through photos and reports.
9. Community Engagement: Educate and raise awareness among residents.
10. Post-Clean-up Evaluation: Review success and plan future initiatives.

b) Tree plantation initiatives

Group tasks for Tree plantation initiatives,

1. Community Awareness: Workshops to educate on tree benefits.
2. Community Participation: Engage locals in all planting
3. Team Building: Group activities to strengthen community bonds.
4. Leadership Development: Empower individuals to lead initiatives.
5. Communication Workshops: Enhance effective messaging.
6. Problem-solving Discussions: Address planting challenges.
7. Environmental Responsibility: Foster care for green spaces.
8. Cultural Integration: Incorporate local traditions into initiatives.
9. Sustainability Education: Teach sustainable planting practices.
10. Monitoring and Evaluation: Assess impact and plan improvements.

c) Environmental conservation awareness

Group tasks for Environmental conservation awareness

1. Educational Workshops: Teach about conservation methods.
2. Art Competitions: Promote environmental themes through art.
3. Street Plays: Perform interactive skits in public spaces.
4. Awareness Walks: Organize marches with environmental messages.
5. Tree Plantation: Plant trees to enhance green spaces.
6. Clean-up Campaigns: Remove litter from local areas.
7. Guest Lectures: Invite experts to discuss environmental issues.
8. Film Screenings: Show documentaries on conservation topics.
9. Social Media Campaigns: Spread awareness through online platforms.
10. Community Workshops: Educate on waste management and sustainability.

d) Health and sanitation programs

1. Health Education Sessions: Conduct informative sessions on hygiene, disease prevention, and nutrition.
2. Sanitation Infrastructure Evaluation: Assess the effectiveness of existing sanitation facilities and propose improvements.
3. Community Clean-up Events: Organize collective efforts to clean and maintain public spaces for better health outcomes.
4. Distribution of Hygiene Kits: Provide essential hygiene items such as soap, toothpaste, and sanitary products to community members.
5. Vaccination Drives: Coordinate vaccination campaigns to protect against prevalent diseases and promote community health.

6. Water Quality Testing: Conduct regular testing of water sources to ensure safe drinking water for residents.
8. Personal Hygiene Workshops: Offer workshops focusing on personal grooming, handwashing techniques, and menstrual hygiene.
9. First Aid Training: Provide basic first aid training to community members to equip them with life-saving skills.
10. Community Health Surveys: Conduct surveys to assess health needs and gather feedback for future program planning.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No.	Equipment Name with Broad Specifications	Relevant LLO Number
1	Basic engineering measurement instruments, GPS data collection devices, and open-source GIS software like Google Earth and QGIS, along with the Microsoft Office suite.	ALL

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

NOT APPLICABLE

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Formative assessment (Assessment for Learning) Report and presentation of fieldwork activities, Self- Learning (Assignment)	--

X. SUGGESTED COS- POS MATRIX FORM

NOT APPLICABLE

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Mark Stafford Smith and Pamela Matson	Sustainable Development: Principles, Frameworks, and Case Studies	Oxford University Press, ISBN: 9780199588952
2	Katar Singh	Rural Development: Principles, Policies and Management	SAGE Publications Pvt. Ltd, ISBN:978-9351502867.
3	Anand Kumar, Asim Kumar Mandal, and R. Venkata Rao	Maharashtra: Governance and Development"	Routledge India, ISBN: 978-0367709133
4	Dalai Lama and Howard C. Cutler	The Art of Happiness	Riverhead Books, and the ISBN: 978-1594488894.
5	Stephen R. Covey	The 7 Habits of Highly Effective People	Simon & Schuster, ISBN : 978-1982137274.
6	Local college students, UMA staff	Sample Case Studies on the UMA website	IITB-UMA team

XI. LEARNING WEBSITES & PORTALS

Sr.No.	Link/Portal	Description
1	https://www.ugc.gov.in/pdfnews/4371304_LifeSKill_JeevanKaush al_2023.pdf	UHV: UGC Course on life skills. Unit 4 i.e. Course 4 is to be referred
2	https://nss.gov.in/	The National Service Scheme (NSS) website provides information about the NSS program in India. It includes details about the objectives, history, and structure of NSS. Additionally, the website offers resources for NSS volunteers and coordinators, such as program guidelines, training materials, and reports.
3	https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/20160111315015238 08.pdf	Government Resolution of Government of Maharashtra regarding Unnat Maharashtra Abhiyan
4	https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/20160615145407370 8.pdf	Government Resolution of Government of Maharashtra regarding Unnat Maharashtra Abhiyan Guidelines
5	https://www.humanvaluesfoundation.com/.	The Human Values Foundation website offers educators resources for teaching human values and social-emotional learning to children and youth. It provides curriculum-based programs, lesson plans, and activities to foster character development, resilience, and positive behaviour. Additionally, the website shares insights into the foundation's mission, values, and the global impact of its programs in schools.

Name & Signature: **Mr. S.B.Kulkarni** Lecturer in Mechanical Engineering **(Course Experts)**	
Name & Signature: **Smt. J. R. Hange** (Programme Head)	Name & Signature: **Shri. S.B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CM / IT**
PROGRAMME CODE	**06/07**
COURSE TITLE	**DATA STRUCTURE**
COURSE CODE	**CM31202**
PREREQUISITE COURSE CODE & TITLE	**CM21204**
CLASS DECLARATION	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme										
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CM31202	DATA STRUCTURE	DSC	4	-	2	-	6	3	3	30	70	100	40	25	10	25#	10	-	-	150

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, # - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course,
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Data structure is a subject of primary importance in Computer Engineering. Organizing or structuring data is important for implementation of efficient algorithms and program development. Efficient problem solving needs the application of appropriate data structure during program development. The practice and assimilation of data structure techniques is essential for programming. The course will help students to develop the capability of selecting a particular data structure.

III. COURSE-LEVEL LEARNING OUTCOMES (CO'S)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Describe Data structures, Complexity and Array operations.
CO2: Illustrate searching & sorting algorithms.
CO3: Develop applications of Stack.
CO4: Apply operations on queues.
CO5: Write programs to perform operations on Linked List.
CO6: Implement traversing methods of Tree & Graph.

THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		SECTION I		
		UNIT-I INTRODUCTION TO DATA STRUCTURES (CL Hrs-6, Marks-09)		
1.	**TLO 1.1** Define data structure terminologies. **TLO 1.2** Enlist various data structure Operations. **TLO 1.3** Differentiate between various complexities. **TLO 1.4** Use dynamic memory allocation in programs. **TLO 1.5** Write algorithms to perform operations on array.	**1.1 Definition** : Data Structures & Abstract Data Types **1.2 Classification of Data structures:** Linear, Nonlinear, homogeneous, non-homogeneous, static & dynamic. **1.3 Arrays**: Definition & types of array, Memory representation of one & two dimensional array, Application of arrays. **1.4 Operations on Arrays**: Insertion ,Deletion, Traversal **1.5 Algorithm**: The role of an algorithm in computing, analyzing algorithms, Designing algorithms. **1.6** Time and Space Complexity **1.7** Big-Oh Notation	Hands-on Demonstration Presentations	**CO1**
		UNIT-II SEARCHING & SORTING (CL Hrs-08, Marks-14)		
2	**TLO 2.1** Write algorithm and programs for various searching and sorting techniques **TLO 2.2** Use sorting methods to sort dataset.	**2.1 Searching** Linear Search, Binary Search **2.2 Sorting** Bubble Sort, Insertion sort, Selection sort Merge sort, Radix sort	Hands-on Demonstration Presentations	**CO2**
		UNIT-III STACKS (CL Hrs-09, Marks-12)		
3	**TLO 3.1** Implement Stack data structure to carry out various data structure operation. **TLO 3.2** Use stack to solve various problems (likes prefix to postfix conversion, evaluation of expression, Tower of Hanoi etc).	**3.1** Definitions & examples of stack Primitive operations : Push, Pop Overflow & underflow of stack. Representation of stack using array Stacks using Dynamic Arrays or linked list **3.2 Applications of stack. :** Expression Evaluation and Conversion, Polish notation and expression conversion, Reverse String. **3.3 Recursion** Definition and Concept, Types of Recursion Recursion versus Iteration	Hands-on Demonstration Presentations	**CO3**
		SECTION II		
		UNIT- IV QUEUES (CL Hrs-06, Marks-10)		

4	**TLO 4.1:** Define and implement Queue data structure. **TLO 4.2** Perform various operations on queue. **TLO 4.3** Use and identify different types of queue.	**4.1** Definitions & examples of Queues **Concept of Queues** : Front, Rear ,FIFO **Primitive Operations:** Searching, Insertion, Deletion. Overflow & underflow of Queue. **4.2 Types of Queue**: Circular queue, Priority queue, Dequeues **4.3** Representation Of Queue using Array **4.4** Circular queues using Dynamic arrays or linked list	Hands-on Demonstration Presentations	**CO4**
UNIT –V LINKED LIST (CL Hrs-08, Marks-13)				
5	**TLO 5.1** Implement linked list data structure to carry out various data structure operations. **TLO 5.2**Use Linked list to implement other data structures. **TLO 5.3** Perform different operations on linked list.	**5.1. Introduction and Terminologies** Node, Next Address and Pointer, Null pointer, Empty list, Linked List Versus Array **5.2. Types of lists** Single Linked list, double linked list, Circular list **5.3. Operations on Single linked list** Searching, Insertion, Deletion	Hands-on Demonstration Presentations	**CO5**
UNIT –VI TREES & GRAPHS (CL Hrs-08, Marks-12)				
6	**TLO 6.1** Draw binary tree for given data set. **TLO 6.2**Write algorithm for binary tree traversal. **TLO 6.3** Write algorithms to perform given operation on Binary Search Tree. **TLO 6.4** Define terminologies related to Graph. **TLO 6.5** Represent graph using adjacency list and adjacency matrix	**6.1 Introduction and Terminologies** Sub-tree, root ,leaf , left, right, parent, child, siblings, ancestor, descendant, level, depth **6.2 Type of tree** Binary tree, Binary Search tree **6.3 Operations on trees** Insertion, Deletion, Searching **6.4 Traversing** Pre-order, In-order, Post-order **6.5 Graphs**: Introduction and terminology Linear Representation of Graph**:** Adjacency List, Adjacency Matrix of directed graph, Warshall's Algorithm; Shortest Paths, Depth-first search, Breadth-first search	Hands-on Demonstration Presentations	**CO6**

IV. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO 1.1:** Write logical steps for given program flow **LLO 1.2** Write the standard English like statements for programming flow of given Problem statement **LLO 1.3** Calculate the complexity of given problem statement.	*Write an algorithm and calculate the complexity for insertion and deletion of an element from an array.	2	CO1

2	**LLO 2.1:** Declare and initialize the Array. **LLO 2.2** Write C program for implementation of one Dimensional array. **LLO 2.3** Perform the given operations on array.	Program using Arrays : *Write a C program to insert an element *Write a C program to delete an element	2	CO1
3	**LLO 3.1**: Develop Logic for Searching an element from an array. **LLO 3.2** Write C programs to perform Searching.	*Write a C program using linear Search. *Write a C program using Binary Search.	2	CO2
4	**LLO 4.1:** Develop Logic for bubble, Insertion sort algorithm. **LLO 4.2** Write C programs to perform Sorting elements of an array.	*Write C program using Bubble sort. *Write C program using Insertion sort.	4	CO2
5	**LLO 5.1:** Develop Logic for radix, Merge Sort algorithm. **LLO 5.2** Write C programs to perform Sorting elements of an array.	*Write C program using Radix sort. *Write C Program using Selection Sort.	4	CO2
6	**LLO 6.1:** Develop logic for PUSH and POP operations. **LLO 6.2**: Implement different applications of stack.	Program using Stack : *Write a program to PUSH and POP an element.	2	CO3
7	**LLO 7.1:** Implement application of stack to check whether the string is palindrome or not.	Write C program with functions- To check whether given string is palindrome or not that using a stack (Using Reverse String concept)	2	CO3
8	**LLO 8.1:** Develop logic for recursion operation using stack. **LLO 8.2:** Implement different applications of recursion.	Program on Recursion: *Write a program to display Fibonacci series. Write a program to find Factorial of given number.	2	CO3
9	**LLO 9.1:** Develop logic for insert and delete operations. **LLO 9.2:** Write programs for insert and delete operation.	*Program using Queue: a) Write a program to **insert** an element. b) Write a program to **delete** an element.	2	CO4
10	**LLO 10.1:** Implement the logic to traverse a linked list. **LLO 10.1:** Apply a logic of searching on Linked List.	*Write Programs to traverse single link list. Write Programs to search an element in sorted and unsorted linked list.	2	CO5
11	**LLO 11.1:** Write a C program to implement insertion and deletion operation on linked list at different locations.	*Program using Single Linked List : **Insertion and Deletion** (Hint : Use Switch case) a) At the Beginning b) At the End c) Before the node d) After the node	4	CO5
12	**LLO 12.1:** Demonstration of different operations on tree.	*Program for demonstration of Tree Operations :– Create, Insert, In-order, Pre-order, Post-order Traversal.	2	CO6
13	**ALL**	*Micro-project (Refer section **V** for micro project list)	2	ALL

Note: Out of the above suggestive LLOs –

1. '*' Marked Practical's (LLOs) are mandatory.
2. A judicial mix of LLOs is to be performed to achieve the desired outcomes

V. SUGGESTED MICRO PROJECT/ASSIGNMENT/CASE STUDIES ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Micro project

The micro project has to be industry application-based, internet-based, workshop-based, laboratory-based or field-based as suggested by the Teacher.

A) Develop a Supermarket Billing System using C. The key features of this application are listed below:

1. **Bill Report**: It shows the bill report of all the items added in supermarket billing system.

2. Add, Remove or Edit items: With this feature one can add, remove and modify item details. In add items, one can add information or details such as item no., item name, manufacturing date, price, quantity, tax percent, and many more.

3. Show item details: This feature allows users to see the items and the corresponding details given for the item while adding the item.

Use file to store the data.

B) Design and develop the Tic-Tac-Toe Game using C.

Assignment

Prepare a journal of practical performed in the laboratory.

VI. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Hardware: Personal computer Pentium IV,2 GHz minimum (i3-i5 preferable), RAM minimum 2 GB.	For all experiments
2	C/C++ Compiler	

VII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
SECTION I								
1	I	Introduction to Data Structures	CO1	06	4	3	2	09
2	II	Searching & Sorting	CO2	08	2	4	8	14
3	III	Stacks	CO3	09	4	4	4	12
SECTION II								
4	IV	Queues	CO4	06	2	4	4	10
5	V	Linked List	CO5	08	-	5	8	13
6	VI	Trees & Graphs	CO6	08	4	4	4	12
			Grand Total	**45**	**16**	**24**	**30**	**70**

VIII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Lab performance, Assignment, Self-learning and Seminar/Presentation	Lab. Performance, viva voce

IX. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (Cos)	Programme Outcomes(Pos)							Programme Specific Outcomes *(PSOs)	
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	3	3	3	3	1	2	3	1	3
CO2	3	3	3	3	1	3	3	2	3
CO3	3	3	3	3	1	3	3	2	3
CO4	3	3	3	3	1	2	3	2	3
CO5	3	3	3	3	1	2	3	2	3
CO6	3	3	3	-	1	3	3	2	3

Legends:- High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

X. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Reema Thareja	Data Structures using C	Oxford Publications
2	Yashawant Kanetkar	Data Structures Through C	BPB Publications
3	Lipschultz	Data Structures Schaum Outline Series	McGraw Hill Education, New Delhi.2013, ISBN-13: 978-0070701984
	ISRD Group	Data Structures Using 'C	McGraw Hill Education, New Delhi.2013,ISBN-13:978-12590006401

XI. LEARNING WEBSITES & PORTALS

1. https://www.w3schools.in/data-structures-tutorial
2. https://www.geeksforgeeks.org/data-structures
3. https://www.tutorialspoint.com/data_structures_algorithms/index.htm

Name & Signature:

Mrs. Usha C Khake
Lecturer in Computer Engineering

Mrs. Shobha A. Ade
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(Course Experts)

Name & Signature:

Smt. J. R. Hange
(Programme Head)

Name & Signature:

Mr. S. B. Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CM**
PROGRAMME CODE	**06**
COURSE TITLE	**ADVANCED COMPUTER NETWORK**
COURSE CODE	**CM41204**
PREREQUISITE COURSE CODE & TITLE	**COMPUTER NETWORK (CM31206)**
CLASS DECLARATION	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme												
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical							
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CM41204	ADVANCED COMPUTER NETWORK	DSC	2	-	2	2	6	3	3	30	70	100	40	25	10	25@	10	25	10	175

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course,
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

This course is aimed at providing the students with conceptual understanding of Computer Networks with respect to Network and above layers of TCP/IP model. It aims at providing in-depth knowledge of Network Organization, addressing, role of various protocols in Internetworking Environment and Security.

III. COURSE-LEVEL LEARNING OUTCOMES (CO'S)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Setting up and Designing of a network.
CO2: Analyzing different packet routing techniques.
CO3: Demonstrate Process to Process Communication.
CO4: Demonstrate the World Wide Web organization.
CO5: Analyze the types of web documents and network management systems using HTTP.

THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
SECTION I				
UNIT- I. Network Layer I (CL Hrs-06, Marks-18)				
1.	**TLO1.1** Define Logical addressing. **TLO1.2** Explain NAT and its use. **TLO1.3** Describe IPV4 and IPV6	**1.1** Logical Addressing: IPv4 Addresses- Address space, Notations, classful addressing, classless addressing, Network address translation (NAT), IPv6 Addresses- Structure, Address space. **1.2**Internetworking: Need for Network Layer, Internet as a Datagram network, Internet as a Connectionless Network, IPv4- Datagram, Fragmentation, Checksum, Options. **1.3** IPv6- Advantages, Packet format, Extension headers, Transition from IPv4 to IPv6- Dual Stack, Dual Stack, Tunneling, Header translation.	Classroom Learning Collaborative Learning Program development tools	**CO1**
UNIT-II Network Layer II (CL Hrs-06, Marks-12)				
2	**TLO2.1** List error reporting and query messages. **TLO2.2** Compare direct and indirect delivery. **TLO2.3** Describe routing table. **TLO2.4** Describe routing protocols.	**2.1** ICMP-: Types of messages, Message format, Error reporting, Query. **2.2**Delivery: Direct vs Indirect Delivery. **2.3**Forwarding- forwarding Techniques, Forwarding Process, Routing Table, Unicast. **2.4** Routing Protocols: Optimization, Intra and Interdomain Routing, Distance Vector Routing , Link State routing.	Classroom Learning Collaborative Learning Program development tools.	**CO2**

		UNIT- III **(CL Hrs-06, Marks-14)**		
3	**TLO3.1:**Explain process to process delivery **TLO 3.2:** Classify Multiplexing and demultiplexing **TLO 3.3:**Compare Connection oriented and Connectionless services. **TLO 3.4:** Discover TCP and UDP protocols **TLO 3.5:** Illustrate congestion control methods.	**3.1** Process to Process : Delivery Client/Server Paradigm, Multiplexing and demultiplexing, Connectionless. **3.2** Connection-Oriented Service, Reliable vs. Unreliable. Three Protocols, User Datagram Protocol(UDP)- Well Known Ports for UDP, User Datagram, Checksum, UDP Operation, Use of UDP, TCP- TCP Services, TCP Features, Segment, A TCP Connection, Flow Control, Error Control, Congestion Control. **3.3** Congestion: Network Performance, Congestion Control- Open Loop Congestion Control, Closed Loop Congestion Control.	Classroom Learning Collaborative Learning Program development tools.	**CO3**
		UNIT –IV Application Layer I: DOMAIN NAME SYSTEM **(CL Hrs-7 Marks-14)**		
4	**TLO 4.1:** Define name space in WWW. **TLO 4.2:** Summarize working of internet. **TLO 4.3**: Demonstrate working of DNS. **TLO 4.4:** Describe working of Email application. **TLO 4.5**: Classify POP and IMAP.	**4.1** Name Space: Flat Name Space, Hierarchical Name Space, Domain Name Space- Label, Domain Name, Domain, Distribution of Name Space- Hierarchy of Name Servers, Zone, Root Server, Primary and Secondary Servers **4.2** DNS in the Internet: Generic Domains, Country Domains, Inverse Domain, Resolution- Resolver, Mapping names to Addresses, Mapping Addresses to Names, Recursive resolution, Iterative Resolution, Caching. **4.3** ELECTRONIC MAIL AND FILE TRANSFER: Electronic Mail- Architecture, User Agent, Message Transfer Agent: SMTP, Message Access Agent: POP and IMAP, Web-based Mail.	Classroom Learning Collaborative Learning Program development tools.	**CO4**

UNIT V –Application Layer II: WWW AND HTTP (CL Hrs-06, Marks-12)				
5	**TLO 5.1**: Illustrate working of cookies **TLO 5.2:** Differentiate between Static Documents and Active Documents **TLO 5.3:** Explain Proxy Server **TLO 5.4:** Demonstrate Network Management	**5.1**Architecture: Client(Browser),Server, Uniform Resource Locator, Cookies **5.2** Web Documents: Static Documents, Active Documents, HTTP- HTTP Transaction, Persistent vs. No persistent Connection, Proxy Server Network Management System: Configuration Management, Fault Management, Performance Management, Security and Accounting Management. **5.3**HTTPS:The Details HTTPS: Overview , HTTPS Schemes ,Secure Transport Setup(SSL Architecture)	Classroom Learning Collaborative Learning Program development tools.	**CO5**

IV. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO 1.1:** Design a network	*Design a network using Router, Gateway and switches with its required specifications using Cisco Packet Tracer. (using IPv4 addressing)	4	CO1
2	**LLO 2.1:** Analyze and Connect the network to ISPs	*Connect the above network to the internet using available ISPs in India and study different types of ISP's (Using IPv4 addressing)	2	CO1
3	**LLO 3.1**: Create Subnetwork	*Modify above network and create minimum two subnetworks.	2	CO1
4	**LLO 4.1:** Design a network	*Design a network using Router , Gateway and switches with its required specifications using Cisco Packet	2	CO1

		Tracer.(using IPv6 addressing)		
5	**LLO 5.1:** Configure Routing Protocol	*Configure Routing protocol (Distance Vector Routing RIP)using Cisco Packet tracer Simulator	3	CO2
6	**LLO 6.1:** Study different Traffic profiles	*Configure Network traffic analysis tool and study different traffic profiles. (Software :Wireshark)	2	CO3
7	**LLO 7.1:** Configure user agent for mail services.	*Configure User agent for E-mail services.	2	CO4
8	**LLO 8.1:** Configure SMTP.	*Configure SMTP protocol using Cisco packet tracer	4	CO4,CO5
9	**LLO 9.1:** Configure POP3	*Configure POP3 protocol using Cisco packet tracer	4	CO4,CO5
10	**LLO 10.1:** Configure IMAP	*Configure IMAP protocol using Cisco packet tracer	2	CO4,CO5
11	**LLO 11.1:** Configure FTP server and client	*Configure FTP server and client using Cisco packet tracer	2	CO4
12	**LLO 12.1:** Configure Routing Protocol	*Configure Routing protocol (Link State Routing OSPF) using Cisco Packet tracer Simulator	3	CO2

Note: Out of the above suggestive LLOs –

1. '*' Marked Practicals (LLOs) Are mandatory.
2. A judicial mix of LLOs is to be performed to achieve the desired outcomes

V. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Self-Learning YES

Assignment

NA

IKS: Invention of Zero

Self-Learning Activity

a) Set up FTP Server and Client on one network or simulator. Transfer files from client to server and Vice versa.

b) Set up Telnet Server and Client on one network or simulator. Create users on the server and access it through the client.

c) Design a network for an educational institution or any other business by gathering their requirements and design using Simulator with cost estimation.

d) Implement a simple firewall using tools like iptables or Windows Firewall and test its functionality.

e) Analyze Network Traffic using Wireshark or Tcpdump to capture network traffic.

f) Analyze Wireless Network Performance using tools Wireshark or Tcpdump to capture wireless network traffic.

g) Design and implement a simple network-based IDS.

h) Evaluate the performance of the IDS in detecting various types of network attacks.

LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	1) Personal Computer Intel Pentium Onwards Minimum 2GB RAM. 500Gbyte HDD installed with Windows 8 onwards.	ALL
2	1)Cisco Packet Tracer or any other Network Simulator Software	1,2,3,4,5,6,7,8,9, 10,11,12

VI. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	**Network Layer I**	CO1	06	04	08	06	**18**
2	II	**Network Layer II**	CO2	06	04	04	04	**12**
3	III	**Transport Layer**	CO3	07	04	06	04	**14**
4	IV	**Application Layer I: DOMAIN NAME SYSTEM**	CO4	07	04	06	04	**14**
5	V	**Application Layer II: WWW AND HTTP**	CO5	06	04	04	04	**12**
			Grand Total	**Grand Total**	**20**	**28**	**22**	**70**

VII. ASSESSMENT

VIII. METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Lab performance, Assignment, Self-learning, and Seminar/Presentation	Lab. Performance, viva voce

IX. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (Cos)	Programme Outcomes(Pos)							Programme Specific Outcomes *(PSOs)	
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	2	2	2	1	-	1	2	2	-
CO2	2	2	2	2	-	1	2	2	-
CO3	2	2	-	1	-	1	2	2	
CO4	2	2	2	2	-	1	2	2	1
CO5	2	2	2	2	-	1	2	2	1

Legends:- High:03, **Medium:**02, **Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

X. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Behrouz A. Forouzan	Data Communication and Networking	McGraw-Hill Higher Education, 4th Edition, January 2007 ISBN : 978-0072967753
2	Bobbi Sandberg	Networking The Complete Reference	Tata McGraw Hill, 3rd Edition, June 24, 2015· ISBN :9339222199
3	David Gourley, Brian Totty, Marjorie Sayer, Anshu Aggarwal, Sailu Reddy	HTTP: The Definitive Guide	O'Reilly Media, Inc. ISBN:9781565925090

XI. LEARNING WEBSITES & PORTALS

1. **http://www.nptel.ac.in**

Name & Signature: **Mrs. Bharati M. Purohit** Lecturer in Computer Engineering **Mrs. Nanda R. Wagh** Lecturer in Computer Engineering **(Course Experts)**	
Name & Signature: **Smt.J.R.Hange** (Programme Head)	Name & Signature: **Shri. S.B. Kulkarni** (CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE
'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN COMPUTER ENGG AND INFORMATION TECHNOLOGY**
PROGRAMME CODE	**06/07**
COURSE TITLE	**IoT and ROBOTICS**
COURSE CODE	**CM51202**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION	**NO**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CM51202	IoT and ROBOTICS	SEC	1	--	2	1	4	2	--	--	--	--	--	50	20	25@	10	25	10	100

Total IKS Hrs for Term: 0 Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, **#** - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as '**Detained**' in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as '**fail**' and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.
6. * Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

This course is responsible for the super-fast evolution of industry 4.0, where the operations are mostly automated thus eliminating the need for much human intervention. The course describes the network of physical objects-"things" that are embedded with sensors , softwares and other technologies. IoT devices gather information and send it along to a data server where the information is collected, processed and used to make host of tasks easier to perform. IoT and robotics enable the creation of innovative solutions to real world challenges.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1 Integrate hardware and software for IoT Applications.
CO2 Create IoT applications by interfacing various sensors, actuators and embedded boards.
CO3 Develop IoT applications using IoT networking devices.
CO4 Create Robotic application using various commands.
CO5 Install Industrial Robot.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No.	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mappedwith TLO's	Suggested Learning Pedagogies	Relevant Cos
UNIT 1: BASICS OF INTERNET OF THINGS (CL Hrs. -03, Marks- Nil)				
1	**TLO 1.1** Describe IoT building blocks with their relationship. **TLO 1.2** State the features of various Embedded boards. **TLO 1.3 E**xecute a simple Arduino program.	1.1 Introduction of IoT, Things, framework, Emerging Trends, Economic Significance, Technical Building Blocks 1.2 Physical design of IoT, Logical design of IoT, Sensors and Actuators, 1.3 IoT Issues and Challenges, IoT Security and Privacy 1.4 IoT Applications.	Hands-on Demonstration Presentations	**CO1**
UNIT 2 : SENSORS AND ACTUATORS (CL Hrs. - 04, Marks-Nil)				
2	**TLO 2.1** Select various sensors for IoT applications. **TLO 2.2** Interface sensors with Arduino **TLO 2.3** Identify the working techniques of the Sensor. **TLO 2.4** Identify various Actuators available. **TLO 2.5** Explain the process of interfacing the appropriate actuator with Embedded boards. **TLO 2.6** Write the steps for displaying output on various display devices.	2.1 IoT sensor types: Active and Passive Sensors, Analog sensors Digital Sensors 2.2 Programming with Arduino Sensors: sensor, Humidity Sensor, Temperature Sensor, Water Sensor, Motion Sensor, Fire Detection Sensors, Smoke Detection Sensors, Gas Detection Sensors, Soil moisture sensors 2.3 Basic Working Technique of Sensor 2.4 Programming and Interfacing actuators: displaying on LED/LCD with ATMEGA328. 2.5 Displays: LCD, I2C LCD, 7-segment display 2.6 Actuators: Relay, stepper motor, Buzzer, Potentiometer etc.	Hands-on Demonstration Presentations	CO2

UNIT 3: COMMUNICATION IN IOT DEVICES (CL Hrs-03, Marks-Nil)				
3	**TLO 3.1** Explain IoT Protocols. **TLO 3.2** Write the process to use IoT Wireless networking devices in developing IoT applications. **TLO 3.3** Explain the method of performing Wi-Fi connectivity to WEB.	3.1 Introduction to IoT networking - IoT Protocols- HTTP, MQTT, CoAP etc. 3.2 IoT Wireless devices and uses in IoT : LPWAN(Low Power Wide Area Networks),Cellular(3G/G4/5G), Bluetooth, Zigbee, Wi-fi, RFID 3.3 Wi-Fi connectivity to WEB using ESP826 3.4 Raspberry Pi Architecture, Features, Raspberry Pi Vs Arduino, Raspbian OS	Hands-on Demonstration Presentations	CO3
UNIT4:INTRODUCTION TO INDUSTRIAL ROBOTS AND SAFETY(CLHrs-03 ,Marks-Nil)				
	TLO 4.1 Explain the types of industrial robot. **TLO 4.2.** Identidy various elements of the robot system. **TLO4.3** Perform the safety practices while using robot.	4.1 Introduction, Types of robots, Laws of robots. 4.2 Safe practices while handling the robots, applicable safety standard, general safety information 4.3 Basic elements of robot system (Robot Anatomy)-Base, manipulation arm, end effectors, sensors and transducers, actuators and drives, control system	Hands-on Demonstration Presentations	CO4
UNIT5:PROGRAMMING OF INDUSTRIAL ROBOT (CLHrs-02,Marks-Nil)				
5	**TLO 5.**1 Perform installation of industrial robot. **TLO 5.2** Use teach pendant for industrial robot teaching **TLO 5.3** Operate the industrial robot for given condition **TLO 5.4** Perform maintenance of industrial robot.	5.1 Industrial robot installation lifting and mounting of robotic arm and controller. 5.2 Connecting power cable ,encoder cable and teach pendant . 5.3 Robot operation, switching mode jogging, homing the robot. 5.4 Managing robot errors and false logging in and configuration I/O . 5.5 Robot programming: brief introduction to teach pendant, robot programming instruction (MOVE, POINT , WAIT , SET , IF , ELSE, LOOP , HALT, JUMP).	Hands-on Demonstration Presentations	CO5

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No.	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles/Tutorial Titles	Number of Hrs.	Relevant Cos
1	**LLO1.1** Install any embedded system. **LLO1.2** Write a simple Arduino program to interface LED using Arduino Uno IDE.	*a) Install any one embedded system and interface the embedded board with it. (ex- Arduino IDE and Arduino UNO) b) Interface LED with Arduino and write a program to turn it ON/OFF using delay.	2	CO1
2	**LLO 2.1** Interface LDR sensor with Arduino **LLO 2.2** Write a program for the detection of Light.	* Interface the LDR sensor with Arduino and write a program for the detection of Light.	2	CO1
3	**LLO 3.1** Interface Analog Temperature Sensor (e.g. LM35) with Arduino **LLO 3.2** Write a program to sense the Temperature of an Object.	* Interface Analog Temperature Sensor (e.g. LM35) with Arduino and write a program to sense the Temperature of an Object.	2	CO2
4	**LLO 4.1** Interface DHT11 sensor and with Arduino **LLO 4.2** Write a program to display Humidity and Temperature.	* Interface Humidity and Temperature sensor (e.g. DHT11) with Arduino and write a program to display Temperature and Humidity on a serial monitor.	2	CO2
5	**LLO 5.1** Interface Relay and temperature sensor with Arduino **LLO 5.2** Write a program to control relay state based on input from IR sensor	Control action using Relay with Arduino and write a program to turn it ON/OFF when Temperature increases or decreases.	2	CO2
6	**LLO 6.1** Interface PIR/IR/ Ultrasonic Sensor with Arduino/ Raspberry Pi **LLO 6.2** Write program to Detect the motion of object/ Detect the obstacle/ Measure the Distance between sensor and object.	*Interface PIR Sensor with Arduino/ Raspberry Pi to Detect Motion of object and write a program to display motion detected or not. OR Interface IR sensor with Arduino/ Raspberry Pi and write a program to detect obstacle. OR Interface Ultrasonic Sensor with Arduino/Raspberry Pi write a program to measure the Distance between sensor and object.	2	CO2

7	**LLO 7.1** Bluetooth module and LED with Arduino **LLO 7.2** Create Android Application using MIT App Inventor to control LED /Relay	Interfacing Bluetooth Module with Arduino & Creating Android Application using MIT App Inventor to control LED /Relay.	2	CO3
8	**LLO 8.1** Install the appropriate OS for the embedded board. **LLO 8.2** Connect various accessories to Rasberry Pi	***** Setup Raspberry Pi as an interactive computer by installing the appropriate OS with the following accessories: i) display ii) cable to connect Raspberry Pi to display iii) keyboard iv) mouse v) SD card	4	CO3
9	**LLO 9.1** study various components and anatomy of industrial robot. **LLO 9.2** study basic robot motions for given application	*Perform installation of industrial robot: START, STOP, HOMMING, JOGGING (LINEAR AND JOINT MODE)	4	CO4
10	**LLO 10.1** Make a use of basic commands in robotics	*Basic robot program instructions-MOVE,POINT,WAIT,SET,IF,ELSE,HALT,JUMP	2	CO5
11	**LLO 11.1** Make a use of Merged movement commands for robotics applications **LLO 11.2** Program robot to Pick and place operation using suction gripper.	*a) Industrial robot program for Merged movement, circular and arc movement. b) Setup and programming for suction based pick and place.	4	CO4,CO5
12	**LLO 12.1** Program robot for spray painting.	*Perform spray painting of a given part using Robotic arm.	2	CO4, CO5

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Self-Learning:

Automatic Street Light- The Street Light should be automatically ON in the evening and automatically OFF in the morning. LCDand Serial Monitor show the Light Intensity value on the First Line and the Status of the Street Light on the Second Line. USE RGB LED for street Light and use orange colour.

Home Automation through PC- Design and develop a project to control 8 home devices through a PC serial monitor, LCD connected to the project will show the Status of Devices is on or off. Also, show the status of all devices on the serial monitor.

Motion-enabled Room Light- The light present in the Room should automatically ON when human motion is detected and automatically OFF in the absence of human motion. LCD and Serial monitor shows the appropriate message as "Motion detected! Light ON" and "No Motion! Light OFF" when a particular

condition is fulfilled.

Electronic Smart Blind Stick- If someone is in front of a blind person, the LED and Buzzer should be on and the LCD willshow the message" Obstacle. Be Alert" Otherwise LED and Buzzer will remain off and the LCD show the message "Safe.. Keep Walking".

Electronic Notice Board- Any Message sent from the Serial Monitor should be displayed on LCD.

Robotic Sorting System -Setup and programming for Logistic sorting robotics system.

Robotic MIG welding -Setup and programming for robotic MIG welding.

Case study on future robot technology.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No.	Equipment Name with Broad Specifications/Instrument Required	Relevant LLO
1	Sensors-LDR, IR, PIR, Ultrasonic Sensor, DHT11, LM35, Gas and smoke sensor	2,3,4,5,6,7
2	Bluetooth, Wi-Fi, and Ethernet modules	All
3	Arduino/NodeMCU/Raspberry Pi-controllers	All
4	Actuators- LED, Buzzer, Switches, Relay, Sprinkler,I2C LCD, 7-segment display, potentiometer, Servo motor, Stepper motor, DC motor, Camera module	All
5	Accessories - Resistors, Jumper wires, Bread Board	All
6	Software tools-Arduino UNO IDE, Tinkercad, Linux	All
7	Machine tending compatible with industrial Robot-dummy parts ,application pannel,safety fence,operating pannel and HMI,Cell peripheral items,Robot with control pannel ,teach pendant,power cables	9,10,11,12
8	Python lab-Raspberry Pi microcontroller,Arduino microcontroller,I/O box	9,10,11,12

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Unit	Unit Title	Aligned Cos	Learning Hours	R Level	U Level	A Level	Total marks
1	**BASICS OF INTERNET OF THINGS**	**CO1**	**03**	--	--	--	--
2	**SENSORS AND ACTUATORS IN IOT**	**CO2**	**04**	--	--	--	--
3	**COMMUNICATION IN IOT DEVICES**	**CO3**	**03**	--	--	--	--
4	**INTRODUCTION TO INDUSTRIAL ROBOT AND SAFETY**	**CO4**	**03**	--	--	--	--
5	**PROGRAMMING OF INDUSTRIAL ROBOT**	**CO5**	**02**	--	--	--	--

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment forLearning)	Summative Assessment (Assessment ofLearning)
Each Practical will be assessed considering 60% weightage to the process, and 40% weightage to the product.	End Semester Exam based on Practical performance and Viva-voce.

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (Cos)	Programme Outcomes(Pos)								
	PO-1 Basic and Discipline-Specific Knowledge	**PO-2 Problem Analysis**	**PO-3 Design/ Development of Solutions**	**PO-4 Engineering Tools**	**PO-5 Engineering Practices for Society, Sustainability and Environment**	**PO-6 Project Management**	**PO-7 Life Long Learning**	**PSO-1**	**PSO-2**
CO1	**1**	**2**	**1**	**3**	**1**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**
CO3	**2**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**2**
CO5	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**

Legends:- High:03, **Medium:**02, **Low:**01, **No Mapping:** --
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr. No.	AUTHOR	TITLE	PUBLISHER
1	Cornel M Amariei	Arduino Development Cookbook	PACKT publishing Ltd. ISBN 978-1-78398-294-3
2	Arshdeep Bahga, Vijay Madisetti	Internet of Things: A Hands-On Approach	Orient Blackswan New Delhi ,ISBN: 978- 0996025515 628/- 2
3	David Hanes, Gonzalo Salgueiro, Patrick Grossetti Cisco Press –	IoT Fundamentals: Networking Technologies, Protocols, and Use Casesfor the Internet of Things	Cisco Press ISBN: 978-1- 58714-456- 1 599
4	Simen Monk	Raspberry Pi Cookbook	Publisher(s): O'Reilly Media, Inc. ISBN: 9781098130923
5	Mikell P.Groover,Micheil Weiss,Roger N.Nagel,Nicholas G.Ordrey and Ashish Dutta	Industraial Robotics	McGraw Hill education(India) Pvt. Ltd,Chennai 2012, ISBN:9781-1-25-900621-0

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://github.com/microsoft/IoT-For-Beginners	All practicals
2	https://www.javatpoint.com/difference-between-sensors-and-ac tutors	Sensors and Actuators
3	https://www.geeksforgeeks.org/introduction-to-internet-of-th ings-iot-set-1/	Online content of Internet ofThings
4	https://hands-on-books-series.com/iot.html	Introduction to IoT
5	https://hands-on-books-series.com/iot.html	Hands-on approach to IoT
6	https://www.raspberrypi.org/	Raspberry Pi Hands-on tutorial

Name & Signature: **Smt. J. P.Dandale** Lecturer in Computer Engineering	Name & Signature: **Smt. Priya K.Zade** Lecturer in Computer Engineering **(Course Experts)**	Name & Signature: **Smt. S.P.Dudhe** Lecturer in Information Technology
Name & Signature: **Smt.J.R.Hange** (Programme Head)	Name & Signature: **Shri. S.B. Kulkarni** (CDC In-charge)	

GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	**DIPLOMA IN CM**
PROGRAMME CODE	**06**
COURSE TITLE	**DATA MINING**
COURSE CODE	**CM51201**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CM41204	DATA MINING	DSC	4	--	2	--	6	3	3	70	30	100	40	25	10	25#	10	--	--	150

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment**, SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, # - External Assessment,***#** - Online Examination,**@$** - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours**.
5. * Self-learning hours shall not be reflected in the Timetable.

6.* Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Data mining is a process used by companies to turn raw data into useful information. By using software to look for patterns in large batches of data, businesses can learn more about their customers to develop more effective marketing strategies, increase sales and decrease costs. The objective of this course is to train students in data mining and data warehousing concepts using open-source tools, languages and datasets.

III. COURSE-LEVEL LEARNING OUTCOMES (CO's)

Students will be able to achieve & demonstrate the following CO's on completion of course-based learning

CO1: Understand concepts of data mining.
CO2: Implement statistical methods on data.
CO3: Apply data pre-processing techniques.
CO4: Use classification and clustering techniques.
CO5: Use open-source tools for data mining.
CO6: Describe data warehouse concepts.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
SECTION-I				
UNIT-I BASICS OF DATA MINING (CL Hrs-6, Marks-08)				
1.	**TLO1.1**.DataMining concept. **TLO1.2** Describe the architecture of data mining **TLO1.3** Kinds of patterns **TLO1.4** Cluster and outlier analysis.	**1.1** What is data mining? Issues and Challenges in DM, DM Applications. **1.2** Kinds of Data, Database Data, Data Warehouses, Transactional Data Other Kinds of Data, Architecture of data mining. **1.3** Kinds of Pattern Characterization and Discrimination, Mining frequent patterns, associations and correlations, Classification and regression analysis for predictive analysis **1.4** Cluster analysis, Outlier analysis.	Hands-on Demonstration Presentations	**CO1**
UNIT-II KNOW DATA CONCEPTS (CL Hrs-10, Marks-10)				
2	**TLO2.1**Mining Techniques and Attribute Relation File Format (ARFF). **TLO2.2** Practice basic Statistical calculations on Data using WEKA, and Tableau. **TLO2.3** Describe different dispersion techniques.	**2.1** Data Attributes: Nominal Attributes, Binary Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes **2.2** Central Tendency- Mean, Median, and Mode for grouped and ungrouped data. **2.3** Dispersion: Range, Quartiles, Variance, population Standard Deviation, and Interquartile Range, an outlier.	Hands-on Demonstration Presentations	**CO2**
UNIT-III DATA PREPROCESSING (CL Hrs-15, Marks-17)				
3	**TLO3.1** 3a. Data preprocessing **TLO3.2** Data cleaning **TLO3.3** Data integration **TLO3.4** Data reduction	**3.1** Need of preprocessing, Tasks in Data Preprocessing **3.2** Data Cleaning, Missing Values Noisy Data, Data Cleaning as a Process **3.3** Data Integration Entity Identification Problem, Redundancy and Correlation Analysis, Tuple Duplication, Data Value Conflict Detection and Resolution **3.4** Data Reduction, Wavelet Transforms Principal Component Analysis, Attribute Subset Selection, Parametric data reduction Histograms, Clustering	Hands-on Demonstration Presentations	**CO3**

SECTION-II				
UNIT-IV CLASSIFICATION AND CLUSTERING (CL Hrs-15, Marks-18)				
4	**TLO4.1**: . Describe various classification methods. **TLO4.2** Describe clustering.	**4.1** Basic Concepts, Decision tree induction, Bayes classification methods, Rule-based classification, Support vector machines,K-Nearest neighbour classifier, Genetic algorithms, Fuzzy sets **4.2** Clustering: K means, Hierarchical clustering, Partition clustering	Hands-on Demonstration Presentations	**CO4**
UNIT –V OPEN SOURCE DATA MINING TOOL (CL Hrs-04, Marks-04)				
5	**TLO 5.1** Any data mining tool introduction. (e.g. WEKA tool,Tableau) **TLO 5.2** Features of data mining tool.	**5.1** Data mining tool introduction and installation **5.2** Features of data mining tool: Installation, Load data, File formats, Preprocessing data, Classifiers, Clustering, Association, Feature Selection.	Hands-on Demonstration Presentations	**CO5**
UNIT –VI DATA WAREHOUSING(CL Hrs-10, Marks-13)				
6	**TLO 6.1** Data Warehousing concept. **TLO 6.2** Describe the architecture of data warehousing.	**6.1** Basic concepts, Differences between Operational Database Systems and Data Warehouses, Characteristics of Data Warehouse, Functionality of Data Warehouse, Advantages, disadvantages and Applications of Data Warehouse. **6.2** Data warehouse: A Multitier architecture, stages of data warehouse Data warehouse models: Enterprise Warehouse, Data Mart, Virtual Warehouse. Extraction, Transformation and loading, Metadata repository.	Hands-on Demonstration Presentations	**CO6**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/ TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	**LLO 1.1:** Understand the concept of ARFF files.	*Make use of ARFF files taking input and displaying the output of the files.	2	CO1,CO2
2	**LLO 2.1:** Understanding and Installing Data Mining Tool.	*Install and use data mining tools.	2	CO5
3	**LLO 3.1:**.Create an ARFF file using CSV.	*Convert any Excel file to .csv format and prepare it as an ARFF file.	2	CO1,CO2
4	**LLO 4.1:** Apply data cleansing techniques on datasets.	*Apply data cleansing on any two datasets. 1:http://archive.ics.uci.edu/ml/ 2: www.kdnuggets.com/datasets/)	2	CO3

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/ Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
5	**LLO 5.1**: Apply preprocessing and classification techniques to the dataset.	*Classify any two datasets using a decision tree. (www.kdnuggets.com/datasets/)	4	CO4
6	**LLO 6.1** Apply and implement different Classification techniques on given datasets.	*Demonstration of classification rule process on dataset employee. arff using naïve Bayes algorithm.	2	CO4
7	**LLO 7.1** Apply and implement support vector algorithm on given datasets.	*Demonstration of classification rule process on dataset cricket.arff using support vector algorithm.	2	CO4
8	**LLO 8.1** Apply and implement different Clustering techniques on given datasets.	*Demonstration of clustering rule process on dataset iris.arff using simple k-means.	2	CO4
9	**LLO 9.1:** Perform clustering techniques on the dataset.	*Demonstration of hierarchical Data Clustering algorithms on the weather data set.	2	CO4
10	**LLO 10.1 Apply** data different association techniques on datasets.	*Demonstration of Association rule process on any dataset	2	CO4
11	**LLO 11.1:** Handle Various open-source data mining tools.	*Practice various data mining techniques using open-source tools.	2	CO5
12	**LLO 12.1** Handle Various open-source data warehouse tools.	*Install and use the Teradata data warehouse tool.	2	CO6
13	**ALL**	*Micro project: Refer to Point 11 (Any One Micro project to be done)	4	ALL

Note: Out of the above suggestive LLOs –

1. '*' Marked Practicals (LLOs) Are mandatory.
2. A judicial mix of LLOs is to be performed to achieve the desired outcomes

VI. SUGGESTED MICRO PROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

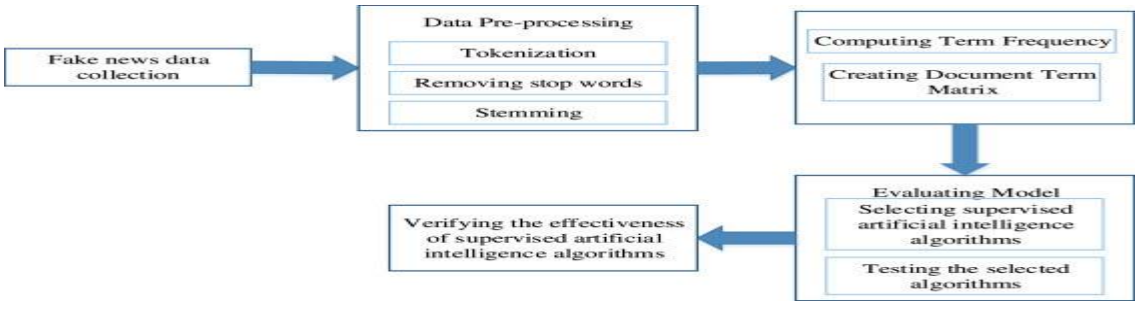
Self-Learning NA

Micro project

Following is suggestive list of case study for Micro-project:

1. **Fake news detection**

   Develop a system for Fake news detectionusing using decision tree algorithm.

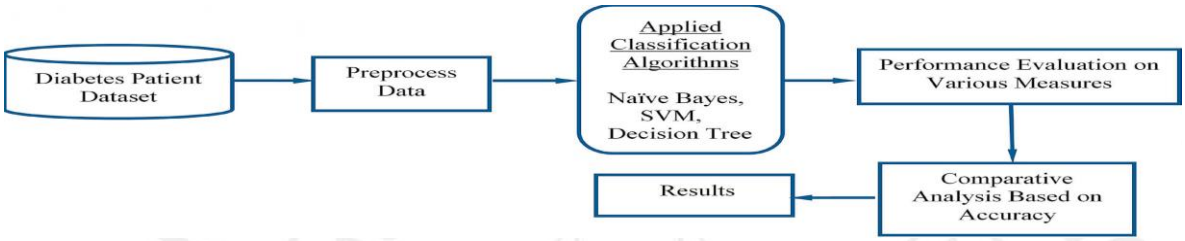


2. **Detecting Phishing website**

   Fraudsters and cybercriminals use this opportunity and create fake sites that look similar to the original to collect sensitive user data. develop an algorithm to detect phishing sites based on characteristics like security and encryption criteria, URL, domain identity, etc. using rule based classification algorithm or any from algorithm from curriculum.

3. **Diabetes prediction**

   Develop a system for Diabetes prediction using naïve bayes/SVM algorithm.



4. **House price prediction**

   Develop a system for house price prediction ,The data can be the location and size of the house and facilities near the house.

5. **Credit Card Fraud Detection**

   Develop a system using Python to create a classification problem using genetic algorithm to detect credit card fraud by analyzing the previously available data.

6. **Anime recommendation system**

   Develop a system for anime recommendation system using fuzzy set. Each user can add anime to their list and give a rating and this data set is a compilation of those ratings.

7. **Mushroom Classification**

   Develop a system for mushroom classification using rough set approach.

8. **Heart Disease Prediction**

   Develop a system for Heart Disease Prediction using Decision tree,/Naive Bayes/SVM calculations, etc.

9. **Adult Census Income Prediction**

   Develop a system for Adult Census Income Prediction using KNN The Dataset contains variables like age, work class, hours per week, sex, etc. including other variables that can foretell whether the annual income of an individual is greater than 50K or not.

10. **Titanic Survival Prediction**

    Develop a system for Titanic Survival Prediction A Titanic Dataset is created by Kaggle The data contains explanatory variables like Passenger details like Class, Gender, Age, Fare, etc.

11. **Movie Recommendation System**

    Develop a system for Movie Recommendation System using Hierarchical clustering/KNN algorithm.

12. **Customer Segmentation**

    Develop a system for Customer Segmentation using partitioning clustering/k means algorithm.

13. **Predicting Loan Defaulters**

    Develop a system for Predicting Loan Defaulters using Naïve bayes algorithm and apply all dispersion techniques(use weka tool)

14. **Web Click Prediction**

    Develop a system for Web Click Prediction using KNN algorithm. First collect the data on user behavior such as clickstreams, timestamps, referral sources, etc. Now, preprocess the data by cleaning it and extracting relevant features from the data that could be used for prediction (e.g., user demographics, browsing history, time of day, device used).

15. **Social Network Analysis**

    Implement system for Social Network Analysis using decision tree algorithm.

16. **Group event recommendation**

    Implement Group event recommendation system for using k means algorithm.

17. **Protecting user data on social networks**

    Develop a system for Protecting user data on social networks using genetic algorithm.

18. **Personality Classification project using data mining**

    Develop a system for Personality Classification project using data mining using rule based classification.

19. **HandWritten digit recognition**

    Implement HandWritten digit recognition system for using k means algorithm.

20. **Intelligent Transportation System**

    Implement Intelligent Transportation System using k means algorithm/partitioning algorithm.

21. **Speech emotion recognition**

    Develop a system for Speech emotion recognition using regression analysis.

22. **Predictive analysis**

    Develop a system for Predictive analysis using fuzzy set approach.

23. **Case Study on Amazon: E-commerce and Personalization datawarehouse**

24. **Case Study on Netflix: Entertainment and User Preferences datawarehouse**

25. **Use data reduction techniques for Telecommunications: AT&T**

Note:
The faculty must allocate any 1 case study to individual student for project. Considering the students technical skills.

Assignment

Prepare a journal of practicals performed in the laboratory.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Open source data mining tools/Programming languages **(e.g. WEKA tool, Tableau, R Programming Environment, Python, Java, etc)**	ALL
2	Open Source DATA SETS	ALL

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr. No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
SECTION I								
1	I	Basics of data mining	CO1	06	4	4	--	08
2	II	Know data concepts	CO2	10	3	3	4	10
3	III	Data Preprocessing	CO3	15	4	7	6	17
SECTION II								
4	IV	Classification and clustering	CO4	15	4	6	8	18
5	V	Open source data mining tool	CO5	04	2	2	--	04
6	VI	Data warehousing	CO6	10	4	4	5	13
			Grand Total	**60**	**21**	**26**	**23**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Lab performance, Assignment, Self-learning and Seminar/Presentation	Lab. Performance, viva voce

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (Cos)	Programme Outcomes(Pos)							Programme Specific Outcomes *(PSOs)	
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	2	-	1	2	-	-	1	-	2
CO2	2	3	2	2	-	-	2	-	2
CO3	2	1	2	2	1	1	-	-	3
CO4	1	2	2	1	2	-	-	-	2
CO5	1	2	2	3	1	2	1	-	2
CO6	1	1	2	1	-	1	-	-	2

Legends:- High:03, **Medium**:02, **Low**:01, **No Mapping:** -
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Data Mining Concepts and Techniques	Jiawei Han and Micheline Kamber	Morgan Kaufmann, 3rd edition,25 July 2011 • ISBN-10: 9780123814791 • ISBN-13: 978-9380931913
2	Data Mining Techniques	Arun K Pujari	Orient Longman Publishers, Second edition,1 January 2010 • ISBN-10: 8173716722 • ISBN-13: 978-8173716720
3	Fundamentals of Data Warehouses	Jarke, M., Lenzerini, M., Vassiliou, Y., Vassiliadis, P.	Springer, 2nd, rev. and extended ed. 2003 edition (November 26, 2002) • ISBN-10 : 3540420894 • ISBN-13 : 978-3540420897
4	Principles of Data Mining	David Hand, Heikki Mannila, Padhraic Smyth.	PHI, 1st edition, (January 1, 2008) • ISBN-10 : 8120324579 • ISBN-13 : 978-8120324572

XII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.solver.com/xlminer-data-mining	All practicals
2	https://www.solver.com/xlminer-data-mining	All practicals
3	https://www.xlminer.com/	All practicals
4	https://www.tutorialspoint.com/weka/what_is_weka.html	All practicals
5	https://www.cs.waikato.ac.nz/ml/weka/	All practicals

Name & Signature:

Smt. L.S.Korade
Lecturer in Computer Engineering

Smt. S.J.Siraskar
Lecturer in Computer Engineering

(Course Experts)

Name & Signature:

Smt.J.R.Hange
(Programme Head)

Name & Signature:

Shri. S.B. Kulkarni
(CDC In-charge)

GOVERNMENT POLYTECHNIC, PUNE

'120– NEP' SCHEME

PROGRAMME	**DIPLOMA IN CM/IT**
PROGRAMME CODE	**06/07**
COURSE TITLE	**OPERATING SYSTEM**
COURSE CODE	**CM31201**
PREREQUISITE COURSE CODE & TITLE	**NA**
CLASS DECLARATION COURSE	**YES**

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme											
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL&TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
CM31201	OPERATING SYSTEM	DSC	4	-	2	-	6	3	3 Hrs	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Term: 0Hrs

Abbreviations: CL-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA**-Formative Assessment**, SA**-Summative assessment, **IKS**– Indian Knowledge System, **SLA**-Self Learning Assessment

Legends:@-InternalAssessment,**#**-ExternalAssessment,***#**-OnlineExamination,**@$**-InternalOnlineExamination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR**(Formative Assessment -Practical)of any course, then the candidate shall be declared as **'Detained'** in that course.
2. If a candidate does not secure minimum passing marks in SLA(Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are**(CL+LL+TL+SL)hrs.*15Weeks**
4. **1credit** is equivalent to**30 Notional hours**.
5. *Self-learning hours shall not be reflected in the Timetable.
6. *Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Operating Systems are system programs, which are very essential components of Computer system. Two primary aims of operating systems are to manage resources (e.g. CPU time, memory) and to control users and software. Operating system design goals are often contradictory and vary depending on user, software, and hardware criteria. This course describes the fundamental concepts behind operating systems, and examines the ways that design goals can be achieved and practice the concept of Operating System design.

III. COURSE-LEVEL LEARNING OUTCOMES(CO'S)

Students will be able to achieve &demonstrate the following CO's on completion of course-based learning

1. Identify types of operating system
2. Describe services of operating system.
3. Execute process management commands.
4. Apply process scheduling algorithms and deadlock handling techniques.
5. Understand memory management techniques
6. Describe organization of file system.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
		SECTION-I		
		UNIT-I INTRODUCTION (CLHrs-08,Marks-10)		
1	**TLO1.1** Explain the functioning of given component of OS. **TLO1.2** Explain characteristics of the given type of operating system. **TLO1.3** Identify type of operating system suitable for the given type of application. **TLO1.4**Execute command on command line for the given task.	**1.1**Operating System: Evaluation of operating system, concept, Functions of Operating system. **1.2**ViewsofOS: User View, System View **1.3**Types of operating systems: Batch operating system, Multiprogramming operating system, Multitasking operating system, Real-Time Embedded Systems, Multimedia Systems, Distributed System, Mobile OS(Android, iOS) **1.4**Open-Source Operating System: Linux, BSD Unix. **1.5**Booting Process of operating systems	Hands-on Demonstration Presentations	**CO1**
		UNIT-II SERVICES AND COMPONENTS(CLHrs-10,Marks-10)		
2	**TLO1.2** Start, stop and restart the given service in Linux. **TLO2.2**Explain use of given system call of specified OS. **TLO2.3**Explain process that follows in managing the given resource. **TLO2.4** Explain use of the given operating system tool..	**2.1** Different Services of Operating System. **2.2** Component of operating system: Process Management, Main memory Management, file Management, I/O system management, secondary storage management **2.3** System Calls-Concept ,types of operating system calls **2.4** Use of operating system tools, user management, security policy, device management, performance monitor, task Manager.	Hands-on Demonstration Presentations	**CO2**
		UNIT-III PROCESS MANAGEMENT(CLHrs-10,Marks-12)		
3	**TLO3.1**Explain functions carried out in the given process state. **TLO3.2** Describe the function of the given component of process stack in PCB. **TLO3.3**Explain the characteristics of the given multithreading model. **TLO3.4**Describe method of Executing the given process command with example.	**3.1** Process-Process states, Process Control Block (PCB). **3.2** Process Scheduling-Scheduling Queues Schedulers, Context switch. **3.3**Operations on Process: Creation, Termination **3.4** Inter-Process Communication (IPC): Introduction, shared memory system and message passing system. **3.5** Multithreading Models. **3.6** Thread Libraries, Threading Issues.	Hands-on Demonstration Presentations	**CO3**

SECTION-II				
UNIT-IV CPU SCHEDULING AND DEADLICK (CLHrs-12, Marks-14)				
4	**TLO4.1:** Justify the need and objective of given job scheduling criteria with relevant example. **TLO4.2**Explain with example the procedure of allocating CPU to the given process using the specified OS. **TLO4.3**Calculate turnaround time and average waiting time of the given scheduling algorithm. **TLO4.4** Explain functioning of the given necessary condition leading to deadlock.	**4.1** Scheduling types-Scheduling objective, CPU and I/O burst cycles, Pre-emptive, Non-Per-emptive. **4.2** Scheduling criteria, Types of scheduling algorithms-First come first served (FCFS), shortest job first (SJF), Shortest Remaining Time(SRTN),Round Robin (RR) Priority scheduling, multilevel queue scheduling. **4.3** Critical section problem. **4.4** Deadlock- system, Models, Necessary condition leading to Deadlocks, Deadlock Handling- Preventions, avoidance and Recovery.	Hands-on Demonstration Presentations	**CO4**
UNIT–V MEMORY MANAGEMENT(CLHrs-10,Marks-14)				
5	**TLO5.1**Describe the working of specified memory management function. **TLO5.2**Explain characteristic of the given memory management techniques. **TLO5.3**Write algorithm for the given page replacement technique. **TLO5.4**Calculate page fault for the given page reference string.	**5.1** Basic Memory Management-Partitioning, Fixed and variable, **5.2** Free space management techniques-Bitmap, Linked List. **5.3** Introduction to page tables. **5.4** Segmentation, Fragmentation, Page Fault **5.5** Virtual memory-Introduction to paging, Demand Paging **5.6** Page replacement Algorithm-FIFO, LRU, Optimal.	Hands-on Demonstration Presentations	**CO5**
UNIT–VI FILE MANAGEMENT(CLHrs-10,Marks-10)				
6	**TLO6.1**Explain the structure of the given file system with example. **TLO 6.2** Describe mechanism of the given file access method. **TLO 6.3** Explain procedure to create and acess method.	**6.1** File-concept, Attributes, Operations, types and File System Structure. **6.2** Access Methods-Sequential, Direct, Swapping, File Allocation Methods-Contiguous, Linked, Indexed. **6.3** Directory Structure-Single level, two level, tree-structured directory, Disk organization and Disk Structure-Physical structure, Logical structure, Raid structure of Disk, RAID level 0 to 6. **6.4** File System Implementation: Partitions and Mounting, Virtual File Systems	Hands-on Demonstration Presentations	**CO6**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment/Practical Titles /Tutorial Titles	Number of hrs.	Relevant Cos
1	**LLO1.1:** Understand Operating system installation.	*Advanced Linux Installation: Network and Dual Boot	02	CO1
2	**LLO2.1:** Understand the concept of disk partitioning.	*Linux Disk Management using fdisk utility to create, delete and change the partitions on the disk.	02	CO2
3	**LLO3.1**Understand to change the permissions of file and directories.	*Setting/Changing file and directory related permissions chmod and umask command.	02	CO2,CO6
4	**LLO4.1** Understand the various commands to display information about file and directories.	*Displaying File Information : inodes, inodes and directories, cp and inodes, mv and inodes, rm and inodes, ls –l	02	CO2,CO6
5	**LLO5.1** Explore the concept of Mount and unmount	*Working with Linux-supported File Systems: Mounting and Unmounting to be tested with external drives.	02	CO2
6	**LLO6.1** Recognize different commands related to process Management. **LLO6.2** Practice all process commands.	*Linux Process Management : Jobs: Background, Kills and Interruptions and setting process priority Get Process status, Find Processes by Pattern or User, Display the Most Active Processes, wait for a process, sleep processes, Kill processes, kill all processes(Executing commands for process management–ps, fg, sleep, exit, bg, kill ,killall, nice, at, jobs)	04	CO3
7	**LLO7.1U**nderstand the concept of system states. **LLO7.2**Explore User management and group management. **LLO7.3**Practice group management activities**.**	*A. System states :init Shutting down and changing Run levels, Managing Users and Groups: Adding and Removing users with adduser, usermod and userdel commands B. Adding and Removing groups with group add, groupmod and groupdel commands, Superuser-The root ,UserDesktop, System Time and Date	02	CO3
8	**LLO8.1** Explore Job scheduling commands	*Scheduling jobs with crontab: cron daemon, crontab options, The format of crontab file, Environment variable settings, crontab command lines	02	CO4
9	**LLO9.1** Understand the Memory Management related commands	*Linux: Memory Management Practicing top, htop, vmstat and free command	02	CO5
10	**LLO10.1** Understand the working of scheduling algorithms **LLO10.2**Develop a program for Different scheduling algorithm	*Write a C program to calculate total waiting time and turnaround time of n processes with FCFC algorithm and Priority Algorithm.	04	CO4

11	**LLO11.1**Understand the concept of page replacement algorithm	*Write a c Program to implement FIFO page replacement algorithm.	02	CO5
12	**LLO 12.1** Explore all shell commands	*Executing various Shell commands Creating shell variables, writing shell scripts using decision making and various control structures., Executing various shell utilities, using file test and string test conditions in scripts, Making use of Positional Parameters. Configuring your own login shell using Functions in Shell scripts.	02	ALL
13	**Micro project**	Develop a micro project.	**02**	**ALL**

Note: out of the above suggestive LLOs–

1. '*'Marked practical (LLOs) Are mandatory.
2. A judicial mix of LLOs is to be performed to achieve the desired outcomes.

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING)

Self-Learning NA

Micro Project

Suggestive list of micro-project:

1. Create a report depicting features of different types of Operating system–Batch operating system, Multi-Programmed, Time shared, multiprocessor system, Real time System, Mobile Operating system etc. with example.
2. Make a comparative chart to calculate total waiting time and turn-around time of n processes with different CPU scheduling algorithm.
3. Implement a CPU scheduling algorithm for Shortest Remaining Time First and shortest Job first algorithm.
4. Compare FCFS,SJF, Priority and Round Robin with respect to turn around time and average waiting time. Give the reason of problems arises in FCFS.
5. Write a shell script that tests the connectivity of group of computers.
6. Write a shell script that counts number of files and number of directories in a directory.
7. Prepare a help guide using shell script for all the major Linux commands.
8. Write a shell script to find out-Whether given file exists.
9. Create a simple FAT file system using C programming.
10. Develop a simple memory allocation in c.
11. Implementing Demand paging in Operating system.
12. Create report on Linux Utilities in detail.
13. Prepare report on various generations of computer system and operating system.

Note:
The above is suggestive list of case studies for Micro project.

1. The faculty must allocate any 1case study in group of 2 students. Considering the students technical skills.

Assignment

Prepare a journal of practical performed in the laboratory.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	a) Computer System with all necessary Peripherals and Internet connectivity. b) Linux like any Operating system Software)Any Browser(Any General Purpose Computer available in the Institute)	ALL

VIII. SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr .No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction	CO1	08	04	04	02	10
2	II	OS Services and components	CO2	10	02	04	04	10
3	III	Process Management	CO3	10	02	04	06	12
4	IV	CPU Scheduling and Deadlock	CO4	12	02	04	08	14
5	V	Memory Management	CO5	10	04	06	04	14
6	VI	File Management	CO6	10	04	04	02	10
Grand Total				60	18	26	26	70

IX. ASSESSMENT METHODOLOGIES / TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
Lab performance, Assignment ,Self-learning and Seminar/Presentation	Lab. Performance, viva .

X. SUGGESTED COS-POS MATRIX FORM

Course Outcomes (Cos)	Programme Outcomes(Pos)							Programme Specific Outcomes *(PSOs)	
	PO-1Basic and Discipline-Specific Knowledge	**PO-2 Problem Analysis**	**PO-3 Design/ Development of Solutions**	**PO-4 Engineering Tools**	**PO-5 Engineering Practices for Society, Sustainability and Environment**	**PO-6 Project Management**	**PO-7 Life Long Learning**	**PSO-1**	**PSO-2**

CO1	-	-	-	1	-	1	2	-	-
CO2	1	-	-	1	-	-	1	-	1
CO3	1	1	1	1	1	1	2	1	1
CO4	1	2	2	-	-	1	1	1	1
CO5	1	1	1	-	-	2	1	3	2
CO6	1	1	1	-	-	1	1	3	2

Legends:-High:03, **Medium:**02,**Low:**01, **No Mapping:** -
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr.No	Author	Title	Publisher
1	Silberschatz Galvin, Gagne,John Wisley&Sons	Operating System Concepts	Wiley and Sons, Ninth Edition, Galvin. 2015, ISBN: 978-5 1-265-5427-0 2 **ISBN-13:**978-0470128725
2	Achyut S. Godbole, Tata McGraw-Hill	Operating Systems	TataMcGrawHillEducation,2015, ISBN: 97800705911343
3	D.M. Dhamdhere, TMH	System Programming & Operating System	McGraw-Hill Education;ISBN:9780074635797
4	Milan Milenkovic, TMH	Operating System Concept & Design	McGraw Hill Education **ISBN-10:**0074632728 **ISBN-13:**978-0074632727

XII. LEARNING WEBSITES & PORTALS

1. www.cs.wisc.edu/~bart/537lecturenotes-UniversityofWisconsin Madison.
2. www.cs.kent.edu/osf03/notes/index.html-ViliniusGediminasTechnicalUniversity
3. http://www.howstuffworks.com/operating-system1.htm
4. www.tutorialspoint.com/opeartingsystem
5. www.geeksforgeeks.org/operatingsystem

Name &Signature: **Dr.Shankar B.Nikam** Lecturer in Computer Engineering	**Smt.PriyaK.Zade** Lecturer in Computer Engineering **(Course Experts)**	**Smt.V.M.Khanapure** Lecturer in Information Technology
Name &Signature: **Smt.J.R.Hange** (Programme Head)	Name &Signature: **Shri. S.B. Kulkarni** (CDC In-charge)	