Government Polytechnic, Pune
'180 OB' – Scheme

Programme	Diploma in ET/CE/EE//ME/MT/**CM/IT**/DDGM
Programme code	01/02/03/04/05/**06/07**/08/16/17/21/22/23/24/**26**
Name of Course	**Operating Systems**
Course Code	**CM3101**
Prerequisite course code and name	-
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)			Examination Scheme				Total Marks
						Theory		Practical		
L	T	P	C			ESE	PA	*ESE	PA	
					Marks	80	20	25	25	150
04	0	02	06		**Exam Duration**	3 Hrs	1 Hr	2 Hr		

(*):OE (Oral Examination)
Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

2. 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.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:
- **Manage operations of Operating System.**

4. **COURSE OUTCOMES (COs)**

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Differentiate between types of operating systems.
2. Describe services of operating system.
3. Describe process management and execute related commands.
4. Describe various processor scheduling algorithms and deadlock handling techniques.
5. Explain different approaches to memory management.
6. Describe and manage structure and organization of the file system.

5. **SUGGESTED PRACTICALS/ EXERCISES**

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

Sr. No.	Unit No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Relevant CO	Approx. Hrs. Required
1	1	Advanced Linux Installation: Network and Dual Boot	CO1	02
2	2	Linux Disk Management using fdisk utility to create, delete and change the partitions on the disk.	CO2	02
3		Setting/Changing file and directory related permissions chmod and umask command.	CO2,CO6	02
4		Displaying File Information : inodes, inodes and directories, cp and inodes, mv and inodes, rm and inodes, ls –l	CO2,CO6	04
5		Working with Linux-supported File Systems: Mounting and Unmounting to be tested with external drives	CO2	02
6	3	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,Kill processes, kill all processes(Executing commands for process management –ps, fg, bg, kill ,killall, nice, at ,jobs)	CO3	04
7	3	System states :init Shutting down and changing Runlevels, Managing Users and Groups: Adding and Removing users with adduser,usermod and userdel commands	CO3	04
8		Adding and Removing groups with groupadd,groupmod and groupdel commands, Superuser-The root User Desktop,System Time and Date	CO3	02
9	4	Scheduling jobs with crontab : cron daemon, crontab options, The format of crontab file, Environment variable settings, crontab command lines	CO4	02
10	5	Linux: Memory Management Practicing top, vmstat and free command	CO5	02
11	ALL	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.	ALL	06
		Total		**32**

Sr.No.	Performance Indicators	Weightage in %
a.	Installation/configuration of OS	40
b.	Correctness of Executing various commands	30
c.	Writing and executing programs to get desired output	10
d.	Observations and Recording	10
e.	Answer to sample questions	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr. No.	Equipment Name with Broad Specifications	Experiment Sr.No.
a	Computer Systems (Any Computer System with basic configuration)	ALL
b	Linux or alike OS such as Ubuntu,CentOS,RedHat etc.	ALL

7. THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
SECTION I: UNIT 1: INTRODUCTION (Weightage-10 , Hrs- 10)	
1a. Explain the functioning of given component of OS. 1b.Explain characteristics of the given type of operating system. 1c. Identify type of operating system suitable for the given type of application. 1d. Execute command on command line for the given task.	1.1 Operating System: Concepts, Components of OS, And Operations of OS: Process Management, Memory Management, Storage Management, Protection and Security. 1.2 Views of OS: User View, System View 1.3 Operating System Operations: Dual Mode, Timer 1.4 Special-Purpose Systems: Real-Time Embedded Systems, Multimedia Systems,Batch OS,Time Shared OS,Distributed System,Mobile OS(Android,iOS) 1.5 Open-Source Operating System: Linux, BSD Unix
UNIT 2. OS SERVICES AND COMPONENTS(Weightage-14 , Hrs- 14)	
2a. Start, stop and restart the given service in Linux. 2b. Explain use of given system call of specified OS. 2c. Explain process that follows in managing the	2.1 Different Services of Operating System. 2.2 System Calls-Concept, types of operating system calls 2.3 OS component-Process Management, Main memory Management, file Management, I/O system

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
given resource. 2d. Explain use of the given operating system tool.	management, secondary storage management 2.4 Use of operating system tools, user management, security policy.

UNIT 3. PROCESS MANAGEMENT(Weightage-16 , Hrs- 08)

3a. Explain functions carried out in the given process state. 3b. Describe the function of the given component of process stack in PCB. 3c. Explain the characteristics of the given multithreading model. 3d. 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

Section-II UNIT 4 CPU SCHEDULING AND DEADLICK(Weightage-16 , Hrs- 12)

4a. Justify the need and objective of given job scheduling criteria with relevant example. 4b. Explain with example the procedure of allocating CPU to the given process using the specified OS. 4c. Calculate turnaround time and average waiting time of the given scheduling algorithm. 4d. 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 Types of scheduling algorithms-First come first served (FCFS), shortest job first (SJF), Shortest Remaining Time (SRTN), Round Ribon(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.

UNIT 5. MEMORY MANAGEMENT(Weightage-14 , Hrs- 10)

5a. Describe the working of specified memory management function. 5b. Explain characteristic of the given memory management techniques. 5c. Write algorithm for the given page replacement technique. 5d. 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.

UNIT 6 : FILE MANAGEMENT(Weightage-10 , Hrs- 10)

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
6a. Explain the structure of the given file system with example. 6b. Describe mechanism of the given file access method. 6c. Explain procedure to create and access 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

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No	Unit Title	Teaching Hrs	Distribution of Theory Marks			
			R Level	U Level	A and above Levels	Total Marks
1	**Introduction**	10	04	04	02	10
2	**OS Services and components**	14	02	06	06	14
3	**Process Management**	08	02	04	10	16
4	**CPU Scheduling and Deadlock**	12	02	04	10	16
5	**Memory Management**	10	04	04	04	14
6	**File Management**	10	04	04	02	10
	Total	64	18	26	34	80

9. STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

    a. Prepare Journal for practical's
    b. Undertake micro projects

10. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

    a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
    b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
    c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
    d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
    e. Guide student(s) in undertaking micro-projects.

11. SUGGESTED MICRO-PROJECTS

    a. Study and present three Microsoft Device Drivers
    b. Study and present HDFS configuration
    c. Write a shell script that schedules a process and run the shell script at specific time.
    d. Write a shell script that tests the connectivity of group of computers.
    e. Write a shell script that counts number of files and number of directories in a directory.

12. LEARNING RESOURCES

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

13. SOFTWARE/LEARNING WEBSITES

    a) www.cs.wisc.edu/~ bart/537 lecture notes-University of Wisconsin Madison.
    b) www.cs.kent.edu/osf 03/notes/index.html- ViliniusGediminas Technical University
    c) http://www.howstuffworks.com/operating-system 1.htm
    d) www.en.wikipedia.org/wiki/Operating system ay a

14. PO - COMPETENCY- CO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	1	-	1	2
CO2	1	-	-	1	-	-	1
CO3	1	1	1	1	1	1	2
CO4	1	2	2	-	-	1	3
CO5	1	1	1	-	-	2	3
C06	1	1	1	-	-	1	3

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	1	-
CO4	1	-
CO5	3	-

C06	3	-

Sign:
Name: (Smt.N.P.Sarwade)
   (Smt.A.B.Bhusagare)
   (Smt.A.M.Galshetwar)
   (Smt.N.R.Wagh)
   (Course Expert /s)
	Sign:
	
	Name: Shri. U.V. Kokate
	 (Head of Department)

Sign:
 	
Name: Shri. U.V. Kokate
  (Program Head)
(Computer Engineering Dept.)
	Sign:
	
	Name: Shri A.S.Zanpure
	   (CDC)

Government Polytechnic, Pune

'180 OB'– Scheme

Programme	Diploma in ET/CE/EE//ME/MT/**CM**/**IT**/DDGM
Programme code	01/02/03/04/05/**06/07**/08/16/17/21/22/23/24/**26**
Name of Course	**Java Programming-I**
Course Code	**CM3102**
Prerequisite course code and name	--
Class Declaration	**No**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				Total Marks
					Theory		Practical		
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
				Marks	80	20	25	25	150
03	00	02	05	**Exam Duration**	3 Hrs	1 Hr	2 Hr		

(*):PE (Practical Examination)

Legends: L- lecture-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

2. RATIONALE

Java is platform independent, open-source object oriented programming language enriched with free and open source libraries. In current industrial scenario java has broad industry support and is prerequisite with many allied technologies like advanced java, java server pages, and Android Application Development. Thus current industrial trends necessitate acquiring Java knowledge for Computer engineering and Information technology graduates. This course develops necessary skills in students to apply object oriented programming techniques in java so that students will be able to develop complete applications using core java.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:

- **Build applications using Java.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Develop programs using Object Oriented methodology in Java.
b. Develop programs to apply all access modifiers, array and string.
c. Implement Interface and Develop program using multithreading.
d. Implement Exception Handling.
e. Develop program using graphics & applet.
f. Develop programs for handling I/O and file streams.

5. SUGGESTED PRACTICALS/ EXERCISES

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

Sr.No	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours required
1	I	Setup a Java Programming development environment by using: a. Command prompt. (Class path and path setup b. Any IDE (Eclipse, J creator etc.) Test the JDE setup by implementing a small program.	CO1	04
2		Develop programs to demonstrate use of different control statements.		
3		Develop programs to demonstrate use of 'for' , 'while' and 'do-while' looping Statements		
4		Develop programs for implementation of implicit and explicit type casting in JAVA.		
5	II	Develop programs for implementation a) Constructer b) multiple Constructers	CO2	10
6		a) Develop a program to accept input using command line argument. b)Develop programs for implementation of Arrays in JAVA		
7		Develop programs for implementation of different function of String and StringBuffer Class.		
8		Develop programs for implementation of a) Vector b) HashMap		

		c) Wrapper		

9		Develop a program for implementation of
		   a) method overriding.
		   b) method overloading.		

10		Develop programs for implementation of
		   a) Single inheritance
		   b) multiple inheritance
			CO3	

11	III	Develop programs for implementation of multilevel inheritance by applying various access controls to its data members and methods.		06
12		Develop programs for creating classes in a package, accessing a package, importing a class from other package.		
13		Develop a program for implementation of Multithreading Operation.	CO3,CO4	
14	IV	Develop programs for implementation of a)exception handling b) User defined exception handling.		04
15		Develop minimum two basics Applets. Display output with applet viewer and browser. Develop a program on basic applet Develop program using control loops in applets.	CO5	

16	V	Develop a Program to draw following shapes , Graphics and Applets
		   a. Cone
		   b. Cylinders
		   c. Cube
		   d. Square inside a circle
		   e. Circle inside a Square
				04

17	VI	Develop programs for implementation of a) I/O classes b) file stream classes	CO6	04
		TOTAL HOURS :		32
		MINI PROJECT: Implement mini project using all the JAVA concepts		

Sr.No.	Performance Indicators	Weightage in %
a.	Correctness of algorithm	40
b.	Debugging ability	20
c	Quality of input and output displayed (messaging and formatting)	10
d.	Preparing assignments (write-ups, program and output).	20
e.	Submit assignment on time.	10
	Total	**100**

6.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr. no.	Equipment Name with Board Specification	Pro Sr. no.
1.	Computer with JDK 1.8 or above	All
2.	Any IDE for JAVA Programming such as Eclipse ,Jcreator or any other	All

7.   THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit- I Basics of JAVA(Weightage-09, Hrs- 06)	
1a. State Features of Java. 1b. Write Programs to create classes and object for given problem. 1c. Enlist different data types & Operators in Java. 1d.Constuct the expressions using implicit and explicit type conversions to solve the given problems. 1e.Develop the programs using relevant control structure to solve the given problems.	1.1 Java Features. 1.2 Defining a class, Fields declaration, Methods declaration, Creating object, Accessing class members. 1.3 Java tokens and data types, constants and symbolic Constant, variables, Dynamic initialization, Data types, array and string, Scope of Variable, typecasting and standard default value. 1.4 Operators and Expressions, Type conversions in expressions, Mathematical functions- min(), max(), sqrt(), pow(), exp(), round(), abs(). 1.5 Decision making and looping: If statement, if else statement, nested if else statement, if else if ladder, the switch statement, nested switch statement, The ?: operator, the while statement, the 'for' statement, break, continue and return statement, nested loops ,labeled loops, for-each version of the for loop.
UNIT 2 Derived Syntactical Constructs in JAVA(Weightage- 13 , Hrs- 08)	
2a. Use constructors for the given programming problem. 2b. State different visibility controls. 2c. Write the programs by implementing array to solve the given problems. 2d. Develop programs using vectors, wrapper and HashMap	2.1Constructors and methods type of constructors, nesting of methods, argument passing the 'this' keyword, command line arguments, garbage collection, finalize() method, the object class. 2.2Visibility Control Public, Private Protected, Default, friendly protected access. 2.3Arrays and Strings: Types of arrays, creating an array,

classes for the given problem.	strings, string classes and string buffer, vector, wrapper classes, HashMap. Enumerated types.

UNIT 3 Inheritance , interface and package(Weightage- 19   , Hrs- 10)

3a. Describe Inheritance. 3b. Enlist different types of Inheritance. 3c. Differentiate between overloading and overriding for given example. 3d. Develop program using the specified interface. 3e. Create user defined package for the given problems. 3f. Add class and interface to the given package.	3.1 Inheritance: concept of inheritance, Types of Inheritance. 3.2 Single Inheritance, multilevel Inheritance, Hierarchical Inheritance, method and constructors overloading and overriding. Dynamic method dispatch, final variables final methods, use of super, abstract methods and classes, static members. 3.3 Interfaces: Define Interface, implementing interface, accessing interface variables. 3.4 Package: Define package, types of package, naming and creating packages, accessing packages, import package, static imports, adding class and interfaces to a package.

UNIT 4 Exception handling and Multithreading(Weightage- 13 , Hrs- 08)

4a. Define Exception,Errors& its types. 4b. Develop program for handling the given exception. 4c. Develop a program for throwing our own Exceptions. 4d. Explain the function of the specified phase in thread life cycle using the given example.	4.1 Errors and Exception: Types of errors, exceptions, syntax of exception handling code, build-in exceptions, chained exceptions, creating own exception (throw clause). 4.2 Multithreaded Programming Creating a Thread: By extending thread class and by implementing Runnable interface, lifecycle of thread, Thread Methods: wait(), sleep(), notify(), resume(), suspend(), stop(). Synchronization, inter-thread communication, deadlock.

UNIT 5 JAVA applets and Graphics Programming(Weightage- 18 , Hrs- 08)

5a. Describe the given phase of applet life cycle using a typical example. 5b. Develop programs using applet implementation for the given problem. 5c. Develop a Program for passing Parameters to Applets 5d. Develop program for implementing different font methods.	5.1 Introduction to applets: Applet, Applet life cycle (skeleton), Applet tag, Adding Applet to HTML file, passing parameter to applet, embedding <applet> tags in java code, adding controls to applets. 5.2 Graphics Programming: Graphics classes, lines, rectangles, ellipse, circle, arcs, polygons, color and fonts, font class, variable defined by font class, font methods.

UNIT 6 Managing I/O Files in JAVA(Weightage- 08 , Hrs- 08)

6a. Use I/O stream classes in a program to solve the given problem. 6b. Write Program for reading and writing character stream to and from the given files. 6c. Write Programs for reading and writing bytes to and from given files.	6.1 Introduction and concept of streams. 6.2 Stream classes. 6.3 Byte Stream classes: Input stream classes, Output stream classes. 6.4 Character stream classes, using streams. 6.5 Using file class: I/O Expressions, Creation of files, Reading/Writing characters, Reading/Writing bytes,

6d. Write program to demonstrate use of primitive data types with the specified stream.	Handling primitive Data types.

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of JAVA	06	2	2	5	9
II	Derived Syntactical Constructs in JAVA	08	2	2	9	13
III	Inheritance , interface and package	10	4	5	10	19
IV	Exception handling and Multithreading	08	4	3	6	13
V	JAVA applets and Graphics Programming	08	5	4	9	18
VI	Managing I/O Files in JAVA	08	3	1	4	8
	Total	**48**	**20**	**17**	**43**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:
   a. Prepare journal based on practical performed in laboratory.
   b. Follow Coding Standards.
   c. Give seminar on relevant topic
   d. Undertake micro-projects.
   e. Develop variety of program to improve logical skills.
   f. Develop Application oriented real world programs.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)
   These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:
   a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
   b. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
   c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.

d. Guide student(s) in undertaking micro-projects.
e. Correlate subtopics with major topics and concepts.
f. Use proper equivalent analogy to explain different concepts.
g. Use Flash/Animations to explain various components and operation.
h. Teacher should ask the students to go through instruction and Technical manuals.

11. SUGGESTED MICRO-PROJECTS

MINI PROJECT: Implement mini project using all the Java concepts studied in the above units.

(Only for Class Declaration Courses)

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her.In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three.**

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

12. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Programming with Java	E. Balagurusamy,	Tata McGraw Hill
2	The Complete Reference Java2	Herbert Schildt,	Tata McGraw Hill,5th Edition
3	The Complete IDIOT's Guide To JAVA 2	Michael Morrison	PHI,2 edition

13. SOFTWARE/LEARNING WEBSITES

1. http://www.nptel.ac.in
2. https://www.tutorialspoint.com/javaprogramming
3. https://onlinecourses.nptel.ac.in

14. PO - COMPETENCY- CO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	1	1	1	2
CO2	3	2	3	2	1	2	2
CO3	3	2	3	3	1	2	2
CO4	3	2	3	3	1	2	1
CO5	3	2	3	3	1	2	2
CO6	3	2	3	3	1	2	2

15. PSO - COMPETENCY- CO MAPPING

	PSO1	PSO2
CO1	-	3
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	3
CO6	-	2

Sign: Name: Smt.H S Pawar Name: Smt.S P Panchakshari Name: Smt. K S Gaikwad (Course Expert /s)	Sign: Name: Shri. U. V. Kokate (Head of Department) (Computer Engineering)
Sign: Name: Shri. U V Koakte (Program Head) (Computer Engineering)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune
(An Autonomous Institute of Govt. of Maharashtra)
Scheme: 180 OB

Programme Name	:	Diploma Programme in CO/IT
Programme Code	:	06/07
Course Title	:	Data Structures
Course Code	:	CM3103
Prerequisite course code and name	:	CM2101- Programming in 'C'
Class Declaration	:	YES

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				
					Theory Marks		Practical Marks		Total Marks
L	P	T	C		ESE	PA	*ESE	PA	
3	2	1	6	Marks	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	2 Hrs		

(*):PE (Practical Examination)
Legends: L-lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

2. RATIONALE
Data structures are an important aspect of Computer Engineering and Information technology. Data structures are mathematical and logical model of storing and organizing data in a particular way in computer. After studying this course, student will be able to understand and identify different types of data structures, use algorithms with appropriate data structures to solve real life problems.

3. COMPETENCY
The aim of this course is to attend following industry identified competency through various teaching learning experiences:
- **Implement relevant algorithms using Data Structures**.

4. COURSE OUTCOMES (COs)
The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Describe Data structures, Complexity and Array operations.
2. Use algorithms for searching and sorting techniques with Arrays.
3. Implement programs for Stack, Queue and Recursion using Arrays.
4. Write programs to perform operations on Linked List.
5. Write algorithms to implement Tree data structure.
6. Describe Graph and its traversing methods.

5. PRACTICALS/ EXERCISES
The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Implement Programs based on: Structures & Dynamic Memory allocation	I	02
2.	Implement Program to perform insertion and deletion operations on One Dimensional Array.	I	02
3.	Implement Program for matrix operations using Multidimensional Arrays. (Eg. Matrix Addition, Subtraction and Multiplication)	I	02
4.	Implement programs for following search techniques. i. Linear search ii. Binary Search	II	04
5.	Write Programs to implement sorting algorithms. (Bubble sort, Selection sort, Insertion sort, Merge sort, Radix sort, Shell sort)	II	04
6.	Write Program to perform Push and Pop operations on Stack using array.	III	02
7.	Write Program to perform Insert and Delete operations on Linear Queue using array.	III	02
8.	Write Program to implement Tower of Hanoi.	III	02
9.	Write Programs to traverse singly linked list.	IV	02
10.	Write Programs to search in sorted and unsorted linked list.	IV	04
11.	Write Programs to perform following operations on Singly linked list. i. To insert a node at beginning and at given location. ii. To delete a node.	IV	04
12.	Write Program to create Binary Search Tree and perform Inorder, Preorder and Postorder traversal.	V	02
	Total		**32**
Following is the list of extra practical that can be given to Fast learner student.			
1.	Write Program to traverse Doubly link list.		
2.	Write Program to perform Insert and Delete operations on Doubly link list.		
3.	Write Program to perform Insert and Delete operations on Linear Queue using link list.		
4.	Write Program to perform Insert and Delete operations on Circular Queue using array.		
5.	Write Program to perform Insert and Delete operations on Circular Queue using link list.		
6.	Write Programs to perform Search, Insert and Delete operations on BST.		
7.	Write Program to implement Heap Sort algorithm.		

Sr. No.	Performance Indicators	Weightage in %
a.	Use of Appropriate tool to solve the problem (Process)	40
b.	Quality of output achieved (Product)	30
c.	Complete the practical in stipulated time	10
d.	Observations and Recording	10
e.	Answer to sample questions	10
	Total	**100**

6. MAJOR EQUIPMENTS/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

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

7.   THEORY COMPONENTS
The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		SECTION-I
UNIT I Introduction to data structures and Arrays	1a. Define data structure terminologies. 1b. Enlist various data structure Operations. 1c. Differentiate between various complexities. 1d. Use dynamic memory allocation in programs. 1e. Write algorithms to perform operations on array.	1.1 Introduction, Basic Terminology, Elementary data structure, Organization, Classification of data structure. 1.2 Operations on data structures: Traversing, Inserting, deleting, Searching, sorting, and merging. 1.3 Complexity: Time Complexity, Space Complexity, Big 'O' Notation. 1.4 Dynamic memory Allocation. 1.5 Arrays: Introduction, Representation of linear arrays in memory. 1.6 Traversing linear Arrays, Inserting and Deleting. 1.7 Multidimensional Arrays.
UNIT-II Searching and Sorting Techniques	2a. Write algorithm and programs for various searching and sorting techniques 2b. Apply Hashing techniques to store and retrieve element from given	2.1 Searching: Basic search techniques, Linear Search, Binary search. 2.2 Hashing: Hash functions, Collision Resolution, Linear probing, Chaining. 2.3 Sorting: General background. 2.4 Sorting Techniques: Bubble sort, Selection sort, Insertion sort, Merge sort, Radix sort, Shell sort.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	data set. 2c.Use sorting methods to sort dataset.	
UNIT III Stacks, Queues & Recursion	3a. Implement Stack and Queue data structure to carry out various data structure operation. 3b. Use stack and queues to solve various problem (like prefix to postfix conversion, evaluation of expression, Tower of Hanoi, etc). 3c. Differentiate between stack and queue.	5.1 Stacks: Concept, representing stacks in 'C', Applications of stacks. 5.2 Polish Notations (Prefix, postfix, Infix), Quick sort. 5.3 Recursion: Recursive definitions and processes, Recursion in 'C', writing recursive programs factorial, Fibonacci. 5.4 Tower of Hanoi, Implementation of recursive, procedures by means of stack. 5.5 Queues: The queue and its sequential representation, concept of queues, circular queues, priority queues.
	SECTION-II	
UNIT IV Linked Lists	4a. Implement linked list data structure to carry out various data structure operations. 4b. Use Linked list to implement other data structures.	4.1 Introduction, Singly link list Representation of link list in memory. 4.2 Creating, Traversing, Searching in Sorted and Unsorted Linked List. 4.3 Memory allocation, garbage Collection. 4.4 Inserting into linked list, Deleting from a linked list. 4.5 Header links list, Two-way list, Implementation of link list.
UNIT V Trees	5a. Draw binary tree for given data set. 5b. Write algorithm for binary tree traversal. 5c. Write algorithms to perform given operation on Binary Search Tree. 5d. Create Heap tree for given dataset.	5.1 Tree Terminologies: Degree of node, level of node, leaf node, Depth/Height of tree, In-degree and Out-degree, path, Ancestor and Descendant node. 5.2 Tree Types: General Trees, Binary trees, Binary Search Trees 5.3 Binary Tree Traversal methods: Inorder, Preorder, Postorder traversal using stack. 5.4 Binary search tree (BST), searching and inserting BST, deleting from BST. 5.5 Heap: Inserting into a Heap, Deleting the root of Heap, Heap sort.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT VI Graphs	6a. Define terminologies related to Graph. 6b. Represent graph using adjacency list and adjacency matrix 6c. Solve problems to find out shortest path using Warshall's algorithm. 6d. Write algorithm to traverse the given graph.	6.1 Introduction, Graph Terminologies: Graph, Node(Vertices), Arcs(Edges), Directed Graph, Undirected Graph, In-degree and Out-degree, Adjacent, Successor, Predecessor, relation, path, sink. 6.2 Linear Representation of Graph: Adjacency List, Adjacency Matrix of directed graph. 6.3 Warshall's Algorithm; Shortest Paths. Linked representation of graph, traversing a graph (BFS,DFS). 6.4 Applications of Graph.

8. SPECIFICATION TABLE

Unit No	Unit Title	Teaching Hrs	Distribution of Theory Marks			
			R Level	U Level	A and above Levels	Total Marks
1	**Introduction to data structures and Arrays**	**06**	4	6	2	**12**
2	**Searching and Sorting Techniques**	**08**	2	4	8	**14**
3	**Stacks, Queues & Recursion**	**10**	2	4	8	**14**
4	**Linked Lists**	**08**	2	4	8	**14**
5	**Trees**	**10**	2	4	8	**14**
6	**Graphs**	**06**	2	4	6	**12**
	Total	**48**	14	26	40	**80**

9. STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

   a. Prepare journal of practicals.

10. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

   a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
   b. About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the

development of the COs through classroom presentations (see implementation guideline for details).

c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
d. Guide student(s) in undertaking micro-projects.
e. Use proper equivalent analogy to explain different concepts.
f. Use Flash/Animations to explain various components, operation and
g. Teacher should ask the students to go through instruction and Technical manuals.

11. **SUGGESTED MICRO-PROJECTS**
(Only for Class Declaration Courses)

Only one micro-project *is planned to be undertaken by a student that needs to be assigned to him/her.In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three.***

*The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more Cos which are in fact, an integration of PrOs, Uos and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented Cos.*

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

A) *Write menu driven program to incorporate all the data structures.*
B) *Write menu driven program to implement all operations on Singly and Doubly Linked lists.*

12. **LEARNING RESOURCES**

Sr. No.	Title of Book	Author	Publication
1	Data Structures Schaum Outline Series	Lipschultz	McGraw Hill Education, New Delhi.2013, ISBN-13: 978-0070701984
2	Data Structures Using 'C'	ISRD Group	McGraw Hill Education, New Delhi.2013,ISBN-13:978-12590006401
3	Data Structures	Dr. Rajendra Kawale	Devraj Publications

13. SOFTWARE/LEARNING WEBSITES
a. **https://www.w3schools.in/data-structures-tutorial**
b. **https://www.geeksforgeeks.org/data-structures/**
c. **https://www.tutorialspoint.com/data_structures_algorithms/index.htm**

14.   **PO – COMPETENCY-CO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
Describe Data structures, Complexity and Array operations.	2	2	3	1	1	1	3
Use algorithms for searching and sorting techniques with arrays.	2	2	3	2	1	1	2
Implement programs for Stack, Queue and Recursion using Arrays.	2	3	3	1	1	1	2
Write programs to perform operations on Linked List.	2	3	3	2	1	1	2
Write algorithms to implement Tree data structure.	2	3	3	1	1	1	2
Describe Graph and its traversing methods	2	3	3	1	1	1	2

PSO - COMPETENCY- CO MAPPING

	PSO1	PSO2
Describe Data structures, Complexity and Array operations.	1	2
Use algorithms for searching and sorting techniques with arrays.	2	3
Implement programs for Stack, Queue and Recursion using Arrays.	2	3
Write programs to perform operations on Linked List.	2	3
Write algorithms to implement Tree data structure.	2	3
Describe Graph and its traversing methods	2	3

(Smt.H.F.Khan/ S. B. Nikam) Signature of Course Experts	(Mr.U.V.Kokate) Signature of Head of the Department (Computer Engineering)
(Mr. U. V. Kokate) Signature of Programme Head	(Mr. A.S. Zanpure) Signature of CDC In-charge

Government Polytechnic, Pune
'180 OB' – Scheme

Programme	Diploma in ET/CE/EE//ME/MT/**CM**/IT/DDGM
Programme code	01/02/03/04/05/**06/07**/08/16/17/21/22/23/24/**26**
Name of Course	Object Oriented Programming : C++
Course Code	**CM3104**
Prerequisite course code and name	-- --
Class Declaration	**Yes**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				Total Marks
					Theory		Practical		
L	**T**	**P**	**C**		**ESE**	**PA**	***ESE**	**PA**	
03	01	02	06	**Marks**	80	20	25	25	150
				Exam Duration	3 Hrs	1 Hr	2 Hr		

(*): PE (Practical Examination)
Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

2. RATIONALE

This subject intends to teach the students the basic concepts of object-oriented programming (OOP) using C++ programming language. Object-Oriented Programming offers a new and powerful way to cope with the programming complexities wherein programs are prone to error and software errors can get expensive. Its goal is clearer, more reliable, more easily maintained programs. This subject will act as backbone for all other subjects that are based on Object Oriented concept.

3. COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:
- **Build logical and cognitive thinking for solving real time problems.**

4. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Know the difference between procedural language and object oriented language.
2. Understand the basic concepts of object oriented programming.
3. Learn reusability of code with the help of functions in C++.
4. Understand the key feature of object oriented programming like polymorphism.
5. Understand and implement the concept of inheritance.
6. Handle exceptions and implement files.

5. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

Sr.No	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours required
1	I	Write a simple C++ program to print "HELLO" on the output screen	CO1 - Know the difference between procedural language and object oriented language.	02
2	II	Write a program to perform simple mathematical operations.	CO2 - Understand the basic concepts of object oriented programming.	04
3		Write a program to implement class and object concept.		
4		Write programs to implement all the control structures in C++.		
5		Write programs to implement various access specifiers.		
6	III	Write a simple program to implement functions in C++	CO3 - Learn reusability of code with the help of functions in C++.	06
7		Write a program to implement call by reference and return by value concept.		
8		Write a program to implement following concepts: a) Inline functions b) Friend functions c) Static function d) Object as a function argument and returning object		
9		Write a program on nesting of functions.		

		Write a program to perform following string operations using pre-defined string functions and without using pre-defined string functions :- a) String concatenation b) String Comparison c) Find position of an character in a given string d) String reversing		
10				
11	IV	Write a program to implement operator overloading	**CO4** - Understand the key feature of object oriented programming like polymorphism.	**06**
12		Write a program to implement operator overriding (polymorphism).		
13		Write a program to implement type conversion concept.		
14	V	Write a program to implement following types of inheritances using various access specifiers :- a) Single inheritance b) Multilevel inheritance c) Multiple inheritance d) Hierarchical inheritance e) Hybrid inheritance	**CO5** - Understand and implement the concept of inheritance.	**08**
15		Write a program to implement pointers concepts		
16		Write a program to implement following concepts: a) Virtual functions b) Pure virtual function		
17	VI	Write a program to perform various operations using File concepts	**CO6** - Handle exceptions and implement files.	**06**
18		Write programs to handle pre-defined and user-defined exceptions.		
TOTAL HOURS :				**32**
MINI PROJECT: Implement mini project using all the C++ concepts				

Sr.No	Performance Indicators	Weightage in %
a.	Drawing the flowchart for the given problem statement	20
b.	Writing an algorithm for the given problem statement	20
c.	Writing the code	10
d.	Observations and error handling	10
e.	Interpretation of result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report in time	10
Total		**100**

6.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
1	Basic configuration systems with editor supporting C++ language program execution.	ALL

7.   THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. INTRODUCTION TO OBJECT OREIENTED PROGRAMMING (Weightage-12, Hrs- 06)	
1a. Define procedural and object oriented programming language. 1b. Differentiate between procedural and object oriented programming language. 1c. Explain the features of object oriented language. 1d. Write a simple program to learn source file, compilation and linking of various files together.	**1.1 Procedural programming** What is procedural programming? Features of procedural programming. Drawbacks of procedural programming. **1.2 Object Oriented Programming** Definition on Object Oriented Programming, Object Oriented Programming paradigm, basic concepts of Object Oriented Programming, benefits of Object Oriented Programming, Object Oriented languages, applications of Object Oriented Programming. **1.3 Beginning with C++** What is C++, C++ program structure, object, class, example of object and class, creating the source file, compiling and linking
UNIT 2 BASICS OF OBJECT ORIENTED PROGRAMMING (Weightage- 14 , Hrs- 10)	
2a. Understand various basic concepts of C++ language. 2b. Define class and object. 2c. Understand memory allocation concepts. 2d. Differentiate between constructors and destructor.	**2.1 Tokens, Expressions and Control Structures** Tokens, keywords, identifiers, constants and symbolic constants, data types and its classifications, type casting, **Variables**: introduction, declaration, dynamic initialization, reference. **Operators** : introduction, scope resolution operator, type cast operator, memory management operators, operator precedence, **Expressions**: introduction, types, special assignment expressions. **Access Specifiers**: introduction, why there is need of access specifiers, types of access specifiers. **Control structures** : introduction, types of control structures like sequence structure, selection structure, loop structure, example of all the types of structures like if-else, while, do-while, for, switch with its syntax and usage.

	2.2 Classes and Objects
	Classes: Introduction, use of classes in OOP, syntax to declare class, local classes.
	Objects: introduction, memory allocation for objects, static data members, array of objects, objects as function arguments, returning objects.
	2.3 Constructors and Destructors
	Constructors : introduction, syntax, concept of memory allocation using constructors, types of constructors, constructors with default arguments, dynamic initialization of objects, dynamic constructors
	Destructors : introduction, syntax, concept of memory de- allocation using destructors, example.

UNIT 3 FUNCTIONS IN C++ (Weightage- 12 , Hrs- 08)	
3a. Define function and implement function prototypes. 3b. Understand various types of functions. 3c. Implement string functions and perform various operations on the same.	**3.1 Introduction** The main function, function prototype, call by reference, return by reference, inline functions, default arguments, const arguments
	3.2 More on function Function overloading, friend functions, virtual functions, pure virtual functions, inline functions, making outside function inline, nesting of member functions, private member functions, static member functions, object as a function argument, returning an object.
	3.3 String functions Introduction, library string functions, creating string objects, manipulating string objects, string characteristics, accessing characters in strings, user defined functions to implements library string functions.

UNIT 4 OPERATOR OVERLOADING,POLYMORPHISM AND TYPE CONVERSION (Weightage- 14 , Hrs- 06)	
4a. Explain the concept of operator overloading. 4b. Understand and implement object oriented programming language key feature like polymorphism. 4c. Implement type conversion for various data types.	**4.1 Operator Overloading :** Introduction, defining operator overloading, overloading unary operators, overloading binary operators, overloading binary operators using friends, manipulation of strings using operators, rules of overloading operators. **4.2 Polymorphism** : Introduction, why polymorphism is useful, syntax and example. **4.3 Type Conversion** : Introduction, basic to class type, class to basic type, one class to another type, data conversion example.

UNIT 5 INHERITANCE AND POINTERS (Weightage- 14 , Hrs- 08)	
5a. Define inheritance. 5b. Explain the need of inheritance. 5c. Implement various types of inheritances. 5d. Describe pointers in C++	**5.1 Introduction :** Definition of inheritance, defining derived classes, concept of base class and sub class, types of inheritance, making private member inheritable, single inheritance, multilevel inheritance, multiple inheritance, hierarchical inheritance, hybrid inheritance, **5.2 More on inheritance :** virtual base class, virtual functions, abstract classes, constructors in derived classes, member classes using nesting of classes. **5.3 Pointers** : Introduction, definition, syntax to declare pointer, pointers to objects, this pointer, pointers to derived classes, example on pointers
UNIT 6 FILES AND EXCEPTION HANDLING (Weightage- 14 , Hrs- 08)	
6a. Define files in C++. 6b. Implement various operations that can be performed on files. 6c. Execute a program to handle exceptions in the programs.	**6.1 Files:** Introduction, classes for file stream operations, opening and closing a file, detecting end of file, more about open(), file modes, file pointers and their manipulations, sequential input and output operations, updating a file, random access of file, error handling during file operations, command line arguments. **6.2 Exception Handling** : Introduction, basics of exception handling, types of exceptions, structure to handle an exception, exception handling mechanism, throwing mechanism, catching mechanism, re-throwing an exception, specifying exceptions.

8.   SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	INTRODUCTION TO OBJECT OREIENTED PROGRAMMING	06	4	6	2	12
II	BASICS OF OBJECT ORIENTED PROGRAMMING	10	4	6	4	14
III	FUNCTIONS IN C++	08	4	6	2	12
IV	OPERATOR OVERLOADING,POLYMORPHISM AND TYPE CONVERSION	06	4	6	4	14
V	INHERITANCE AND POINTERS	08	4	6	4	14
VI	FILES AND EXCEPTION HANDLING	10	4	6	4	14
	Total	48	**24**	**36**	**20**	**80**

9.   SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

    a. Prepare journals based on practical performed in laboratory.
    b. Search information about more object oriented programming concepts.

10.   SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

    a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
    b. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
    c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
    d. Guide student(s) in undertaking micro-projects.
    e. Correlate subtopics with major topics and concepts.
    f. Use proper equivalent analogy to explain different concepts.
    g. Use Flash/Animations to explain various components, operation and
    h. Teacher should ask the students to go through instruction and Technical manuals

11.   SUGGESTED MICRO-PROJECTS

MINI PROJECT: Implement mini project using all the C++ concepts studied in the above units.

Following are some of the examples for micro-projects:
    (a)   Railway reservation system
    (b)   Payroll management system
    (c)   Supermarket billing system
    (d)   Telephone directory system

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three.**

    The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Object Oriented Programming with C++	E Balagurusamy, Tata McGraw Hill	ISBN 10: 0070473390 ISBN 13: 9780070473 393
2	Beginning C++ - The complete Language	Ivor Horton , Shroff Publishers	ISBN 978-1-4302-4882-8
3	Object Oriented Programming in C++	Robert Lafore, BPB	ISBN-10: 8176351865; ISBN-13: 978-8176351867
4	Teach Yourself C++	Herbert Schildt, Tata McGraw Hill	ISBN 10: 007070368X ISBN 13: 9780070703681.
5	The C++ Programming Language	Bjarne Stoustrup, Addison-Wesley 2000	ISBN 978-0321992789

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.com
2. https://www.quora.com
3. https://www.softwaretestinghelp.com
4. https://www.geeksforgeeks.org
5. https://www.tutorialspoint.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	-	-	-
CO2	3	2	2	2	-	1	-
CO3	2	2	3	2	-	2	-
CO4	2	2	3	2	-	2	-
CO5	2	2	3	2	-	2	-
CO6	2	2	3	2	-	2	-

	PSO1	PSO2
CO1	-	1
CO2	-	2
CO3	-	3
CO4	-	3
CO5	-	3
CO6	-	3

Sign:
 	
Name: Mrs. G. B. Garud
      Mrs. S. P. Panchakshari
      (Course Experts)
	Sign:
	
	Name: Mr. U. V. Kokate
	      (Head of Department)
	      (Computer Dept.)

Sign:
 	
Name: Mr. U. V. Kokate
      (Programme Head)
      (Computer Dept.)
	Sign:
	
	Name: Mr. A. S. Zanpure
	      (CDC)

Government Polytechnic, Pune
'180OB' – **Scheme**

Programme	Diploma in Computer Engineering
Programme code	**06/26**
Name of Course	**Principles of Digital Techniques and Microprocessor Programming**
Course Code	**CM3105**
Prerequisite course code and name	**(No Pre-requisite)**

1. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)			Examination Scheme				Total Marks
						Theory		Practical		
L	T	P	C			ESE	PA	*ESE	PA	
				Marks		80	20	25	25	150
04	00	02	06	**Exam Duration**		3 Hrs	1 Hr	2 Hr		

(*):PE (Practical Examination)
Legends: L- lecture,T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

2. RATIONALE
As computer engineering student, it is essential to know fundamentals of digital electronics to understand the concept of microprocessor and its application. Microprocessor is challenging, to meet challenges of growing advanced microprocessor technology. The student should be conversant with microprocessor programming.

3. COMPETENCY
The aim of the course is to attend following industry identified competency through various teaching learning experiences:
- Simplify logic circuit using Boolean algebra.
- Develop assembly language code

4. COURSE OUTCOMES (COs)
After completing this course students will be able to
1. Perform arithmetic operations with various number systems.
2. Differentiate various logic gates and apply the logic using Boolean algebra.
3. Test combinational logic circuits of Multiplexer and De-Multiplexer.
4. Construct K-MAP using logic functions and vice versa.
5. Describe Microprocessor architecture.
6. Write, debug and execute 8086 programs

5. SUGGESTED PRACTICALS/ EXERCISES

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

Practical No.	Unit	Specific Learning Outcomes (Psychomotor Domain)	Course Outcome	Hours.
1.	Number System, Codes & Logic Gates and Boolean Algebra	Know the Digital Lab 1.IC Tester 2.Multimeter 3.Bread Board 4.Trainer Kit	--	02
2.		Study of Basic Gates ICs (7400, 7404, 7408, 7486, 7432) and verification of Truth tables by monitoring the output of ICs on Bread Board.	CO2	02
3.		To derive AND, OR, NOT gates using universal gates by forming circuits on Bread Board.	CO2	02
4.		Verify De-Morgan's Theorem by forming the circuit on Bread Board.	CO2	04
5.	Standard representation for logic function & Sequential Logic Design	Minimization and realization of function using K-maps and its implementation by constructing the circuit on bread board.	CO4	02
6.	Combinational logic design using MSI circuit	Verify of Multiplexer & De-multiplexer.	CO3	02
7.	Microprocessor, Microprocessor Architecture & Microcomputer Systems	Introduction to Assembler, it's interface, and steps to write, debug and execute assembly language programs using IDE	CO6	02
8.	8086Assembly Language Programming	Addition and subtraction of two 16-bit numbers.	CO6	02
9.		Multiplication and division of 8-bit/16-bit/32-bit signed/ unsigned numbers.	CO6	04
10.		Sum of given series of numbers (8-bit / 16-bit)	CO6	02
11.		Find the smallest and greatest number from the given series.	CO6	02
12.		Arrange the given numbers in ascending and descending order.	CO6	02
13.		String related programs (any 5)	CO6	02
14.		Programs using Procedure, Macros – 2 of each	CO6	02
		Total Hours		**32**

Sr.No.	Performance Indicators	Weightage in %
a.	Correctness of algorithm	40
b.	Debugging ability	20
c	Quality of input and output (messaging and formatting)	10
d.	Preparing assignments (write-ups, program and output).	20
e.	Assignment submission (on-time)	10
Total		**100**

6.   MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned**.**

Sr.no.	Equipment Name with Board Specification	PRO's (Sr. no.)
1.	Computer with any assembler and debugger	All

7.   THEORY COMPONENTS

The following topics/sub topics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency**.**

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Units 1: Number System, Codes & Logic Gates and Boolean Algebra (Weightage-15 , Hrs-12)	
1a. Convert codes from one number system to another. 1b. Perform arithmetic operations with different number systems. 1c. Differentiate various logic gates and apply the logic on Boolean algebra. 1d. Explain theorems for Boolean algebra. 1e. Create simplified logic circuits.	1.1 Introduction to Number systems: Decimal, Binary, Octal, Hexadecimal 1.2 Binary arithmetic: Addition, subtraction, multiplication, Division 1.3 One's complement, Two's Complement, Signed Numbers, Codes, Error code. 1.4 Logic Gates: Introduction, Working principals and Truth of AND, OR, NOT, NOR, NAND, EX-OR, EX-NOR Gates, Universal Gates 1.5 Boolean Algebra: Basic Boolean Operations, Basic Laws of Boolean Algebra, Duality Theorem, De-Morgan's Theorems
Unit 2:Standard representation for logic function & Sequential Logic Design (Weightage-12 , Hrs- 10)	
2a. Construct K-MAP using logic functions and vice versa. 2b. Simplify equations in the minterms/maxterms.	2.1 KARNAUGH map representation, Simplification of logic function using K-MAP **2.2** Minimization of logical function specified in minterms/maxterms or truth table **2.3** Don't care conditions
Unit 3: Combinational logic design using MSI circuit (Weightage-13, Hrs- 10)	
3a. Design Multiplexer and De-Multiplexer. 3b. Implement combinational logic design with multiplexers. 3c. Implement combinational logic design with demultiplexers.	3.1 Multiplexer and their use in combinational, logic design 3.2 De-multiplexer/decoders and their use in combinational logic design 3.3 De-multiplexer: 4 to 16-line DEMUX. Demux design using sop method. 1:4, 1:8, 1:16 DEMUX.

Unit 4: Microprocessor, Microprocessor Architecture & Microcomputer Systems (Weightage-14 , Hrs- 12)	
4a. Describe Microprocessor architecture. 4b. Understand 8086 registers and instruction format. 4c. Draw timing diagram for read/write memory cycle.	4.1 Microprocessor – Introduction, Features, and its Operations 4.2 Memory & I/O Devices 4.3 8086 Microprocessor - Introduction, Architecture, and Working, Pin configuration 4.4 Memory segmentation in 8086 4.5 Minimum mode and Maximum mode configuration of 8086 4.6 Instruction timing
Unit 5: 8086 Assembly Language Programming (Weightage-15 , Hrs- 10)	
5a. Write and execute 8086 programs for addition, subtraction. 5b. Write programs implementing branching.	5.1 Instruction format and Addressing modes in 8086 5.2 8086 Instructions set and classification of instructions - Arithmetic, Logical, Data transfer, String, Bit manipulation, Flag manipulation, Branching, Machine Control
Unit 6: Procedure and Macro in Assembly Language Program, and Interrupts (Weightage-11 , Hrs- 10)	
6a. Write and execute assembly language program using procedures 6b. Write and execute assembly language program using macros	6.1 Procedures - Defining Procedure, Directives used, FAR and NEAR, CALL and RET instructions, Reentrant and Recursive procedures, Assembly Language Programs using Procedure. 6.2 Macros - Defining Macros, Assembly Language Programs using Macros, Directives used. 6.3 8086 interrupts – Introduction, Interrupt Service Routines (ISR)

8. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Number System, Codes & Logic Gates and Boolean Algebra	12	05	04	06	15
II	Combinational logic design using MSI circuit	10	03	03	06	12
III	Standard representation for logic function & Sequential Logic Design	10	03	03	07	13
IV	Microprocessor, Microprocessor Architecture & Microcomputer Systems	12	04	04	06	14
V	8086 Assembly Language Programming	10	03	04	08	15
VI	Procedure and Macro in Assembly Language Program, and Interrupts	10	03	04	04	11
Total		64	22	24	34	80

9.   **SUGGESTED STUDENT ACTIVITIES**

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

   a. Prepare journal based on practical performed in laboratory.
   b. Follow Coding Standards.

10.   **SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)**

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

   a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
   b. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
   c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
   d. Guide student(s) in undertaking micro-projects.
   e. Use proper equivalent analogy to explain different concepts.
   f. Use of PowerPoint slides and videos, numerical exercises to understand basics of number system, digital techniques, and basic processor functionalities
   g. Self-learning through online tutorials to develop solution using assembly code
   h. Use of simulator to demonstrate assembly code

11.   **SUGGESTED MICRO-PROJECTS**

      NA

12.   **SUGGESTED LEARNING RESOURCES**

Sr. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	R P Jain	McGraw Hill Education; 4th edition
2	Microprocessors and Interfacing: Programming and Hardware, Intel Version	Douglas Hall	McGraw-Hill Education; 2nd edition

13.   **SOFTWARE/LEARNING WEBSITES**
      1. http://www.nptel.ac.in
      2.https://www.tutorialspoint.com/
      3. http://www.nptel.ac.in
      4.https://www.tutorialspoint.com/

14. **PO - COMPETENCY- CO MAPPING**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	1	3	2	-	1	-
CO2	-	2	1	2	-	-	1
CO3	1	2	3	3	-	1	1
CO4	-	1	2	3	-	1	1
CO5	-	3	3	3	1	1	2

	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Sign:
 	
Name: 1) Smt M.G.Yawalkar
      2) Smt. A. S. Paike
     (Course Expert /s)
	Sign:
	
	Name: (Mr. U. V. Kokate)
	  Head of the Department
	(Computer Engineering)

Sign: Name: (Mr. U. V. Kokate) Programme Head (Computer Engineering)	Sign: Name: Shri A.S.Zanpure (CDC In-charge)

Government Polytechnic, Pune

'180 OB' – **Scheme**

Programme	Diploma in ET/CE/EE//ME/MT/**CM**/IT/DDGM
Programme code	01/02/03/04/05/**06**/07/08/16/17/21/22/23/24/**26**
Name of Course	**Computer Graphics using C**
Course Code	**CM3106**
Prerequisite course code and name	-

1.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)		Examination Scheme				Total Marks
					Theory		Practical		
L	T	P	C		ESE	PA	*ESE	PA	
				Marks	80	20	25	25	150
03	01	02	06	Exam Duration	3 Hrs	1 Hr			

(*):PE (Practical Examination)

Legends: L- lecture-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

2.   RATIONALE

Computer graphics is the discipline of generating images with the aid of computers. Today, computer graphics is a core technology in digital photography, film, video games, cell phone and computer displays, and many specialized applications. This course provides an introduction to the principles of computer graphics. In particular, the course will consider methods for object design, transformation, scan conversion, visualization and modeling of real world and enables student to create impressive graphics easily and efficiently.

3.   COMPETENCY

The aim of this course is to attend following industry identified competency through various teaching learning experiences:
   Develop Programs using graphics concepts.

4.   COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Manipulate visual and geometric information of images.
2. Develop programs in C/ C++ applying standard graphics algorithms.
3. Perform and demonstrate basic and composite graphical transformations on given object.
4. Implement various clipping algorithms.
5. Develop programs to create curves.
6. Recognize types of projections.

5.   SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

Sr. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Relevant CO	Approximate Hours Required.
1	1	Write program to draw various graphics objects (Pixel, Circle, Line, Ellipse, Rectangle, Triangle, Polygon)	1	02
2	2	Write a program to draw line using DDA algorithm	2	02
3		Write a program to draw line using Bresennham's algorithm	2	02
4		Write a program to draw Circle using Bresennham's algorithm	2	02
5		Implement Flood fill algorithm for Polygon filling.	2	02
6		Implement Boundary fill algorithm for Polygon filling.	2	02
7	3	Write a program for 2 D Translation, Scaling and Rotation.	3	04
8		Write a program for 2 D Reflection and Shear.	3	02
9		Write Program for 3-D Translation, Scaling and Rotation.	3	04
10	4	Write Program for Line Clipping.	4	04
11		Write Program for Polygon Clipping.	4	04
12	5	Implement Bezier curve.	5	02
		Total Hrs		**32**

S.No.	Performance Indicators	Weightage in %
1	Use graphics software tool for programming to create, edit, compile the programs/applications.	20
2	Write program to draw graphics objects.	30
3	Debug, test and execute the programs/applications	30
4	Able to answer oral questions.	10
5	Submission of assignment in time.	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
1	Hardware: Personal computer, (i3-i5 preferable), RAM minimum 2 GB onwards.	ALL
2	Operating system: Windows XP/Windows 7/LINUX onwards.	
3	Software: turbo C with dosbox or Emulated C.	

7. THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Specific Learning Outcomes (Cognitive Domain)	Topics and subtopics
UNITS 1 : COMPUTER GRAPHICS SYSTEMS (Weightage-10 , Hrs- 06)	
1a. Describe working of Raster scan display 1b. Write syntax and use of Primitive operations 1c. Describe Coordinate representation. 1d. Select and use various graphics file formats. 1e. Use different graphics functions and standards.	1.1 Raster scan display 1.2 Primitive operations: - moveto, lineto 1.3 Graphics Software 1.4 Coordinate representations 1.5 Graphics file formats: Basics, advantages, disadvantages – BMP – GIF – JPEG – TIFF – PCX 1.6 Graphics Functions & Standards: Text mode, Graphic mode Shapes, colors, Graphics standards.
UNIT 2: RASTER SCAN GRAPHICS (Weightage-20 , Hrs- 12)	
2a. Apply line drawing algorithms to generate line. 2b. Apply circle drawing algorithms to generate circle. 2c. Describe scan conversion. 2d. Describe different Character Generation Methods. 2e. Describe Frame Buffer 2f. Apply Polygon filling algorithms to generate Polygon. 2g. Describe Antialiasing technique	2.1 Line Drawing Algorithms 2.2 Digital Differential Analyzer 2.3 Bresenham's Algorithm 2.4 Circle Generation- Symmetry of circle, Bresenham's Algorithm. 2.5 Scan conversion 2.6 Character Generation Methods 2.7 Frame Buffer 2.8 Polygon Filling : Seed fill algorithms: Flood fill, Boundary fill, scanline algorithm . 2.9 Antialiasing technique

UNIT 3: 2-DIMENSIONAL AND 3-DIMENSIONAL TRANSFORMATIONS(Weightage-20 , Hrs- 10)	
3a. Perform various transformations on given graphics object 3b. Use composite transformations. 3c. Write need of homogeneous coordinates	3.1 Basic Transformations: Translation, Scaling, Rotation 3.2 Matrix representations & homogeneous coordinates 3.3 Composite Transformations 3.4 Three dimensional transformation 3.5 Other transformations :Reflection, Shear
UNIT 4: WINDOWING & CLIPPING TECHNIQUES (Weightage-16 , Hrs- 10)	
4a. Define Windowing and Clipping. 4b. Apply clipping algorithms for area, text and line. 4c. Describe Window to-viewport transformation.	4.1 Windowing concepts. 4.2 Clipping algorithms 4.3 Area clipping 4.4 Line clipping: Cohen Sutherland clipping algorithm, Cyrusbeck , Liang Barsky, Mid point subdivision 4.5 Polygon clipping: Sutherland Hodgeman polygon clipping 4.6 Text clipping 4.7 Window to-viewport transformation
UNIT 5: HIDDEN SURFACE ELIMINATION AND CURVES(Weightage-14 , Hrs- 10)	
5a. Implement hidden line and surface algorithms. 5b. Draw various curves using curve generation algorithms. 5c. Identify different types of projections.	5.1 Hidden line elimination & hidden surface elimination (back face removal, z-buffer, painters algorithm and Warnock's algorithms) 5.2 Bezier and B-Spline curves, Hilbert's Curve, Koch curve 5.3 Projections: Perspective and parallel Projection and its types

8. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Computer Graphics Systems	06	04	04	02	10
II	Raster Scan Graphics	12	04	08	08	20
III	2-Dimensional and 3-Dimensional Transformations	10	04	08	08	20
IV	Windowing & Clipping Techniques	10	04	06	06	16
V	Unit 5: Hidden surface Elimination and Curves	10	02	06	06	14
	Total	48	**18**	**32**	**30**	**80**

9. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

    a. Prepare journals based on practical performed in laboratory.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

    These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

    a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.

    b. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).

    c. With respect to item No.8, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.

    d. Guide student(s) in undertaking micro-projects.

    e. Correlate subtopics with power plant system and equipments.

    f. Use proper equivalent analogy to explain different concepts.

    g. Use Flash/Animations to explain various components, operation and

    h. Teacher should ask the students to go through instruction and Technical manuals

11. SUGGESTED MICRO-PROJECTS
(Only for Class Declaration Courses)

*Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her.In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three.***

    *The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.*

    A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

    a. *Develop program for moving object.*

    b. *Implement Snake Game.*

    c. *Design Smile Face.*

    d. *Design Clock.*

    e. *Any other micro projects suggested by subject faculty on similar line*

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Computer Graphics	Donald Hearn and M Pauline Baker, Prentice-Hall	
2	Procedural Elements for Computer Graphics	David F.Rogers, McGraw-Hill	
3	Principles of Interactive Computer Graphics	William M. Newman Robert F. Sproull, McGraw-Hill	
4	Computer Graphics	Zhigang Xiang Roy Plastock, Schaum O Series	

13. SOFTWARE/LEARNING WEBSITES
1. https://nptel.ac.in/courses/106106090/
2. https://www.javatpoint.com/computer-graphics-programs
3. https://www.tutorialspoint.com/computer_graphics/index.htm

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	3	2	-	-	2
CO2	3	3	3	3	2	2	3
CO3	3	3	2	2	1	1	2
CO4	2	3	2	3	2	2	3
CO5	2	3	3	3	1	2	2
CO6	1	2	2	1	-	-	1

	PSO1	PSO2
CO1	-	2
CO2	-	3
CO3	-	3
CO4	-	3
CO5	-	3
CO6	-	1

Sign: Name: 1. Smt. S.B.Gosavi 2.Smt. A.M.Galshetwar (Course Expert /s)	Sign: Name: Mr. U.V.Kokate (Head of Department)
Sign: Name: Mr. U.V.Kokate (Programme Head)	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune

'180 OB' – Scheme

Programme	Diploma in Computer Engineering
Programme code	06/26
Name of Course	**Computer Peripherals & Hardware Maintenance**
Course Code	**CM3107**
Prerequisite course code and name	Nil

1.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)			Examination Scheme				Total Marks
						Theory		Practical		
L	**T**	**P**	**C**			**ESE**	**PA**	***ESE**	**PA**	
03	00	02	05	**Marks**		40	10	25	25	100
				Exam Duration		2 Hrs	1 Hr	2 Hr		

(*PE): Practical Examination
Legends: L- lecture, T-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

2.   RATIONALE

For the smooth functioning of computer system it is required to maintain, repair, troubleshoot and do preventive maintenance of the computer system and its peripheral devices. Therefore it is essential for the students to acquire skills in the area of computer maintenance and troubleshooting and its preventive maintenance. This course is focused on developing skills in assembling desktop computers, interfacing input output devices, installation and configuration of Operating systems, loading and configuring various device drivers and troubleshoots various hardware components.

3.   COMPETENCY

The aim of this course is to help the students to attain the following industry identified competency through various teaching learning experiences.

- **Assemble Desktop computer system and maintain computer peripheral equipment's.**

4. COURSE OUTCOMES (COs)

1. Identify and compare different types of computer systems.
2. Select appropriate motherboard and processor for computer systems.
3. Configure various memory and storage devices.
4. Distinguish various power supply and UPS.
5. Assemble computer system with operating system installation and troubleshoot its common problems.

5. SUGGESTED PRACTICALS/ EXERCISES

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

Sr. No.	Unit No.	Practical Exercises	Relevant CO	Approximate Hours Required.
1	1	Identify various computer systems according to its specifications.	1	2
2	2	Identify various components of motherboard and troubleshoot its common problems.	2	4
3	3	Configure BIOS Settings	2	2
4	4	Installing Hard Disk, Manage and format hard disk using various file system.	3	4
5	4	Install operating system (Windows and Linux Family)	5	4
6	5	Installing SMPS and troubleshooting its common problems.	4	2
7	6	Install Local printer (Driver installation and Printer settings) and troubleshoot common problems.	5	4
8	6	Installation of Optical Drive(CD / DVD Drives) and Troubleshooting Common problems	5	2
9	1-6	Assembling and disassembling Desktop computer system.	5	4
10	6	Use diagnostic software for fault finding and preventive maintenance of PC	5	4
			Total	32

Sr.No.	Performance Indicators	Weightage in %
a.	Effective practical implementation within specific time	50
b.	Handling of hardware components	20
c.	Answer to questions	20
d.	Submission of assignment with in time	10
	Total	**100**

6.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
1	Computer system with all necessary components like Motherboard,Processor,RAM,Harddisk,CD/DVD Drive,Hard disk.	All
2	Operating System	5
3	Power Supply (SMPS)	All
4	Printer (any)	7
5	Diagnostic software (Freeware)for fault finding and preventive maintenance tools like Vacuum cleaner/Blower	10

7.   THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. Introduction to computer Hardware **(Weightage-4, Hrs-4)**	
1a. List different types of computer system. 1b. Explain features of desktop system. 1c. Describe laptop features.	Basic Computer Hardware Structure. Different types of computer systems. Features of computer systems : Desktop systems, server computers, Laptops, Tablets
UNIT 2. Motherboard **(Weightage-8, Hrs-10)**	
2a. List components of motherboard. 2b.Explain form factor of motherboard. 2c. Describe external device 2d. Explain buses and expansion slots. 2e.Describe selection criteria of motherboard.	2.1 Features of Motherboards, Components of Motherboard, Form Factor of motherboards, Motherboard Controller 2.2 Memory Support, Graphics Support, BIOS, IDE and SATA Connectors 2.3 Power Supply Connectors, External Devices Interfaces, 2.4 Selection of Motherboards.
UNIT 3. Processing Units **(Weightage-6, Hrs-8)**	
3a. Explain developmental stages of CPU. 3b.Describe CPU overheating issues. 3c. Explain core processors. 3d. List Common problem in processors. 3e. State the use of GPU?	3.1 Processor Features, Developmental Stages of CPU 3.2 Towards Multiple Core Processors, Processor Specifications, CPU Overheating Issues 3.3 Processor: Common Problems and Solutions, Graphics Processing Units.

UNIT 4. Memory and storage **(Weightage-8, Hrs-8)**	
4a. List types of computer memory. 4b. Explain working of hard disk. 4c. Explain the use of solid state drives and blue ray discs. 4d. Describe external storage devices.	4.1 Features of Computer Memory, Types of Computer Memory, Working of Computer Memory, Memory common problems and solutions. 4.2 Hard Disks Details , Working of Hard Disks, Features of Hard Disks, Hard Disk Specifications, Partitioning and formatting hard disks. 4.3 Solid state drives, Blue-ray Discs, External Storage devices.

UNIT 5 Power supply and UPS **(Weightage-6, Hrs-8)**	
5a. List specification for SMPS. 5b. State the selection criteria of SMPS and computer cabinet. 5c. Describe working of UPS. 5d. List UPS features and specifications.	5.1 Features of SMPS, Types of SMPS, Specification for SMPS, Selecting SMPS and Computer Cabinets 5.2 Uninterrupted Power Supply: Working of UPS, Types of UPS, UPS Features and Specifications, UPS Batteries.

UNIT 6 Troubleshooting and Maintenance **(Weightage-8, Hrs-10)**	
6a. Describe troubleshooting tips for printer. 6b. Describe POST? 6c. Explain how to diagnosis general problems. 6d. Explain overclocking the system? 6e. Explain safety precautions.	6.1 Introduction to I/O devices with its troubleshooting tips : Computer Monitor, Keyboard and Mouse, printer, optical drives 6.2 Safety Precautions, Power on self test, Devices and Drivers 6.3 Working with windows registry, overclocking the system 6.4 Diagnosing general problems, Flashing Bios, Preventive Maintenance.

8.   SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to computer Hardware	4	2	2	--	4
II	Motherboard	10	2	4	2	8
III	Processing Units	8	2	2	2	6
IV	Memory and storage	8	2	4	2	8
V	Power supply and UPS	8	2	2	2	6
VI	Troubleshooting and Maintenance	10	2	2	4	8
	Total	**48**	**12**	**16**	**12**	**40**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's Revised Taxonomy)

9. SUGGESTED STUDENT ACTIVITIES

1. Survey of various computer systems like desktop, laptops, servers and peripherals available in the Institute and Industry.
2. Prepare comparative Specification charts of the above survey.
3. Industry visit to understand the industry standard maintenance workflow.
4. Presentation on latest technology used in computer hardware.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

1. Massive open online courses (MOOCs) can be used to teach various topics.
2. Group Discussions on various peripherals and computer systems and its relevant use.
3. Power point presentation to explain functioning of various devices and components.

11. SUGGESTED LEARNING RESOURCES

Sr.No.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	The Complete PC Upgrade &maintenance Guide	Mark Minasi, BPB Publication	ISBN-13: 978-0782114980 ISBN-10: 0782114989
2	The computer hardware installation, interfacing, troubleshooting and maintenance	K.L. James Prentice Hall India Learning Private Limited	ISBN-10: 8120347986 ISBN-13:978-8120347984
3	Computer Installation and Servicing	D Balasubramanian, McGraw-Hill ,2nd Edition, July 15, 2005	0070591180 · 978007059 1189

12. SOFTWARE/LEARNING WEBSITES

1. https://computer.howstuffworks.com/computer-hardware-channel.htm
2. https://www.computerhope.com
3. https://www.tutorialspoint.com/computer_fundamentals/computer_hardware.htm

13. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	3	-	2	2	3
CO2	1	1	3	-	1	3	3
CO3	1	-	3	1	2	3	3
CO4	-	-	2	1	3	2	3
CO5	2	3	3	1	2	3	3

	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	2	-
CO5	3	-

Sign: Name: T.P. Sharma Name: S.P. Ambavane (Course Expert /s)	Sign: Name: Shri U.V. Kokate (Head of Department)
	Sign: Name: Shri A.S.Zanpure (CDC)

Government Polytechnic, Pune
'180 OB' – Scheme

Programme	Diploma in Computer Engineering
Programme code	06/26
Name of Course	Computer Networks
Course Code	CM3108
Prerequisite course code and name	Nil

1.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)			Examination Scheme				Total Marks
						Theory		Practical		
L	T	P	C			ESE	PA	*ESE	PA	
04	00	02	06		Marks	80	20	25	25	150
					Exam Duration	3 Hrs	1 Hr	2 Hr		

(*OE): Oral Examination

Legends: L- lecture-Tutorial/teacher guided theory practice, P-practical, ESE-End semester examination, PA- Progressive Assessment.

2.   RATIONALE

One of the major components of computer based information systems is computer networks. Through computer networks we can share hardware, Software, Processing, Data and Applications besides getting global connectivity for internet based communication and services. For diploma students it is important to understand the function of computer networks and obtain requisite knowledge about hardware and software requirements of networks and acquire skills to establish a network using necessary hardware & software tools and configure various services over it. The objectives of this course are to make students learn the technology of designing, building and maintaining computer networks.

3.   COMPETENCY

The aim of this course is to help the students to attain the following competency through various teaching learning experiences.

- **Use Software and hardware technology to design, establish and maintain computer networks.**

4. COURSE OUTCOMES (COs)

1. Identify and classify various types of computer network.

2. Select relevant transmission media and switching technique as per requirements.

3. Establish network using wireless technology.

4. Configure various network control devices and design a small network.

5. Classify & describe IP addressing and TCP/IP protocols using standard network model.

5. SUGGESTED PRACTICALS/ EXERCISES

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency

Sr. No.	Unit No.	Practical Exercises	Relevant CO	Approximate Hours Required.
1	1	Identify Components of network in your Computer Network Lab.	1	2
2	2	Create network cables (Straight and crossover) and test it using suitable equipment.	2	4
3	3	To connect and understand different network control devices used in LAN	4	2
4	2-4	Connect computer in star topology using wired and wireless medium.	3,4	4
5	4-5	Configure IP address (Statically and Dynamically)	5	2
6	4-5	Run network diagnostic commands : ipconfig, ping ,tracert, netstat, route, arp	5	2
7	4-5	Share file, folder, and printer in peer to peer network.	4	4
8	4-5	Configure router (Home or Small office home office Device)	4	4
9	5	Create a network based on IPV6 address using a simulator.	5	4
10	5	Install wireshark software and configure it as a packet sniffer	5	4
			Total	32

Sr.No.	Performance Indicators	Weightage in %
a.	Effective practical implementation within specific time	60
b.	Handling of networking components	10
c.	Answer to questions	20
d.	Submission of assignment with in time	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practical, as well as aid to procure equipment by authorities concerned.

Sr.No.	Major Equipment/ Instruments Required	PrO. No.
1	Computer Systems (NIC Installed)	All
2	Network control devices and transmission media	All
3	Crimping Tool,RJ45 Connector	2
4	Wireshark sniffer software	10

7. THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
UNIT 1. Fundamentals of computer network (Weightage-14, Hrs-10)	
1. List the benefits and applications of Computer Networks. 2. Classify computer network according to its geography. 3. Select appropriate network architecture according to the requirements.	1.1 Fundamentals of Computer Network- Definition Need of Computer Network, Applications, Component of Computer Network. 1.2 Network Benefits: Sharing Information (File Sharing, Email), Sharing Resources (Printer Sharing, Application Services), Maintaining the Network, Backing up data. 1.3 Computer Network Classifications- Classification of Network by their Geography.- LAN, MAN, WAN. 1.4 Classification of Network by their Component Role--Peer to-Peer Network, client-Server-Based Network
UNIT 2. Transmission Media (Weightage- 14 , Hrs-12)	
1. Explain guided and unguided media. 2. Select appropriate media for network implementation. 3.Differentiate between circuit switched and datagram network	2.1 Guided Media: Types of Cable-Twisted Pair Cable, Co-axial Cable, Fiber Optic Cable. 2.2 Unguided media: Microwave Communication, Radio wave Communication, Satellite Communication. 2.3 Switching Basics: Circuit Switched Networks and Datagram Networks.
UNIT 3. Wireless Communication (Weightage-16, Hrs-12)	
1. Describe IEEE Standards. 2.Establish wireless LAN 3. Create a Bluetooth enabled network.	**3.1** Overview of wireless network **3.2** IEEE Standards : 802.1,802.2,802.3,802.4,802.5 **3.3** Bluetooth: Piconet and Scatternet. **3.4** 802.11 Wireless LAN: Challenges in wireless LAN, Access Point (AP), and 802.11 Protocol Stack.

UNIT 4. Network Topologies and Networking Devices (Weightage-16, Hrs-14)	
1. Compare and use relevant topologies in LAN. 2. Design a small network using network control devices.	**4.1** Network Topologies : i) Bus ii) Ring iii) Star iv) Mesh v) Tree vi) Hybrid. **4.2** Network Control / Connecting Devices : Hub, Repeater, Bridges, Switches, Router, Gateway, Modem, Firewall.
UNIT 5 OSI Reference Model & TCP/IP Model (Weightage-20, Hrs-16)	
1. Identify the protocols working in a layered architecture. 2. Troubleshoot the network using standard network model. 3. Distinguish between IPV4 and IPV6 addresses. 4. Explain various LAN technologies and protocols. 5. Configure nodes with appropriate IP addresses.	5.1 Layers of the OSI Reference Model (Functions of each Layer &Protocols used) – Physical Layer, Data-Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, Application Layer. 5.2 Layered Structure of the TCP / IP Model – Host-to Network, Internet, Transport, and Application. 5.3 Comparison between OSI and TCP / IP Network Model 5.4 IP Addressing – IP Address classes, classless IP addressing. Subnetting, Supernetting and masking, Introduction to IPV6 address. 5.5 Introduction to Dynamic Host Configuration Protocol(DHCP) and Network Address Translation (NAT) 5.6 Ethernet : Introduction , Properties of Ethernet, CSMA/CD, Ethernet Addresses 5.7 Virtual LAN(VLAN) ,Fast and Gigabit Ethernet, Token Ring

8.   SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of computer network	10	6	4	4	14
II	Transmission Media	12	4	6	4	14
III	Wireless Communication	12	4	6	6	16
IV	Network Topologies and Networking Devices	14	4	6	6	16
V	OSI Reference Model & TCP/IP Model	16	6	6	8	20
	Total	64	**24**	**28**	**28**	**80**

9.   SUGGESTED STUDENT ACTIVITIES

1. Identify type of Network in your Department.

2. Design a Network for your Institute.

3. Visit server room and various places where Racks and servers are installed, identify various Network components; collect information about of necessary hardware and software.

4. Prepare Charts of Network Topologies.

10. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

1. Demonstration of local area network installation in the institute and its technology. Give an environment to establish, configure and troubleshoot a small network by giving hands on practice.
2. Massive open online courses (MOOCs) can be used to teach various topics.

11. SUGGESTED MICRO-PROJECTS

Not Applicable

12. SUGGESTED LEARNING RESOURCES

S.N.	Title	Author, Publisher, Edition and Year of publication	ISBN Number
1	Data Communication and Networking	A S Godbole, McGraw-Hill, 2nd Edition, June 13, 2011	0071077707 ,9780071077705
2	Computer Networks	Andrew S. Tanenbaum , Prentice Hall, 5th Edition, January 2010	978-9332576223
3	Data Communication and Networking	Behrouz A. Forouzan, McGraw-Hill Higher Education, 4th Edition, January 2007	978-0072967753
4	Networking The Complete Reference	Bobbi Sandberg, Tata McGraw Hill, 3rd Edition, June 24, 2015	9339222199 ,9789339222192

13. SOFTWARE/LEARNING WEBSITES

1. www.nptel.ac.in
2. www.tutorialspoint.com

14. PO - COMPETENCY- CO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	1	1	1	1	1
CO2	2	2	2	1	1	1	1
CO3	1	2	2	2	2	2	1
CO4	1	2	2	2	2	3	1
CO5	1	2	1	1	1	1	1

	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	1	2
CO4	1	2
CO5	1	3

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Sign: Name: Shri A.S.Zanpure (CDC)	